MINIMUM-PACKAGING TECHNOLOGY FOR PROCESSED FOODS

Report of the APO Multi-Country Study Mission on Minimum-Packaging Technology for Processed Foods held in Thailand, 10-15 September 2001 (SME-OS1-01)

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SUMMARY OF FINDINGS

INTRODUCTION

The Multi-Country Study Mission on Minimum-Packaging Technology for Processed Foods which was organized by the Asian Productivity Organization (APO) and hosted by the Government of Thailand, was held in Bangkok and Chiang Mai from 10 to 15 September 2001. The Foundation for Thailand Productivity Institute (FTPI) implemented the program. Seventeen participants from 13 member countries and three resources speakers, from FAO Regional Office for Asia and the Pacific, Bangkok; Chiang Mai International Consultant Inc.; Chiang Mai, and Chiang Mai Taveekun Ltd. Part., Chiang Mai, attended the study mission. The objectives of the study mission were to: 1) observe the technologies and systems available in the host country for the production and utilization of minimum-packaging materials; and 2) discuss the feasibility of adopting such systems and technologies in member countries.

The study mission consisted of the presentation and discussion of resource papers and country papers. The topics covered by the resource papers were: 1) Minimum-Packaging Technology for Processed Foods – Environmental Considerations; 2) Packaging of Fruits and Vegetables: A Project Experience in Chiang Mai; and 3) Packaging of Processed Beverages. The country papers, on the other hand, focused on the recent changes/growth in the processed food industry, major problems/issues affecting the packaging of processed foods and future prospects of packaging of processed foods in the respective countries. Field visits were made to: 1) Royal Project Foundation Office; 2) Royal Project Foundation, Packaging Department; 3) Food Processing Factory at Chiang Mai University (CMU); 3) Vanasanan Co., Ltd.; 4) Thai Packaging Center, Thailand Institute of Scientific and Technology Research; 5) CP Group Co., Ltd.; 6) Wet Fresh Produce Market; and 7) Tesco Lotus Supermarket. A structured workshop was also conducted wherein the participants analyzed the packaging of sample food products they purchased from a wet fresh produce market and from a supermarket.

The highlights of the study mission are presented below.

HIGHLIGHTS OF RESOURCE PAPERS

Minimum-Packaging Technology for Processed Foods – Environmental Considerations (Alastair Hicks)

Minimum food packaging technology brings traditional foods into a global arena which increasingly emphasizes their commercial and economic aspects. This means that food and packaging technologists become involved in the entire food supply system. This system ranges from the sea, village farm, and plantation to the markets and consumers in towns and cities, not only in their own country but also in distant overseas markets.

The surplus foods grown in the village need to be more carefully harvested, protected from spoilage and damage, packaged and transported by various means to these markets. Unless the goods are sold with minimum spoilage and at their peak flavor, appearance, nutritional value and presented in an attractive way, they may not be consumed. This is a worse situation than if the crop had never been grown and can represent serious loss and waste to a community. In addition, careful environmental considerations need to be given to minimum-packaging forms, to avoid pollution problems and ensure sustainability.

Little investment has been made to improve traditional technologies or in applying scientific knowledge to minimum food packaging in many of the developing countries; meanwhile the more expensive products of imported technologies have further slowed the development of indigenous technologies. It is increasingly recognized that the time has come when these traditional technologies should be upgraded through scientific application of minimum-packaging principles and then integrated with other packaging functions such as marketing and advertising.

Technologies are called traditional if, unaffected by modernization, they have been commonly applied over a long period of time. In general, traditional technologies tend to be cheap, easy to produce, apply,

maintain and repair. They are generally labor-intensive which can be economically beneficial, but as far as traditional food packaging technologies are concerned, the final products are often hygienically substandard and usually have a short shelf life.

Given the circumstances in which many developing countries are facing today, the challenge for these traditional technologies is that often they do not contribute sufficiently to meeting socioeconomic imperatives. It is now clear that there is a need to lessen the dependence on nature, reduce the drudgery, shorten the time of the work involved and upgrade the preparation, quality, packaging, presentation and shelf life of these traditional foods and their packaging, whilst retaining their special characteristics.

It should be borne in mind that the upgrading of traditional food and food packaging technologies is a sensitive area, for which reason the subject should be approached with caution and due regard paid to the social, economic and cultural factors involved, in addition to the gender issues.

Further sensitivity needs to be applied to small business operations, in the preparation and packaging of traditional foods. Programs for this mass production of a particular food, can have dire consequences for the small business operator. In the consideration of the structural characteristics of traditional food industries, in particular in the application of new food technologies and the use of labor-saving continuous large-scale processing, the task needs to be approached thoughtfully.

Several other factors might prevent the actual adoption of an upgraded technology which is otherwise readily available. Lack of purchasing power of the potential consumers can be enough reason for entrepreneurs not to produce in the first place. The same is true of problems related to poor distribution, lack of sales promotion or inability to repair and maintain facilities. Numerous examples also exist of technically and economically sound upgraded technologies, which were rejected by the target group because they collided with sociocultural customs and tradition.

Upgrading of traditional food packaging technologies in many cases, introduces exogenous factors, i.e., the importation of technology from abroad. Whether or not adapted to local circumstances, the use of imported packaging technologies in many developing countries remains restricted to modern technologies; even when these are locally developed, they are more complex to use, repair and maintain. They are also expensive and tend to rely on imported components and nonrenewable sources of energy.

In addition, they tend to be very capital-intensive, which does not necessarily contribute to the solution of unemployment problems. For the purpose of improving traditional food packaging technologies, it would appear desirable either to simplify the modern systems; to improve traditional technologies; or seek a compromise solution between both methods of approach, by a process of adoption and adaptation.

Minimum packaging is an integral part of the processing and preservation of foods and environment, whether micro or macro influences many of these factors. It can influence physical and chemical changes, including migration of chemicals into foods. The flavor, color, texture as well as moisture and oxygen transfer is also influenced by packaging. The environmental effects of temperature changes and light can be modified by packaging materials. The paper considers the more important methods of preservation of foods used by food industries today and how these technologies should integrate with the minimum food packaging required for their processing and marketing.

Packaging of Fruits and Vegetables: A Project Experience in Chiang Mai (Narin Tongsiri)

Northern Thailand is a mountainous area with various groups of hill tribes living in these mountains growing agricultural crops. Since there is very limited land, they have to keep on cutting down forest for more land. They will move to grow their crops elsewhere every three years. Their main cash crop has been opium which is illegal.

In 1969, His Majesty the King visited a hill tribe village in Chiang Mai, after which he immediately founded the Royal Project to solve this problem. Since most of the hill tribes are living in the highland areas with lower temperatures, he started setting up a highland agricultural research station. The purpose of the Royal Project is to help hill tribes to improve their living standard and to enable them to grow useful crops, which will earn them good income, abandon poppy cultivation, and reduce slash-and-burn cultivation by which the forest is destroyed.

In March 1991, the Royal Project was established as a Royal Project Foundation (RPF). It has four research stations and 35 development centers, covering 300 villages with a total population of 80,000 consisting of hill tribes and local people.

One result of the Foundation's work is that hill tribes has come to grow opium replacement crops. There are more than eight kinds of fruits, 26 vegetables and 10 flowers being produced by members of the Foundation. Two packing houses have been set up, one in Chiang Mai, another one in Bangkok. Five small-scale food factories have been founded. One is founded in CMU for processing and research, the rest are operating at Fang, Chiang Mai, Chiang Rai, Sakon Nakorn and Burirum. The products' logo is "Doi Kham", which means "Golden Mountain". Now, the turnover of Doi Kham is around ฿800 million/year. Most of this income goes back to the hill tribes people.

Problems of production in the highlands, marketing of products from hill tribes, packaging of agricultural products and problem of packaging of products from the hill tribes are discussed. It is hard and difficult to work with hill tribes. Some villages may take three days on foot to reach in rainy season. They lack everything. Packaging has played a very important role in keeping a good quality of crops to get higher prices. There are still many developments in proper packaging to be studied and implemented, for higher income generation. Further research and training on using proper minimum packaging is necessary.

Packaging of Processed Beverages (Somjate Sirivatanapa)

An increasing competitiveness in the food industries has resulted in developing packaging productivity. Particularly, minimum packaging which is an important factor in presenting the product and increasing the market share. Packaging has been developed for all commodities.

In view of marketing concerns, the producers should minimize their costs. This can be done by reducing the cost of packaging and other related costs. Packaging of tea, herbal teas and coffee is discussed, mainly using less packaging material while maintaining the safety and quality of the product including attractiveness, rigid standards of hygiene, protection, as well as the use of less expensive materials and environmental friendliness.

Years ago, the processed food industries grew rapidly, but packaging lagged behind the development of new products, resulting in low food safety and quality due to the use of packaging technology which did not match the characteristics of the food which the package contained.

For example, when tea or coffee is packed in paper or paper bag, they have a short shelf life because they absorb moisture, resulting in loss of flavor and aroma. Later, paper/foil and foil was introduced, these types of materials improved the quality and extended the shelf life of tea and coffee. Nowadays there are multilayer combination materials used such as paperboard canister, paper/foil/polyethylene (PE) and Oriented Poly Propylene (OPP).

Today, packaging technology is advancing fast, but changes in material have resulted in increasing costs and causing more environmental pollution. Increasing interest in environmental conservation has triggered a search for ways to minimize the amount of packaging materials used and maintain environmental cleanliness. Different types of packaging materials and shapes are compared and selected, as mentioned in the paper.

Filter paper, waxed paper and paper/foil/transparent film are suitable for tea, herbal teas and coffee. However, the type of materials selected as a packaging for these products, depend largely on their uses and storage time before reaching the consumer. Ideally packaging should be appropriate for the contents, use the minimum materials, be cheap and attractive as well as environmentally friendly.

HIGHLIGHT OF COUNTRY PAPERS

The country papers given showed that the economies of the Asia and the Pacific are still based on agriculture and agricultural products. Particularly since the economic crisis in Asia, there is a clear awareness of the potential for added-value to agricultural materials.

Around 60-75 percent of the populations are directly or indirectly involved in agricultural activities. The sector provides employment to a significant proportion of the countries workforces, yet under-employment exists also.

Income and population growth in the countries, as well as changes in lifestyle resulting from urbanization have generated changes in food eating habits, food purchasing and consumption patterns. In addition, the changing role of women, who are joining the workforce, means there is less time to prepare foods at home, hence convenience and packaged foods are becoming more popular.

Small-scale food enterprises play an important role in the economies of the member countries, particularly in terms of employment generation, better income distribution and as a training ground for entrepreneurs, who later invest in larger enterprises. These small-scale enterprises also have important linkages to related industries such as the manufacture of machinery, food packaging materials and suppliers of food ingredients. It is envisaged that small-scale food enterprises will continue to expand in line with policies and incentives introduced by the governments.

Almost all the small- and medium-size food processing enterprises are agriculturally-based industries, which include: meat and dairy, fruits and vegetables, spices and cereal products and beverage industries.

The establishment and successful operation of small- and medium-scale food processing and packaging enterprises faces a number of significant constraints. These include an insufficient supply of good quality raw materials, a low level of technology, quality assurance challenges, competitive markets in the new era of globalization, and lack of credit and finance.

Plastic flexible film and semirigid packaging products are the major materials used, with glass and other rigid packaging materials (tinplate, aluminum) playing a lesser role generally. Lighter and more compact packaging is being improved, with Polyethylene Terephthalate (PET) and High Density Polyethylene (HDPE) replacing other plastics, aluminum replacing steel and tinplate.

The small- and medium-scale food and packaging companies will continue to play a very important role in the packaging of processed foods in the region. To maintain the momentum of agro-industrial growth, the governments will need to apply suitable policies and incentives, applicable to the food processing industries. A number of government agencies as well as the universities and education system, need to support the development of small- and medium-scale food processing enterprises, by providing technical expertise, for human resources development; as well as financial and marketing assistance.

As the new millenium emerges, minimum food packaging will be greatly influenced by the following factors, in the light of increasing globalization and changing trade environment.

* Consumer behavior: future consumers will continue to be discerning, be ready to try new products, be well-connected into communication systems, be aware of and concerned with environmental issues.
* The main issues affecting packaging will be the depletion of resources, pollution, waste and environmental management.
* Minimum packaging will need to consider the 3 R's of environmental criteria: *Reduce, Reuse* and *Recycle*.
* Changes in distribution will include changes in the retailing scene, moving from the neighborhood store, to supermarkets then hypermarkets, cash and carry and warehouse clubs.
* Legislation and laws will apply to food packaging and labeling, and will need to be harmonized with those of other countries to be acceptable and globally competitive.

Some of the major resulting minimum-packaging trends are predicated to be:

* smaller, affordable pack sizes, single serves
* more ready prepared foods, convenience foods, microwaveable packaging
* easy to open, reseal and storable packaging which is tamper-proof
* Modified Atmosphere Packaging (MAP)
* aseptic and retortable packaging
* PET bottles for high temperature filling
* more attractive, international packaging and graphic designs
* environmentally friendly packaging materials.

The minimum packaging of processed foods in the Asian and Pacific region will need to keep pace with changing times, to ensure the reality of global competitiveness for Asian and Pacific foods.

FIELD STUDIES

For their field studies, the participants visited the following eight places: 1) RPF Office; 2) Packaging, Postharvest and Marketing Department; 3) Royal Food Processing Factory at CMU; 4) Vanasanan Co., Ltd.

in Chiang Mai; 5) Thai Packaging Center, Thailand Institute of Scientific and Technology Research; 6) CP Group Co., Ltd.; 7) Wet Fresh Produce Market; and 8) Tesco Lotus Supermarket in Bangkok. The highlights of these visits are presented below:

Royal Project Foundation

The study mission group visited the RPF Office in the morning of 12 September 2001 after a courtesy meeting with His Serene Highness (HSH) Prince Bhisadej Rajani, the Chairman of the Project.

The Royal Project was established by the King of Thailand in 1969. The activities are carried out by university staff and officials of various establishments, volunteering to undertake research on temperate plants for the hill tribe people, to replace opium plantation and to improve their living standard. In 1992, by Royal Command, the Royal Project was established as a Foundation with His Majesty as its Honorary President, in order to keep its activities operating regularly. The Board consists of HSH Prince Bhisatej Rajani as Chairman, together with nine appointed members. At present, the activities of the RPF cover the areas of Chiang Mai, Chiang Rai, Lamphun, Mae Hong Son, and Phayao, which consist of four research centers performing various duties, such as pilot project, work initiation, research, technology transfer, social development, natural resource conservation, products processing and marketing, involving communities totaling over 80,000 people.

The objectives are: 1) to render humanitarian service to hill tribes; 2) to reduce the destruction of natural resources such as forest and watersheds; 3) to eliminate opium cultivation; 4) to conserve soil quality and make proper use of land, that is, maintain the forests, with farming confined to farmland only; and 5) to produce cash crops for the benefit of the Thai economy.

Three major roles of the RPF are research, development and marketing. The main achievements of RPF include the creation of channels for marketing of temperate vegetables, flowers, fruits, medicinal plants, field crops, pot plants, forest plants and bamboo, dried flowers, processed foods and handicrafts, all under the logo of "Doi Kham".

The RPF has responded to His Majesty's initiative to help the hill tribes to help themselves by growing useful crops which enable them to have a better standard of living.

Royal Project Postharvest Department

1. ***Fresh Produce Packaging***

The RPF is a big undertaking involving professionals from the university and research departments. The qualified teams of people have different responsibilities at different levels. From hill tribe farms to shops and consumers, the fruits and vegetables arrive in optimal condition.

The participants noted that the fruits are packed in stackable plastic containers which are well-ventilated, to keep fruits undamaged during the transportation until they reach the factory, for either processing or packing for retail sales.

The vegetables such as lettuces and cabbages are packed in similar plastic containers. They are first wrapped in newspaper and then put in the containers, to prevent them from deterioration. Different fruits and vegetables are either processed or individually packed for retail sales. Over 60 different fruits and vegetables are packed in 20 different forms. Some fruits and vegetables are canned as well. Fruits are packed individually in a styrene foam net, sometimes wrapped in paper, and put in simple layers separated by cardboard separators to protect them from physical damage.

Tea is packed in small quantities bags, then put in colorful, attractive cardboard box printed with details of the product inside.

Processed fruits are packed in see-through printed packets adequately sealed. All products are labeled "Doi Kham" with the full address of the RPF.

The packaging for retort pouches is mostly in the following forms:

1) For short shelf life products: clear film PE/Polypropylene (PP)
2) For long shelf life products: oriented PET trays and other material.

The packaging for all items is of an international standard and presentable for overseas market. The packaging meets health and other legal requirements, in addition to consumers' needs.

In the Agro Division, the participants noted the following points:

* Flowers come from plants packed and covered in plastic to keep them moist.
* If boxes are not well-stacked, this may cause damage to plastic covers at checking and grading.
* During the poor handling transport and storage, the products may be damaged because not all the boxes have ventilation holes.
* The corrugated boxes may need better quality cardboard and more moisture-resistant paper.
* Plant area codes, sizes, amount, and other packaging symbols are useful.
* The corrugated carton boxes should be improved as follows:
    1) More attractive design and labeling
    2) Need stronger cardboard, improved paper quality and more ventilation holes
    3) To recycle packaging raw materials, they should not have glue, tapes or wax.

2. ***Marketing Department***

The Royal Project outlet shop is strategically located on CMU campus making it accessible to students, faculty, staff, and the public. It is close to the processing plant, to facilitate transport of the products to the outlet. This is a well-planned project to enhance the standard of living of the hill tribes because there is an assurance of products sold to generate income.

This visit showed a wide range of products produced and processed by the hill tribes, as well as the presentable and attractive packaging used. Although the outlet is not big, around 100 m^2, there are many products for selection.

Products offered range from fresh vegetables in PP film bags, vegetable salads with mayonnaise dressing in PP containers, dried candied fruits, e.g., mangoes and apricots, in PP film and laminated bags, dried and fried mixed vegetables in triangular shaped PP film bags, rice crackers in PP film bags, fruit and vegetable juices in easy-open cans, fruit juice concentrates in long-neck glass bottles, snacks in PP bags and metallized film-laminated bags, dried cut flowers, potpourri, etc. Their packaging is very presentable and visually appealing. The packaging design attracts customers with its expensive look but reasonable and affordable price. The packaging has become part of the produce itself.

The packaged products both fresh and processed, have labels; but some of them are only in Thai, which visitors may not understand. To be more international, it is recommended that products be labelled and described, briefly in English.

The packaging of the products is impressive considering it is a small-scale manufacturing project. The packaging really plays an important and major role as an effective and efficient marketing tool in the sales of these products.

The shop outlet is helpful and supportive in sustaining the marketability of the RPF products, resulting in the upliftment of the standard of living of the hill tribes and Thailand as a whole.

Chiang Mai University Food Processing Factory

In the afternoon of 12 September the study mission group visited CMU. Our observations follow:

Objective/Aim:	To have processing of farm produce with a view to provide value addition. Some of the farm produce cannot be sold fresh and it must be processed before marketing.
Year of establishment:	1973
Total cost of factory:	฿10 million including working capital of ฿5 million
Source of funds:	Royal Government of Thailand
Factory area:	1,250 m^2
Operation:	One shift/day, five days in a week
Turnover: ฿10 million/year	
Profit:	฿2 million/year
Areas of operation:	35 extension stations of Royal Project located at distances ranging from 50 km to 300 km, act as collection points for raw materials and agri-farm produce.
Management:	Managed by Royal Project, infrastructural facilities leased from CMU. The coordinator of the activity is a staff member of CMU.

Farm produce for processing:	Raw Produce	Finished Product
	Passion fruit	Juice
	Strawberry	Jam/juice/wine
	Herbs	Dried herbs, tea, etc.
	Vegetables	Cleaned, sliced, packaged vegetables
	Pumpkin, mushroom	Crackers
	Peach	Cleaned peaches
	Plum	Jam
	Persimmon	Dried persimmon in package
	Japanese apricot	Pickled and dried
	Macadamia nuts	Dried and packed
Packaging materials:	Glass bottles, tetra pack, plastic film, paper box containers and cardboard.	
Market outlets:	A total of 10 market outlets including one in the postharvest center itself. One each in Chiang Mai/Bangkok Airports and the remaining seven outlets throughout Bangkok.	
Unit operations:	Receiving platform; cleaning, washing and grading; peeling/cutting; processing including heating/frying; packaging and storage; distribution and marketing; office and laboratory.	
Strengths and weaknesses:	Uninterrupted power and water supply ensures regular working of the unit profitably. The unit provides value addition of the produce cultivated by the hill tribe farmers. The factory has attracted the attention of farmers to change their old cropping patterns to growing farm produce, instead of opium poppy which was grown for decades. Although there is potential for undergoing moderation/complete automation, such changes need to be carefully introduced or they may hamper employment prospects for the people.	

Vanasanan Co., Ltd.

After the CMU factory visit the participants arrived at the Vanasanan Co., Ltd. in Chiang Mai. Vanasanan Co., Ltd. started their food processing business 20 year ago, as a family food business. After eight years operating as a family food processing operation, the Vanasanan Co., Ltd. was formed.

This company started their food processing business by processing vegetable pickles, today Vanasanan Co., Ltd. is a successful company with more than 200 products and with a turnover of about ฿4 million per month.

Vanasanan Co., Ltd. has three processing plants, i.e., a pickle vegetable processing plant, a fermented pork processing plant and a snack processing plant. The company has more than 100 employees working to produce various types of products such as fermented pork, vegetable and fruit pickles such as garlic, mango pickles and also various snack products such as fried rice crackers, and vegetable snacks.

The Vanasanan Co., Ltd. has a joint venture with Frito Lay Co. to produce snacks such as potato chips and rice snacks. One of the problems facing Vanasanan Co., Ltd. is their need for modern packaging materials. At present the company purchases packaging materials from local manufacturers.

Thai Packaging Center, Thailand Institute of Scientific and Technology Research

On 13 September the participants visited the Thai Packaging Center which is located at 196 Phahonyothin Rd., Chatuchak Bangkok, 109090. It was established according to the Thailand National Economic and Social Development Plan under Thailand Institute of Scientific and Technological Research.

This center has 17 personnel working in three sections of the center: the Research and Development; the Seminars and Training Section; and the Testing and Laboratory Section.

The objectives of this center are to: improve and maintain the quality of products; decrease losses; increase export; and upgrade packaging standards of the country to serve the needs of government and private sector.

The activities of Thai Packaging Center are listed as follows:

* Research and development in packaging to serve the needs of the country
* Contract research, e.g., to decrease damage or packaging costs
* Complete packaging cycle services
* Testing packaging materials and containers with modern equipment, for example, water vapor transmission rate meter, bursting strength tester and tear resistance tester
* Technical consultation and advisory service
* Collecting various packaging samples
* Information service – open to public and private sectors, including PACKDATA and list of manufacturers
* Publications – there are many publications offered to the public and private sectors such as packaging information, packaging manuals, conference/seminar proceedings, and packaging journals
* Coordinating center between users and manufacturers, both locally and abroad
* Coordinating packaging exhibitions.

With these objectives, activities and modern technologies, the Thai Packaging Center contributes a great deal in package design and quality image to products which are essential for both successful export and domestic marketing in Thailand.

CP Group Co., Ltd

After visiting Thai Packaging Center the participants visited CP Group Co., Ltd. (Charoen Pokaphand Food Company Ltd.). The General Manager introduced the company staff and showed a company video presentation.

The CP Group comprises a group of companies which form an integrated poultry processing business for exporting frozen raw chicken meat, frozen cooked chicken and duck products.

The business of this company includes the following:

– Feed mill
– Parent stock breeding farms and hatchery
– Broiler farms
– Poultry processing plant
– Food processing plant.

The company was established in 1978 and renovated in 1997. Their Establishment Number is TH21. The total investment of the company is ฿500 million. The number of workers of this company is 700 persons plus 100 in the administration Department and 50 people in the Quality Control Department. The healthcare of workers is at a good level, the company having a full-time registered nurse and a health check-up once a year for each employee.

The company exports their products to European countries, such as Belgium, France, Germany, U.K., using the export code TH. It also exports to Asian countries such as Hong Kong, Japan, Singapore, Republic of Korea with export code EST.

The participants' first impression was that the processing plant is very clean. The walls are made of insulated aluminum panels which are easy to clean and the air-conditioning has a fresh air intake, ozonated through filters. Insectocutors are located at every opening to the outside of the building.

The CP company has a strong environmental control system which consists of Good Manufacturing Practices (GMPs); Hazard Analysis and Critical Control Point (HACCP); and ISO 9002. The environmental management system is ISO 14001 (SGS:UKAS). All certificates of environmental quality are on display in the conference room.

The food processing plant imported equipment from the Netherlands, U.S.A., Switzerland and Japan. The plant has a tumbler, which prepares the marinated meat, and a fryer for the marinated meat.

It also uses a freezing system, which consists of six Individual Quick Freezer (IQF) with -40ºC: two Frigoscandia IQF 300-500 kg/hr/freezers, one York IQF 600-800 kg/hr, and three Frigoscandia IQF 600-800 kg/hr/freezers.

The last stage of the food processing plant is two cold storage units, where they keep the finished product at -25ºC and the capacity of each is 1,000 mt.

The food processing plant produces four kinds of products: steamed chicken, roasted chicken, fried chicken and cooked duck. The process on Line A is 600 mt a month, fully cooked, steamed/roasted, or fried-steamed chicken breasts. For Line B, it is 700 mt a month of semi-cooked, fried chicken legs. For line C, it is 150 mt a month of fully cooked, roasted/boiled/fried duck.

The process of fried chicken starts from the marinating of meat. After the preparation, raw materials are mixed with condiments and spices then spread on the belt, again mixed in water and condiments and then sent to the fryer. The fried products go to the freezer by conveyer. After freezing, the fried products are packed in plastic HDPE packaging material, weighed into 10-kg units, then sealed and passed through a metal detector. The frozen, fried, packed products are brought to the freezer storage and kept for a week, while the in-house laboratory carries out microbiological and chemical testing of samples. When testing is finished, the products are delivered to retail outlets and consumers.

For steamed products, the process is done on another line. Raw materials are prepared, spread on the belt then sent to the steamer for 13 minutes. After steaming they are frozen for 4 minutes at a temperature of -40ºC. Then the product is packed in plastic bags and boxed, then kept in the freezer at -18ºC.

The room temperature for both operators on both lines remains +10ºC. Packaging of the finished products is on a manual basis, for wholesale marketing, in 5-kg/10-kg/20-kg bags.

The General Manager informed the participants that based on market surveys and customers' demand the company has tried to manufacture products ready for use by retail customers. Next year the company will have a Packaging Department which can pack produce in different quantities.

As the participants observed, the company obtains raw materials based on contract farming, since they do not have their own chicken farms. The poultry slaughtering plant exists as a separate processing plant. This separate location enables the company to maintain hygienic conditions. The raw materials from the primary processing plant is carried in refrigerated trucks to the secondary processing plant.

Wet Fresh Produce Market

The study mission group went to the wet fresh produce market at Minburi after visiting the CP Group Co., Ltd., to search for products for evaluation in the workshop the following day. There were three groups: fruits and vegetables (Group 1: Fiji, India Indonesia, Nepal, Pakistan and Philippines); meat and dairy (Group 2: Iran, Malaysia, Mongolia, Nepal and Philippines); and cereals and beverages (Group 3: Pakistan, Republic of China, Sri Lanka and Vietnam). General observations of the Wet Market and their reports are as follows:

The Wet Market is located in the center of Minburi. It is called Wet Market because wet and fresh fruits, vegetables, meat, fish and seafood are mainly sold. The Wet Market covers 100 m x 60 m. The surroundings are quite busy but clean. It is rather crowded but systematically arranged to keep an open market. The shops are covered, well-arranged and clean. There is sufficient space for buyers to move around, walk, buy and see the products and for shopkeepers to display their goods. It is a place where one can get different varieties of fresh fruits, fresh vegetables, fresh fish and seafood under one roof, at cheaper prices than in big supermarkets. Every corner of the place is utilized.

1. ***Fruits and Vegetables***

Varieties of seasonal fresh fruits are available in the Wet Market. There are fruits which could be available in other countries in South East Asia, Far East, Pacific, Middle East and Western countries too. Most of the fresh fruits such as mango, oranges, fresh date, guava, banana (green and yellow), green apple, plum, red apple, custard apple, watermelon, lime, apple, papaya, yellow melon, lichi, peach, sapodilla, coconut 9fresh), grapes (green and black) and pomelo are sold by kg and price ranges from Ɓ25 to Ɓ50. Bananas are sold in 'hands', one hand of yellow ripened bananas costs Ɓ15, and one hand of green bananas costs Ɓ30. Bananas are kept in bamboo baskets covered with newspapers. Typical fruits are: durian, longan, salak (snake fruit), dragon fruit, rambutan, water chestnuts, toddy palm, kiwi, passion fruit, Chinese pear, avocado and Japanese apricot. Water chestnuts, longan, and rambutan are also available in cans and cost Ɓ100 for four cans. Fresh guavas cut in pieces and fresh dates in plastic packets are also available, as well as ready-to-serve fruit in plastic bag packs, thin net packs, and single fruit in foam nets.

Varieties of seasonal green vegetables are available in the Wet Market. They are: cauliflower, watercress, morning glory, water mimosa, wing beans, spinach, spring onions, spring garlic, asparagus, coconut shoot, horse radish (white), bitter gourd, turnips, pumpkins (green and yellow), squash, carrots, small red and green chilies, capsicums (red, yellow and green), long green chilies, bamboo shoots, kale (shoots), and baby Chinese cabbage. All are kept in plastic bags.

Other vegetables like tomatoes, coriander leaves, basil, brinjal (green and long and round dark purple), cucumbers are sold loose by kg in the market, and are not packed. The prices range from ฿25 to ฿50 per kg. Spring onion, garlic, and coriander leaves are sold in bunches, with price starting from ฿10. Fresh mixed vegetable salad (ready to serve [RTS]) is available in plastic bags, costing ฿25.

The Wet Market looks more traditional in the way they have arranged the shops, vegetables, fruits and seafood. On one hand they have fresh vegetables, fruits, seafood sold in a traditional way, but some processed fruit cans, plastic packages, bamboo baskets, plastic bag containers and RTS salads and fruits show that they are also influenced by modern technologies in food processing and minimum packaging.

2. ***Meats and Dairy Section***

There were mostly raw meats, placed on crushed ice to maintain freshness; but very few processed and packaged meats. The displays were of a fairly basic hygienic standard. There were fermented sausages in PP film wrapper and bag, and other types of sausages in PP bags. It was decided to buy the type of sausage in PP bag. These sausages have strings tied to the bags and are then hung for the buyers to see very well even from a distance. There being no other processed and packaged meats and dairy products, the visit was quite short. It was found that the Wet Market was clean and not smelly, and the floor was not slippery and wet. It also had wide corridors for more convenient buying.

3. ***Cereals and Beverages***

Almost all the shopkeepers dealing with rice had both brown and polished rice. The available bulk package was of 100 kg in jute bags. The traders sold rice in packs of 5- and 10-kg. Similarly, both white and brown beans are also available in bulk for sale at any demanded quantity. Dried green peas were also seen in the market. The sales procedure is that buyers request their required quantity and the sellers weigh this into polythene clear plastic bags. This produce was found to be graded, particularly the rice, but these cereals were in a rather unhygienic condition. The rice and beans bags of bulk quantities were found open and at the top there was dust and flies.

In some shops, cereals are found in small packages for single serve and consumption. Their packaging procedure was very simple, the sold quantity of cereal was put in a bag and the top closed by hand, while in the case of small packages they closed the bag and tied it by rubber band.

Beverages were found in recycable glass bottles which would be reused. Fresh coconut juice and other natural fruit drinks are also available, such as coconut. It is worth mentioning that in the Wet Market these products were not hygienically presented in good packaging, which is becoming the demand of modern times.

Tesco Lotus Super Market

On Friday, 14 September, the participants visited Tesco Lotus Supermarket on Rama IV Road, Bangkok. This was to enable the groups to examine packaged food products in relation to their nominated product areas, i.e., fruits and vegetables, meats and dairy, cereals and beverages. The groups' observations are as follows:

Group 1: Fruits and Vegetables

A wide variety of fruits and vegetables are sold at Lotus Supermarket, packaged and processed in different forms such as canned, bottled, pickled and dehydrated, etc. Fresh produce are packed in nets, polystyrene (PS) trays with shrink wrap, cartons and transparent plastic bags. The majority of the fresh produce, however, remains unpacked. These are arranged in 'field' containers as per product type, with price tags attached. Many packaged products do not have individual labels or tags to indicate the actual weight, which had to be weighed and priced separately after selection by customers. For some vegetables like lettuce, string beans and eggplants, a violet tape was placed around the fresh produce, meaning the product can be brought to Japan without restrictions, as it has been locally certified to be insecticide/pesticide-free.

In addition to fresh produce, a salad bar was observed where customers can choose from different types of minimally processed and cooked vegetables and salad dressings packed in glass jars. Also minimally processed fruits such as durian, cantaloupe, pomelo, mango, etc., packed in PS trays with string wraps, were

likewise noted. Boiled peanuts are contained in a steamer to keep them warm. Other products observed were dried vegetables packed in transparent plastic bags, pickled vegetables in transparent plastics and tub-type bottles, mixed fruits in syrups in cups and a variety of cans were observed on the shelves. Processed mung bean paste was molded in different shapes and colors which was interesting since these looked like miniature real fruits and vegetables. Many canned products were observed to have easy-open can ends to facilitate opening, with plastic covers to reseal the opened cans in some products. A plastic spoon or fork was attached to facilitate consumption. Noticeably unavailable were dried fruits.

Groups 2: Meats and Dairy

Tesco Lotus Supermarket is a large supermarket consisting of many sections, the largest being grocery products. There are two major areas of meat and dairy products in the supermarket. One area is a place where fresh products are sold and the other area where processed products are sold.

In the fresh meat and dairy area the products are kept under refrigerated display. Meats are cut and packed suitable to the consumer needs, including meat in PS tray and wrapped with saran wrap. While the dairy products were packed in various plastic containers easy to use by the consumer. The processed meats such as salami, hotdogs and burgers were also kept in the refrigerator display and packed in plastic and vacuum packaging. In the processed dairy product area, there are many processed dairy products displayed such as cheese, tetra pack fresh milk and yogurt. Most processed dairy products are kept refrigerated because these products can easily spoil.

The meat and dairy products in the Tesco Lotus Supermarket have been packed in various types of attractive food packaging.

Group 3: Cereals and Beverages

Group 3 went to the cereal and beverage section and decided to purchase as a group, discussing and collecting items.

Rice was available in bulk packs with open ends as well as in 2-kg, 5-kg and 10-kg sealed packs. From bulk packs the required quantities were measured and packed into smaller PE bags, as per the demand. Other cereals and grains were in 1 kg, 2-kg and 5-kg sealed packs. Also stocked were a large number of cereal-based processed food items such as instant noodles, rice crackers, breakfast cereals, porridges, cereal beverage products, snacks, extruded items, etc., of different flavors and combinations. They were packed in various sizes in cellophane bags, single-, double- and triple-layer pouches, pillow packs, cups of PS, PP trays with shrink wrap, cardboard boxes with and without internal primary packing, cartons with single-serve packs, etc. They were also available as wholesale items in bulk form, containing 10-20 packs in a wholesale pack.

A large number of nonalcoholic beverage products were available, ranging from RTS juices, drinks, concentrates, cordials, mineral waters, dehydrated instant mixes; dry products such as teas, coffee, etc., also beers, wines, drinking water, etc. Packs came in all sizes and shapes ranging from cans, bottles, tetra packs, pouches, plastic containers, cardboard boxes with inner layers and primary packaging; flexible, semirigid and rigid containers, made out of tin, aluminum, glass, paperboard and other laminates, plastics such as PET, PP, PE, PS, etc. Also available were single items or wholesale items in multi-packs.

STRUCTURED WORKSHOP OUTPUT

In the afternoon of Friday, 14 September the groups analyzed the products purchased as follows:

Group 1: Products

1. Fresh salak in plastic bag
2. Minimally processed shredded ginger in plastic pouch
3. Pickled turnip with chili in glass jar
4. Mixed fruit candy in plastic tray
5. Dried bael fruit in plastic bag

Group 2: Products

1. Pasteurized fresh milk in PP bottle
2. Processed cheese wedges in foil packs

3. Yogurt in PS container with peelable cover
4. Round steak ham in vacuum packaging
5. Chiang Mai fermented pork in banana leaves

Group 3: Products

1. Instant noodle soup cup
2. Fruit juices in bottle
3. Instant rice porridge in pouch
4. Instant ginger tea in bottle
5. Green tea bag in box

FINDINGS

For fruits and vegetables, it was found that in the Wet Market and Lotus:

* the fresh produce is normally unpackaged, some are simply packaged in plastic bags, plastic nets, plastic sleeves and plastic bands.
* some produce are minimally processed for consumer convenience, then better packaged in plastic trays with bags or lids.
* dried fruits and vegetables are normally packaged in simple LDPE or PP bag.
* sealing methods are either by heat sealing or stapled.
* canned fruits and vegetables are available, made by medium- or large-sized factories.
* the packaging is appropriate and easy-open (EZO) ends are widely used for single-serve can size.
* family produced products are generally inappropriately labeled.

For the dairy products, it was found that:

* the packaging ranges from thermoformed vacuum laminated film to aluminum foil in paperboard boxes for cheese, rigid plastic containers for yogurt and pasteurized fresh milk.
* the packaging gives various degrees of protection to the contents. The products evaluated have very good and advanced packaging.
* the packaging protects and extends product shelf life very well.

For the meat products, it was found that:

* the packaging ranges from traditional packaging using banana leaves in a PP bag, to sophisticated vacuum packaging.
* the degree of protection varies, depending on the packaging materials used.
* the products chosen for evaluation were from two extremes: traditional packaging and vacuum packaging.
* the traditional packaging needs more improvement while the advanced packaging has very good performance in protecting the product.

For the beverages and cereals, it was found that:

* instant noodle soup cup: PP cup used for this product has several advantages including safety, recyclability, convenience, stability, etc.
* fruit juices: the available soft drinks and juices are packed in a universally acceptable package.
* instant rice porridge: the consumer factor, design factor, and physical factors are normal, and the packaging and environmental factors are good.
* green tea bag: green tea bag is in flexible bag and a semirigid box, with lithograph colors.
* consumer factors are good but it is not attractive, while design and physical factors are good.

* instant ginger tea: the shape of the bottle is very good for handling and transportation and the screw cap is good for this product for frequent opening and closure.

SUMMARY

For the Fruits and Vegetables

* The packaging materials used for fruits and vegetables are generally acceptable. The items for export are well-packed and presented. Fruits and vegetables packed for local sales needs to be improved. Dried fruits and vegetables were not available in packages, which needs to be introduced into both local and supermarkets.

For the Dairy Products

* Packaging of the products is generally attractive and protects the contents well. However, some improvements are needed.
* There should be English translations on the label for foreigners to know the exact content of the packaging to prevent guessing.
* The materials used for the packaging should be reusable or recyclable for sound environmental reasons.
* The structural design of the packaging should consider the anthropometrics of the consumers. For example, the handle size should be comfortable enough for both male and female consumers.

For Meat Products

* Labels should also have English translations on them for foreigners to understand the contents of the package.
* For traditional packaging, the banana leaves can be retained as the primary packaging, but the secondary packaging can be improved to extend shelf life.

For Cereals and Beverages

* Instant noodle soup cup: a good way to pack this product from the view of food quality and environmental concern. If the packaging materials are reduced, it would be much better.
* Fruit juices: in general all the available soft drink and juice are in an attractive package.
* Instant rice porridge: add some information on nutrition in the package.
* Instant ginger tea: reduce the shrink wrap and provide more information on the products.
* Green tea bag: minimize the package.
* Comparing the products from Wet Market to those from the supermarket, the packaging is much better at the latter from the viewpoint of safety, hygiene, and food quality.
* Based on the point of keeping quality and environmental concern, some products are not minimally or optimally packaged.

RECOMMENDATIONS

* There should be a survey in Thailand on fruits and vegetables packaging by a professional organization or university students, supervised by the university; the food packaging companies could be advised of the survey report results, with a request to assist in the areas of improvement recommended.
* Departments of Commerce and Industries and Agriculture should take special initiatives to encourage this area of development.
* The packaging should have English translations for the foreigners to know what they are buying and consuming.
* The packaging materials used should be reusable and recyclable.
* Traditional packaging using banana leaves should be encouraged and improved by laminated film/ pillow pack to extend shelf life through more hygienic packaging.

CONCLUSIONS

The participants of the Multi-Country Study Mission on Minimum-Packaging Technology for Processed Foods were introduced and exposed to a wide range of food packaging options. These ranged from minimally-packaged traditional foods in local markets, to sometimes over-packaged products in large supermarkets by way of contrast.

The participants learned, through the guidance of the resource speakers, the concepts of minimum food packaging technologies, based on principles of food preservation and their integration with the food products', consumers' and markets' essential needs.

As a result the participants considered a draft definition of minimum packaging as follows: ***"Minimum Packaging involves adequate product containment with cost-efficiency, while performing essential functions, to meet technical and sociocultural needs, ensuring quality and safety, with concern for environmental requirements".***

Also discussed was a proposal for the development of a training program on Minimum Packaging for SMEs and Farm Organizations which could be adopted by interested APO member countries.

The field visits and food packaging analysis exercise (see Annex for questionnaire used) reinforced the participants' skills, knowledge and understanding of the developing field of Minimum-Packaging Technology for Processed Foods.

Annex

APO Multi-Country Study Mission on

Minimum-Packaging Technology for Processed Foods

Questionnaire for Food Product and Package Evaluation

Participant's Name . . . . . .

Designation . . . . . .

Country . . . . . .

Date . . . . . .

FOOD PRODUCT AND PACKAGE EVALUATION

Packaging questions
You are asked to look at the sample of packaged food and evaluate it under the following headings:

1. Consumer Factors
2. Design Factors
3. Physical Factors
4. Preservation and Environment Factors

You should allocate a number of points for each factor listed, then add the sub-total to obtain the score out of a possible 100 points. The final form is a Yes/No answer style with points allocated for correct answers.

You may use your notes to refer to, or ask some of the following questions:
* Does the package keep the food contents fresh?
* Does the package impart (give off) any flavor to the food contents?
* Does the package prevent spoilage of the food?
* Do the contents taste better with this (new) package?
* Is it safe and accident-free, for children to use?
* Can freshness be preserved after package is opened?

Other questions to ask are, e.g., what is the:
* durability of the container?
* visibility and appearance of the contents?
* re-usability and versatility of the container?
* environmental impact of the containers?
* raw material availability for the packaging?
* recyclability of the packaging material?

Attached is a useful checklist of other packaging features to refer to:

FOOD PRODUCT AND PACKAGE EVALUATION

Food Product Type . . . . . .
(orange juice, dried nuts, fresh meat)

Retail Package Type . . . . . .
(can, bottle, pouch, container)

Body and Style . . . . . .
(rigid, semirigid, flexible)

Closure and Sealing . . . . . .
(spout, gable top, ring pull)

Labeling and Printing . . . . . .
(lithograph, paper, shrink label)

Transport Package . . . . . .
(carton, box, bag)

Comments:

FOOD PRODUCT AND PACKAGE EVALUATION

A. Consumer Factors	Points Possible	Points Given
1. Convenience	(25)	
– Is it convenient to handle and use?	5	
– Is it a useful shape and size?	5	
– Does it fit the cupboard or fridge easily?	5	
– Will it tip over or spill easily?	5	
– Is it too heavy or too light?	5	
2. Label Information	(25)	
– Is the label clear and concise, can I recognize it easily?	5	
– Does it inform about the food inside?	5	
– Is there information on nutrition?	5	
– Can I calculate the price per unit weight?	5	
– Is there information on all sides of the package?	5	
3. Practical Package	(25)	
– Can the package be opened easily?	5	
– Can it be closed/resealed easily?	5	
– Can it be reused/recycled?	5	
– Can it be disposed of readily?	5	
– Is it made from non-toxic, renewable material?	5	
4. Appeal of Package	(25)	
– Is the package attractive, outstanding?	5	
– Does it have a high quality expensive look?	5	
– Is it pleasing to own this package?	5	
– Would it make a good gift pack?	5	
– Would I enjoy receiving this package?	5	
Sub-total	100	

Comments:

FOOD PRODUCT AND PACKAGE EVALUATION

B. Design Factors	Points Possible	Points Given
1. Shape	(16)	
– Does the shape look attractive?	4	
– Does the shape fit the design?	4	
– Does form follow function?	4	
– Is the pack a stable or unstable shape?	4	
2. Color	(16)	
– Are the colors attractive?	4	
– Do the colors match each other?	4	
– Do the colors clash or disturb?	4	
– Are the colors clear and sharp?	4	
3. Communication	(20)	
– Is the communication attractive?	5	
– Is the information useful?	5	
– Is there too much information?	5	
– Does the information meet the legal requirements?	5	
4. Production Quality	(16)	
– Is the package produced attractively?	4	
– Is the quality of finish high?	4	
– Does the package have defects?	4	
– Has the package been damaged?	4	
5. Originality	(16)	
– Is the package an original design?	4	
– Is it a new and useful design?	4	
– Is there a novel feature on the package?	4	
– Is it an improved package?	4	
6. Appeal	(16)	
– Is the package an appealing one?	4	
– Does it stand out on the shelf?	4	
– Is it better than the competition?	4	
– Does it attract the consumer to buy it?	4	
Sub-total	100	

Comments:

FOOD PRODUCT AND PACKAGE EVALUATION

C. Physical Factors	Points Possible	Points Given
1. Stability Consider stability on packaging line, in storage, in use.	10	
2. Strength of Material Consider strength of material, lightweight, and convenience	10	
3. Size (handling and product content) Consider shape, size, dimensions, geometry.	10	
4. Storage Facility Consider ease of handling, stacking, storage.	10	
5. Production Facility Consider ease of production, manufacture, stability on line and stored.	10	
6. Ease of Filling/Productivity Consider ease of filling, non-spill, high speed, no contamination.	10	
7. Effective Closure, Opening Consider ease of closure, sealability, seal integrity, opening and resealing.	10	
8. Shape Suitable for Packaging Consider packaging material used in relation to shape of package compatible.	10	
9. Tamper and Pilfer-proof Features Is the pack safe from children, tamper and pilfer-proof?	10	
10. Transportation Suitability Can the package be contained, packed easily, stacked securely, transported suitably?	10	
Sub-total	100	

Comments:

FOOD PRODUCT AND PACKAGE EVALUATION

D. Packaging and Environment Factors	Yes	No
Food Preservation Principles		
Food unit operations used		
Cold preservation		
Heat preservation		
Fermentation preservation		
Reduction of water available		
Chemical preservation		
Pickling or curing preservation		
Gas environment control		
Combination preservation		
Packaging Changes to Food		
Biochemical changes		
Microbiological changes		
Physical changes		
Chemical changes		
Toxicity changes		
Trace elements		
Packaging Influence on Foods		
Retains or excludes volatile aroma		
Color and texture influence		
Retains or excludes moisture		
Retains or excludes oxygen		
Allows partial diffusion of gases		
Insulates food against temperature changes		
Protects food from sunlight or UV		
Packaging Influence on Environment		
Cost of package is less than food cost		
Cost of package exceeds food cost		
Package is designed to reduce waste		
Package is in excess of food needs		
Packaging raw material is abundant		
Packaging raw material is scarce		
Packaging can be recycled, sustainable		
Packaging cannot be recycled, has impact on environment		
Sub-total	100	

Comments:

FOOD PRODUCT AND PACKAGE EVALUATION

Your overall assessment of the food package

How would you improve, upgrade, and/or minimize this package?

Comments:

. . . . . .

Signature and date

FOOD PRODUCT AND PACKAGE EVALUATION

Packaging Questions

You are asked to look at the sample of packaged food and evaluate it under the following headings:

A. Consumer Factors
B. Design Factors
C. Physical Factors

CHECKLIST OF OTHER PACKAGING FEATURES

Product . . . . . .

Primary Package Style . . . . . .

Physical Factors:
– Body (17 items)

Finish and Closure:
– Method of closure (11 items)
– Closure efficiency (15 items)

Labeling (15 items)

Printing
– Printing methods (5 items)
– Print quality (22 items)

Transport Package (22 items)
– Package style and material

Comments:

(*Source: PHALD International P/L, Sydney, Australia*)

Package Evaluation	Below Normal (percent)	Normal	Above Normal (percent)
Physical Factors			
Body: (17 considerations) Materials Shape Size (volume) Chemical compatibility Ease of manufacture Stability on packaging line Stability in storage Stability in use Dimensions Geometry Recyclable Rigidity Flexibility Fragility Physical compatibility Surface coatings Print quality		100	
Sub-total			
Finish and Closure			
Method of Closure: (11 considerations) Tuck flap Seal end Heat seal Screw cap Plug fit snap-over Stapling Taping Gluing Peg board header Blister card Skin pack			
Sub-total			

<u>Closure Efficiency:</u> (15 considerations) *Chemical compatibility* Tolerances Surface texture Continuous thread Interrupted thread Flat land seal Peel seal Druggists' fold Soft hem Seamed-on lid Slip lid Friction fit lid Glue receptivity Tamper-proof features Pilfer-proofness ***Sub-total***			
<u>Labeling:</u> (15 considerations) *Materials* Size and shape Guillotine cut Die cut Aqueous adhesive Pressure-sensitive adhesive Thermal adhesive (hot melt) Heat-reactivated adhesive Water-reactivated adhesive Print quality Dimensions Paper quality surface coatings Print quality Over lacquers ***Sub-total***			
<u>Printing</u> *Printing Method*: (5 considerations) Lithography Letterpress Rotogravure Flexography Silk screen ***Sub-total***			

<u>Print Quality:</u> (22 considerations) Number of colors Ink opacity/transparency Ink lay-down Halftones Solids Line and tone Line work Typographic impact Ink adhesion Gloss Positional register Halftone register Dot formation Color fidelity Surface texture Legibility Contrast Rub resistance Over lacquers Head seal medium Glueability Surface cracking or crazing ***Sub-total*** **<u>Transport Package:</u>** (22 considerations) <u>Style:</u> <u>Material:</u> *External dimensions* *Internal dimensions* Internal aspect ratio Pallet area utilization Pallet cube volumetric utilization Count Packing pattern Weight of product on pallet/m of height Optimal pallet cube height Amount of bulge on length (percent) Amount of bulge on width (percent) Pallet stacking pattern Degree of interlock Suitability of fit in ISO container: On pallet As hand stow ***Sub-total***			

Closure Glue seal Taping Stapling Load supportive Suitable for export to tropics ***Sub-total*** Total			

Comments:

Simple Testing Methods for Plastic Materials

Testing Method	Odor/Appearance of Flame	Material
1. Hand-feel	Flexible, soft Stiff, hard Hard but flexible Smooth, slippery, fairly soft Still, hard, solid	LDPE, PVC (soft) PUR HDPE, PP, PVC CA, CAB, CN, P, A PTFE UF, PF, MF, UP
2. In water	Floating Sinking	LDPE, HDPE, PP, EPS PUR, PVC (soft and solid) PS, ABS, CA, CAB, CN, P, PMMA, PA, PTFE, A, UF, MF, UP
3. Cutting	Easily cut Not easily cut	LDPE, HDPE, PP, PVC PF, PA, PTFE, A, PUR, PS, PMMA, UF, PF, ME, UP
4. Burning	Bulk, flame and yellow at the tip of the flame Yellow flame Orange yellow flame Dark yellow flame Yellow with blue at the base Soft blue flame There is (little) smoke Smoke Smoke with sooty particles Material will be broken and a whole color at the edge of burning area	LDPE, HDPE, PA PVC (soft), EN, P, PMMA, PUR PS, EPS, ABS CA, CAB PP A LDPE, HDPE, PMMA, PA, A CA, CAB, EN PS, EPS, ABS, PUP UF, MF
5. Smell	Lighted candle smell Pungent smell like hydrochloric acid Marigold-like smell Bitter but rubbery smell Rancid smell Vinegar Camphor Raspberry-jam Fruity Burning hair Pungent, formaldehyde Acid smell Carbolic acid smell	LDPE, HDPE, PP PVC PVC ABS ABS CA EN P PMMA, UP PA A, UP, MF PUR PF

(*Source: Somjate Siriratanapa 2001*)

Glossary of Packaging Materials

ABS	Acrylonitrile Butadiene Styrene Copolymer
CA	Cellulose Acetate
CPP	Cast Polypropylene
EPS	Expanded Polystyrene, Polystyrene Form
EVA	Ethylene Vinyl Acetate Copolymer
EVOH	Ethylene Vinyl Alcohol Copolymer
GPPS	General Purpose Polyethylene
HDPE	High Density Polyethylene
HIPS	High Impact Polystyrene
LDPE	Low Density Polyethylene
LLDPE	Linear Low Density Polyethylene
MDPE	Medium Density Polyethylene
OPP	Oriented Polypropylene
PA	Polyamide (Nylon)
PE	Polyethylene
PET, PETP	Polyethylene Terephthalate, Polyester Ionomer
PG	Polycarbonate
PP	Polypropylene
PS	Polystyrene
P-PVC	Plasticized Polyvinyl Chloride
PU	Polyurethane
PVA	Polyvinyl Acetate
PVC	Polyvinyl Chloride
PVDC	Polyvinylidene Chloride
SAN	Styrene Acrylonitrile Copolymer
U-PVC	Unplasticized Polyvinyl Chloride

1. MINIMUM-PACKAGING TECHNOLOGY FOR PROCESSED FOODS – ENVIRONMENTAL CONSIDERATIONS

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INTRODUCTION

Technologies are called traditional if, unaffected by modernization, they have been commonly applied over a long period of time. In general, traditional technologies tend to be cheap, easy to produce, apply, maintain and repair. They are labor-intensive which can be economically beneficial, but as far as food packaging technologies are concerned, the final products are often hygienically substandard and usually have a short shelf life.

Many traditional foods have nonetheless remained unchanged in process or package for centuries, due to the fact that they developed in a particular location and are deep-rooted in the natural, cultural, religious and socioeconomic environment. Some have disappeared without a trace as a result of modern influences, while others have expanded on a global scale, becoming household products, e.g. soy sauce, now a multi-million dollar industry. The reasons for this phenomenon need to be examined.

For example, population drift from rural to urban areas has caused drastic changes in the food supply network from farm to the consumer, in many emerging nations. One traditional belief which can no longer be sustained is the old saying that "there are always fish in the rivers and lagoons and rice, taro or cassava in the plantations, therefore let there be no concern for the next meal". It is more likely that the farmer has gone to the city or even overseas and is earning a laborer's wage to keep his family in food during the off-season. So food is now brought to the market by many and various means and redistributed to these new consumers. There are new vistas for traditional food markets, where the technologies are tested beyond their limits.

TRADITIONAL FOOD PACKAGING TECHNOLOGIES

Food Systems

Modern food packaging technology brings traditional foods into a world arena which increasingly emphasizes their commercial and economic aspects. This means that food and packaging technologists become involved in the entire food supply system. This system ranges from the sea, village farm, plantation, to the markets and consumers in towns and cities, not only in their own country, but also in distant overseas markets.

The surplus foods grown in the village need to be more carefully harvested, protected from spoilage and damage, packaged and transported by various means to these markets. Unless the goods are sold with minimum spoilage, at their peak flavor, appearance and nutritional value, and presented in an attractive way, they may not be eaten at all. This is a worse situation than if the crop had never been grown and can represent serious loss and waste to a community.

Very little investment has been made so far in developing traditional technologies or in applying scientific knowledge in most of the developing countries; meanwhile the more expensive products of imported technologies have further slowed the development of indigenous technologies. It is increasingly recognized that the time has come when these traditional technologies must be upgraded through scientific application of packaging principles and then integrated with other functions such as marketing and advertising, into country development programs. In addition, careful environmental considerations need to be given to packaging forms, to enforce sustainability and avoid pollution problems.

Given the circumstances in which many developing countries are facing today, the challenge for their traditional technologies is that often they do not contribute sufficiently to meeting socioeconomic imperatives. This is true also of those food technologies where many of the processing methods have remained unchanged for centuries and are becoming inadequate to cope with modern needs, because they are too labor-intensive and depend too much on natural environmental conditions. It is now clear that there is a need to lessen the dependence on nature, reduce the drudgery, shorten the time of the work involved and upgrade the preparation, quality, packaging, presentation and shelf life of these traditional foods and their packaging.

Women and Food Processing

Women play a major role in most traditional food processing and packaging. They dry leaves, pulses and cereals, make curds and cheese, smoke meat and fish, ferment, grate and dry cassava and carry out a wide range of food preservation and packaging processes. It is indispensable, therefore, that women view the proposed technology improvements as capable of reducing their labor, without diminishing their role and status, or, in the case of marketable products, their profit.

It should be borne in mind that the upgrading of traditional food and food packaging technologies is a sensitive area, for which reason the subject should be approached with caution and due regard paid to the social, economic and cultural factors involved, in addition to the gender issues.

Further sensitivity needs to be applied to the small business operation in the preparation and packaging of traditional foods. Programs for mass production of a particular food, many have dire consequences for the small business operator. In the consideration of the structural characteristics of traditional food industries, in particular the application of new food technologies and the use of labor-saving continuous large-scale processing, the task needs to be approached thoughtfully.

Several other factors might prevent the actual adoption of an upgraded technology which is otherwise readily available. Lack of purchasing power of the potential consumers is a good reason for entrepreneurs not to produce in the first place. The same is true of problems related to poor distribution, lack of sales promotion or inability to repair and maintain facilities. Numerous examples also exist of technically and economically sound upgraded technologies, which were rejected by the target group because they collided with sociocultural customs and tradition.

Upgrading of Food Packaging

Upgrading of traditional food packaging technologies in many cases, introduces exogenous factors, i.e., the importation of technology from abroad. Whether or not adapted to local circumstances, the use of imported packaging technologies in many developing countries remains restricted to modem technologies; even when these are locally developed, they are more complex to use, repair and maintain. They are also expensive and tend to rely on imported components and nonrenewable sources of energy.

In addition, they tend to be very capital-intensive, which does not contribute to the solution of unemployment problems. For the purpose of improving traditional food packaging technologies, it would appear desirable either to simplify the modern systems, or to improve traditional technologies; or seek a compromise solution between both methods of approach, by a process of adoption and adaptation.

FOOD PRESERVATION PRINCIPLES AND THEIR INTEGRATION WITH FOOD PACKAGING

Food Unit Operations

Before food can be packaged, there are many unit operations involved after harvesting the raw materials, including cleaning, grading, disposal of unwanted material, then stabilization of the enzymatic, biochemical and microbial spoilage. If a study of the preservation and packaging of foods is undertaken, a key question is “What factors cause spoilage and deterioration in foods”. The main factors are micro-organisms (bacteria, yeast and molds) as well as enzymes, temperature and biochemical changes in the foods. Food preservation techniques are designed to prevent these spoilage changes and impart a keeping quality or shelf life to the processed foods.

Packaging is an integral part of the processing and preservation of foods and can influence many of these factors. It can influence physical and chemical changes, including migration of chemicals into foods. The flavor, color, texture as well as moisture and oxygen transfer is influenced by packaging. The effects of temperature changes and light can be modified by packaging materials. Let us consider the more important methods of preservation of foods used by food industries today and how they integrate with the food packaging used in their processing.

1. ***Cold Preservation***

Cold is used to slow down or stop the spoilage of foods.

Process		Packaging
– Cool storage	5-12ºC	Cartons and bulk bins
– Cold storage	0-5ºC	Flexibles and
– Frozen storage	-18ºC and below	Semirigids mainly

2. ***Heat Preservation***

Heat is used to inactivate organisms or enzymes of spoilage significance in the foods.

Process		Packaging
– Blanching	100ºC	(further processing needed)
– Pasteurization	60-75ºC	Sanitary sealed containers
– Commercial sterilization	110-130ºC	Hermetic metal or glass containers
– Aseptic processing	130ºC and above	Hermetic and sterile containers

3. ***Fermentation Preservation***

Used to slow down spoilage factors through the production of alcohol or acids which assist in preservation. This technique is often combined with pasteurization.

– Alcoholic products (e.g., beer, fruit wine)
– Acid products (e.g., vinegar, pickled vegetables).

4. ***Reduction of Available Water***

Many spoilage factors require the presence of moisture in order to operate. When this available water is removed or reduced then better preservation can be achieved.

Process	Packaging
– Concentration and evaporation	Flexible
– Drying by solar or mechanical means	Semirigids and
– Salt is increased (e.g., fish)	Rigid containers with barrier properties
– Solids level is increased (e.g., chutney/jams)	
– Freeze-drying (e.g., prawns, mushrooms)	

5. ***Pickling or Curing Preservation***

These methods can be used together with smoking and with refrigeration as a combined form of preservation.

Process	Packaging
Pickled or cured foods (e.g., beef or ham cured with nitrite salts) plus refrigeration	Usually a flexible barrier package, or cans

6. ***Chemical Preservation***

Used to inhibit the spoilage factors and to complement other food preservation techniques.

Process	Packaging
– Benzoic acid (fruit drinks)	Flexible
– Sorbic acid (cheese)	Semirigid and rigid packaging
– Sulphur dioxide (fruit drinks)	
– Antioxidants (fats and oils)	

7. ***Gas Environment Control***

Used to inhibit post-harvest deterioration, often used together with refrigeration.

Process	Packaging
– Carbon dioxide gas (meats, fruits)	Usually flexible
– Nitrogen and carbon dioxide blanket (fats, oils)	Barrier materials
– Vacuum (cheese and meat, poultry)	
– Ozone gas (cheese storage)	

8. ***Combination and assorted methods***

Several food preservation techniques may be effectively combined to reduce spoilage factors to acceptable levels. These include combinations of those listed, together with the following techniques.

Process	Packaging
– Antibiotics (nisin in cheese)	Rigid
– Ultraviolet light (water)	Semirigid and
– Food irradiation (spices sterilization)	Flexibles
– Ultasonics (emulsions)	

INFLUENCE OF PACKAGING ON BIOCHEMICAL AND MICROBIOLOGICAL CHANGES IN FOODS

Biochemical Changes

Fresh foods are biologically active materials. Many complex and varied biochemical reactions can occur, causing desirable or undesirable changes, e.g., in the color of meat, the texture of fruit and vegetables, the flavor of cereals, the nutrients in dairy products. A careful consideration of potential biochemical changes will influence the choice of packaging.

Microbiological Changes

Microbiological growth is a major factor in deciding the most suitable material for packaging a food product. Not only does the packaging material affect the microbial patterns in foods but there is also the effect of microorganisms on the packaging material itself.

Some of the factors to be taken into consideration are the protection of foods from external microbial contamination by the correct use of packaging; the effect on microbial growth in the food or changes within the package head space (e.g., mold growth on the bread; the microbial attack on packaging materials).

INFLUENCE OF PACKAGING ON PHYSICAL AND CHEMICAL CHANGES IN FOOD

Physical Changes

Many foods, e.g., eggs, fresh fruit, biscuits and accelerated freeze-dried products need physical protection. The physical nature of the product and the mechanical properties of the packaging material (e.g., crush strength) need to be established. Stacking and transport hazards to food products need to be examined (e.g., by transport test). It is estimated that a 200-kg load traveling by road transport can receive a jolting force of 1,000 kg/bounce, which is very destructive. Foods also need physical protection from dirt, boring insects, biting rodents, heat thawing, powdering, crushing and breaking.

Chemical Changes

1. ***Toxicity***

Antioxidants; fungicides, plasticizers, colorants, pesticides and other chemicals in the package material can migrate into the food. It is difficult to measure and assess toxicity. However, strenuous efforts must be made to ensure that only food grade materials are used in food packaging material (e.g., there is a food grade of Polyvinyl Chloride [PVC] which is free of hazardous plasticizers). Foods can develop a toxicity inside the package, e.g., botulinum toxin, aflatoxin.

2. ***Trace Elements***

The presence of trace elements can adversely affect food, the packaging material and the consumer. For instance, copper in parchment paper can cause rancidity in butter. Food products high in acid (e.g., fruit juice, pickles) and/or nitrate ions (e.g., spinach, green beans or papaya) will promote very rapid de-tinning in cans and a high tin content in the food. Tinplate will bleach the anthocyanin dyes present in some canned food products. Heat processing of meat can produce hydrogen sulphide which blackens tinplate.

Other examples: lead in solder splash; mercury in fish.

INFLUENCE OF PACKAGING ON FLAVOR, COLOR, TEXTURE, MOISTURE AND OXYGEN TRANSFER IN FOODS

Retention or Exclusion of Volatile Odors

Dairy, cereal and meat products need impermeable systems which exclude odorous compounds (e.g., fish taint or kerosene taint). Odorous inks or printing systems must be avoided, including some price marking systems used by supermarkets.

Aromatic foods need an impermeable system (e.g., glass and foil for coffee) which retains the desirable flavor and aroma as well as excluding moisture. Impermeable systems become permeable to ink by capillary flow through cracks and pinholes, as well as diffusion gradients being set up across flexible films. This diffusion can cause contamination in the foods from the packaging itself.

Color and Texture

Desirable and undesirable color and texture can arise in fresh produce if the action of spoilage agents is not controlled. Enzymes cause browning of apples and also cause softening of fruit. Molds give rise to many discoloration problems, e.g. browning of fruit and green, black, red, white and blue coloring of other foodstuffs, as well as causing texture breakdown of fruits, vegetables and cereals. Bacteria can cause greening in meat and textural breakdown in many different foods. Some of these changes are desirable, e.g., yoghurt (bacteria), blue cheese (mold), apple juice (pectinase enzymes). Packaging systems need to be designed accordingly.

Moisture and Oxygen Transfer

The spoilage agents all need moisture to function. When food spoilage is considered, we use the term "water activity" and measure it in terms of Equilibrium Relative Humidity (ERH). Table 1 gives a guide to the range of foods and microorganisms which exist at various ERH levels.

Table 1. A Guide to the Range of Foods and Microorganisms on the ERH Scale

Food Products	ERH (percent)	Microorganisms Inhibited
Perishable goods (fresh meat, fruit,	100	
vegetables, milk, cream, custards)	95	Food poisoning organisms and most other bacterias
Sweetened imitation creams	90	
Cured meats	85	Micrococci, yeasts, staphylococcus, aureus
Most bakery products	80	Some molds
Jam	75	Most molds
Confectionery (not boiled sweets)	70	
Fruit cake	65	
	60	

1. ***Prevention of Ingress of Moisture***

Dried foods especially must be protected from water vapor. They have a low ERH and will attract moisture to their surface, therefore must be packed in containers having a low permeability to water vapor. Sweets and confectionery become sticky, powders lose their free flowing properties.

2. ***Prevention of Loss of Moisture***

High. moisture content foods can lose moisture to the air, especially fresh foods, greens, meats, causing desiccation. Frozen foods dry out in local areas causing "freezer burn" unless protected. As well as the packaging material itself, the conditions around the outside of the pack are important – whether there is moving or still air.

3. ***Intermediate Conditions***

Consider food products which, if exposed, desiccate and if enclosed, form too high a humidity; or if the temperature drops, condensation forms followed by mold growth. Moisture movement is then controlled by semipermeable film or holes in the film.

Air and Oxygen Transfer

1. ***Removal of Oxygen***

Many foods are susceptible to oxidation, e.g., dairy products, fats and oils. Fresh foods can be stored effectively at as low as 3-5 percent oxygen. The limit for most fresh respiring foods is 2 percent oxygen, below which they suffer harm.

2. ***Building Up of Carbon Dioxide***

Some fresh foods store well at 5-10 percent carbon dioxide except apples which suffer brown-heart, tomatoes (rotting), citrus (deterioration).

3. ***Gas Tight Packs***

The use of hermetic packaging and vacuum will minimize oxygen levels, e.g., cheese, baby food in glass jars, cans. This avoids the 'black neck' appearance of these products.

INFLUENCE OF PACKAGING ON THE RESISTANCE OF A FOOD PRODUCT TO TEMPERATURE CHANGES AND LIGHT DAMAGE

Temperature

Food products are dramatically affected by temperature and temperature changes. Frozen and chilled foods must be maintained at -18ºC and 5ºC, respectively to retain texture (e.g., ice cream) and to prevent growth of bacteria (e.g., meat). Packaging must be designed to insulate foods such that products bought in the supermarket will not deteriorate on the trip home.

Confectionery products must be protected from temperature fluctuations which can cause bloom on chocolates, microbial spoilage of, e.g., filled confectionery. Foil is reasonably effective but not ideal. Temperature control is most important.

If canned products are stored at high temperatures in the tropics then heat-loving bacteria can develop from their spores to give serious problems, e.g., blown cans. Packaging must be able to withstand processing temperatures, e.g., retorting, freezing, microwave, reconstitution.

Light

Food products need to be protected from sunlight or ultraviolet light which causes bleaching of, e.g., cured meat products under supermarket lights, tomato sauce, carrots, milk, cordials in sunlight.

Undesirable oxidation of food products can be initiated by light (in conjunction with oxygen and trace metals, e.g., copper) to cause rancidity and yellowing of butter, browning of wine, off flavors in beer. The use of pigmented film and brown or green glass may be required. Loss of nutrients can occur, e.g., vitamin C in milk.

INFLUENCE OF PACKAGING ON THE ENVIRONMENT

Packaging in the modern world has a considerable impact on the environment. Food packaging makes up two-fifths of the household waste (Senaner, *et al*., 1991).

Packaging also accounts for an increasing share of the costs of the food processing industry, rising from about 4 percent in 1947 to 10 percent in 1987, and continuing to rise. Despite new materials which have reduced packaging weight, the total and relative costs of food and beverage packaging are increasing.

On average, the cost of packaging materials represents about one-fifth of material costs. However, in 10 out of 40 food industry sectors, packaging costs exceed the costs of the edible foodstuff ingredients (Connor and Schiek, 1997).

In most countries packaging continues to be driven by consumer demand, with regulatory bodies playing a limited role. In Europe, however, legislation and taxes on packaging have been established to encourage reduced packaging waste and more sustainable packaging practices.

The use of life-cycle assessment to examine food products in relation to their environmental impacts will play an important role in educating the consumer and enabling decision-makers to encourage the minimization of these impacts (Pagan and Lake, 1999).

A number of trends identified by the World Business Council for Sustainable Development suggest a greater interest in the sustainability agenda by the business world in general (Schmidheiny, *et al*., 1997). These trends are equally applicable to the food industry:

* Environmental regulations and enforcement are getting tougher.
* Some governments are encouraging self-regulation and partnerships with government agencies as an alternative to new environmental laws.
* Environmental groups and businesses are working together more to find solutions.
* Banks and insurers, concerned about environmental liabilities, are looking more closely at their clients co-efficiency records.
* More investors are becoming interested in investing in environmentally responsible companies.

Sustainable Asset Management (SAM), a Swiss research company, surveyed 15 of the largest food manufacturers, to determine how companies rated against a set of sustainability criteria (SAM, 1999). According to the survey, the Unilever Company leads the way through its promotion of sustainable agriculture and it has been producing environmental reports for several years. It was one of the first companies to be signatory to national packaging covenants. The Raisio Company also rated well as it reflected the consumers' desires by being actively involved in developing environmentally friendly transport and packaging systems (Schmidheiny, *et al*., 1997).

While the larger international companies have been most apparent in responding to environmental issues, many others are taking steps to improve environmental performances. Small- and medium-scale enterprises and industries in less developed countries generally lack the capital, time and room to move rapidly towards environmental improvements. These groups need the impetus of improved government frameworks and of the larger companies which they often supply (Pagan and Lake, 1999).

CASE STUDIES OF SOME TRADITIONAL FOODS AND THEIR PACKAGING

China is one example of an ancient civilization in which the different national minority groups have developed their specific food cultures. These traditional foods are a valuable cultural heritage to the Chinese people.

There are examples of foods which have been introduced by cultural transfer and become traditional over time. The processing of rice, wheat, soybean and sesame was introduced to Japan from ancient China, translated first to the centers of power and religion, later to the regions. Hence, such "technology transfer" is not a new phenomenon.

There is a vast difference, however, between the early, more leisurely adoption of transferred food cultures and the explosion of new technology at present threatening to overwhelm traditional food processing and packaging techniques and to suppress the original characteristics of the traditional products. The attraction of traditional foods is related to their wide variety and diversity. For example, in Japan there are approximately 500 varieties of "*Tsukemono*", a fermented pickle. This attraction may be lost when new technology is applied without careful thought.

Another aspect of traditional foods is the way many of them have simply disappeared without trace, whilst others have expanded on a global scale and have become household products in most countries. One such example is soy sauce. Its wide acceptance and commercial expansion may be the result of a wider influence, with regard to meat-like flavors in diets where meat is absent, either by choice or through circumstance. It is found, packaged in a multiplicity of forms, in almost every country.

The question is posed whether there are other traditional foods, which by careful upgrading and packaging can follow the example of soy sauce in becoming widely accepted. Also that these foods can begin to generate higher incomes for small business operators.

Some examples of traditional foods with potential for expansion are from the following countries:

Indonesia

Tempeh – This is a vital source of protein in Indonesia, serving as a meat substitute. It is a product of a solid substrate fermentation, using the mold *Rhizopus oligosporus* as the active organism.

The soybeans are soaked, dehulled, partly cooked and inoculated, then incubated for 1-2 days. This enables the mold to form fibrous mycelia which knit the soybeans together in a compact cake which can be sliced and cooked.

The traditional form of packaging for *tempeh* has been banana leaves as a wrapping material. Now a number of *tempeh* cottage industries are using the tray or the plastic bag technique. The tray of inoculated beans is covered with banana leaves and wax paper, then incubated. The final product is sliced and wrapped in banana leaf, or plastic (polyethylene) bags.

A more recent technique is to incubate the *tempeh* directly in perforated polyethylene bags or tubes with perforations at 0.25-1.3 cm intervals to allow a controlled access of oxygen. The *tempeh* can be sold directly in this packaging.

Source: F. G. Winarno, Food Technology Development Centre, Bogor Agricultural University, Indonesia.

Sudan

1. ***Tahina***

This is a popular food condiment, in Sudan, made from sesame seeds. The seeds are first cleaned, then roasted and ground into a fine slurry. This is packed into plastic bottles or in glass jars and is used as a salad dressing.

2. ***Ful Sudani***

Peanut paste or "*ful sudani*" is made from peanuts which are cleaned, dehulled and roasted. These are then pounded into a paste and packed in small polyethylene bags. This can be upgraded to a standardized improved package to minimize contamination, oxidation, oil loss and adulteration.

3. ***Dried Fruits and Vegetables***

Dried okra, salsa (tomato slice), onions, chilies, lemon and dates are solar dried. There is deterioration due to microorganisms and enzymes because of poor drying procedures. There is also contamination due to lack of packaging of finished products.

4. ***Fasiekh***

It is a salted fresh fish which is kept in an earthenware container for use in curry, cooked with onion, tomato paste and spices. Improved processing and packaging could lengthen the shelf life of this delicacy.

Source: Dr. M. I. Abdul Kareem, Food Research Centre, Khartoum North, Sudan.

Thailand

In Thailand fermentation is a favorite means of food processing and over 44 commercial, traditional fermented foods have been identified. These foods are highly acceptable country-wide and are essential components of diets. They are used as condiments and supply specific flavors as well as being sources of protein, calories and vitamins.

The level of traditional fermented technology of the small and medium food manufacturers are generally at the household or slightly larger (backyard) level. The problems faced are maintenance of quality standards, efficient fermentation on an industrial scale and new product and package development.

Pak Sian Dong is a Thai native fermented vegetable (*Gynandropsis pentaphylla*). It is pickled in liquor which is prepared with coconut juice and salt added, or rice water and salt. The "*Pak Sian*" is wilted in the sun to lower moisture. The fermentation takes only 36-48 hours and the shelf life is only 2-3 days if no further processing is applied. If the process and the packaging were upgraded, this product could be given a longer shelf life.

Source: Naradon Boon-Long, Department of Food Science and Technology, Kasetsart University, Thailand.

Mexico

Tortillas are a multipurpose food, often the main component in the diet for low income bracket people. They are a good calorie source but poor in protein quantity and quality.

The whole corn is boiled in lime water and the cooked mixture stands overnight in the liquor. The mixture is decanted, store-ground and thin pancakes made on a hot plate. The popularity of tortilla requires that it be widely distributed. This requires packaging to minimize moisture entry and prevent physical damage to the tortillas.

Source: Dr. Javier Perez-Villasenor, Professor, Department of Biotechnology, Universidad Autonoma Metropolitana, Mexico.

Nigeria

Whilst fermented starchy foods like gari and ogi are popular in Nigeria across a wide cross section of the population, fermented vegetable protein foods are declining in popularity and acquiring an image of food for low income rural people.

Iru *(Dawadawa)* is an important food condiment and low cost protein source, from the seeds of the African locust bean (*Parki biglobossa*).

These beans are not very edible raw, but fermentation improves their digestibility and flavor. After a 12-24 hour boiling, the beans are softened, the testa removed, washed and reboiled. They are spread on calabash trays in 10 cm layers and an exothermic fermentation takes place, which must be controlled. Then salt is added or the *iru* is sundried or smoked and packed in yam or banana leaves. The upgrading of both process and packaging could enable this product to regain its popularity and reenter the market place.

Source: Dr. S. Ayo Odunga, Department of Botany, University of Ibadan, Nigeria.

Pakistan

1. ***Roti***

An operation for the production of semi-leavened bread was set up as the Roti Corporation of Pakistan. The Corporation was charged with producing good quality, semi-leavened bread under hygienic conditions, modern packaging and distribution. Sixteen plants were set up with a capacity of 35,000 "*rotis*" per shift, a total of nearly 2 million *rotis* per day.

The project had difficulties because:

a) the taste and texture were different from traditional *roti*.
b) the *roti* crumbled on rolling.
c) people wanted fresh *roti* bread.
d) women were dislodged from their work at home.
e) the overheads and packaging made "*roti*" more expensive than home-made ones.

Diversification was the only solution to the economic recovery of the plants.

2. ***Yoghurt or "Dari"***

It is a most common dairy product in Pakistan consumed widely in the hot months of the year. Traditionally "*dari*" has been prepared by unqualified milk retailers in broad earthenware dishes (*Konondas*). The milk is boiled and cooled to around 38ºC then cultured with *dari* from the previous batch. After 6-8 hours it sets, then it is cut and sold fresh. The quality is never uniform.

The product and the process have been upgraded since, with upgrading of the quality control and the packaging. Now the milk is correctly processed, analyzed, standardized, pasteurized, inoculated, incubated and packaged in sanitary plastic containers then refrigerated.

The retail cost is relatively higher, but kept minimal by recycling the containers which are washed, sanitized and reused.

Source: Dr. F. H. Shah, Food Technology and Fermentation Division, Pakistan Council of Scientific and Industrial Research (PCSIR) Laboratories, Lahore, Pakistan.

IMPORTANCE OF FOOD PACKAGING IN FAO PROGRAMS

In fruit and vegetable processing, technical projects cover the entire food chain from the harvesting of horticultural produce through storage, processing, packaging and marketing. Roots and tubers projects range from storage, postharvest loss reduction, through flour production and bakery products development. In vegetable oils, assistance has been provided by FAO in the processing of oilseeds, palm and olive oil extraction, small-scale processing and refining of edible oils.

Other food processing activities range from advisory work on agro-industrial development, coffee processing, coconut processing, cocoa and chocolate projects, soybean and cashew nut processing.

Other examples include:

- development of handling and packaging systems for soft fruits in an Asian country
- upgrading of dates processing and packaging in the Near East region
- introduction of modern packaging methods for highland vegetables and fruits in an Asian country
- a coordinated program of food packaging activities for the Asia and Pacific region covering commodities, packaging materials, equipment and quality aspects of packaging
- projects on the processing and packaging of cereals, including rice, wheat, sorghum, millet, maize and quinoa have been implemented and there has been technical backstopping by FAO in many countries for these staple foods
- feasibility studies are taken to the pilot processing industry stage. Related technical research, training and extension programs have been supported in a dozen countries.

Food packaging is seen as a vital link in the overall chain of food production, processing, marketing and consumption. In the Asia and Pacific region, FAO has been involved in over 40 projects which involve the upgrading of traditional food technologies.

Food packaging is an integral part of the processing and preservation of these staple foods and can also minimize many of the potential spoilage changes, imparting improved keeping quality and increased shelf life to the processed and packaged food.

New Project Proposals

A joint food packaging survey in a number of Asian countries is suggested to identify products which can be upgraded in their packaging, for import replacement and export. Staple commodities such as fresh produce, cereals, legumes, indigenous flours, dehydrated foods, oils and fats could be examined during this survey. The terms of reference for the survey could be:

* to evaluate the utilization of indigenous food packaging in terms of their correct application to the food items being packaged.
* to examine the possibilities for upgrading of indigenous packaging materials to meet the needs of the foods surveyed.
* to prepare a comprehensive report on this survey, followed by publication.

These and other activities and ideas are proposed in recognition of the importance of food packaging in the containment, transportation, distribution, marketing and consumption of high quality traditional foods. The mandate of FAO for the improvement of food processing and packaging places considerable emphasis on the upgrading of traditional food technologies, particularly for staple foods.

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2. PACKAGING OF FRUITS AND VEGETABLES: A PROJECT EXPERIENCE IN CHIANG MAI

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INTRODUCTION

Northern Thailand is different from other parts of the country. It is a mountainous area and has long borders alongside Myanmar and Lao PDR. There are various hill tribes living on these mountains, inside and outside Thailand. Not every one of them holds Thai citizenship, so they do not get services from the government like other Thais. They earn their living by "Swidden Agriculture", i.e., cutting down trees and growing crops for three years, then they repeat the 'slash-and-burn' process again. They grow opium poppy which is easy to grow, high in demand, readily marketed and high in price. This "Swidden Agriculture" problem is yet to be fully solved.

In 1969, His Majesty the King visited a Thai hill tribe village. He realized that "Swidden Agriculture" was a serious problem, and decided to found the Royal Project. His Majesty started the project by buying a piece of land which cost ฿200,000 and that has now taken the name for an orchard: Suan Song Sann (*suan* = orchard, *song sann* = 200,000). This orchard was used as an experiment to grow temperate fruits and vegetables. The purpose of the Royal Project has been to assist and enable the hill tribes, to improve their living standards and incomes by growing useful cash crops instead of opium.

In March 1991, the Royal Project was formed into a Royal Project Foundation. The activities of the Foundation cover five provinces of Thailand: Chiang Mai, Chiang Rai, Lampoon, Mae Hong Sorn and Payao. The foundation has four research stations and 35 development centers covering 300 villages, with a total population of 73,425.

Opium Crop Replacement

Opium was originally a basic cash crop for hill tribes. They destroyed forests by slashing and burning trees in order to grow opium. His Majesty requested staff from universities to experiment in the growing of temperate fruits and vegetables. With a cool climate, advanced technologies and good management, many fruit trees, vegetables and flowers could be grown successfully, i.e., peach, persimmon, Chinese apricot, pear, strawberry, also avocado, fennel, lettuce, spinach, carrot, zucchini, carnation, gladiolus, chrysanthemum, alstromeria, etc. Fruits and vegetables grown by hill tribes are listed in Table 1.

Highland Production Problems

1. ***Land Ownership***

Most of the land belongs to the Forestry Department, as hill tribes people do not own land.

2. ***Irrigation***

Irrigation is a major problem for mountainous areas.

3. ***Lack of Education***

Most hill tribes do not speak much Thai, therefore, it is difficult for them to communicate with the extension staff.

4. ***Lack of Infrastructure***

With accessible roads, it can take three days to travel on foot to villages in rainy season.

Table 1. Major Items Marketed by the Royal Project

Fruits	Vegetables		Flowers
Strawberry	Head lettuce	Japanese bunching onion	Carnation
Cantaloupe	Tomato	Zucchini	Gladiolus
Peach	Celery	Pak choi	Chrysanthemum
Pear	Chinese cabbage	Radish	(standard)
Avocado	Potato	Endive	Rose
Persimmon	Red lettuce	Snap bean	Gerbera
Passion fruit	Leek	Fennel	Alstroemeria
(for processing)	Sweet corn	Eggplant	Rose (miniature)
Japanese apricot	Cucumber	Beetroot	Chrysanthemum (spray)
(for processing)	Spinach	Bell pepper	Gypsophila
	Red cabbage	Parsley	Dried flowers
	Carrot	Baby carrot	
	Cabbage	Herbs	

5. ***Lack of Agricultural Knowledge***

Most of the hill tribes people lack education and knowledge of agriculture.

6. ***Lack of Agricultural Inputs***

The hill tribes lack the essential inputs, which have to be provided by the Royal Project Foundation.

7. ***Lack of Facilities***

The Royal Project Foundation provides them with refrigerated transport, collection centers, and postharvest centers, in order to transport their produce to markets in Bangkok.

Postharvest and Market System

Dr. Danai Boonyakiat, Royal Project Packing House Coordinator, illustrates in his paper "*The Royal Project Postharvest and Market System*" the handling systems for fruits and flowers, and vegetables, respectively, in Figures 1 and 2.

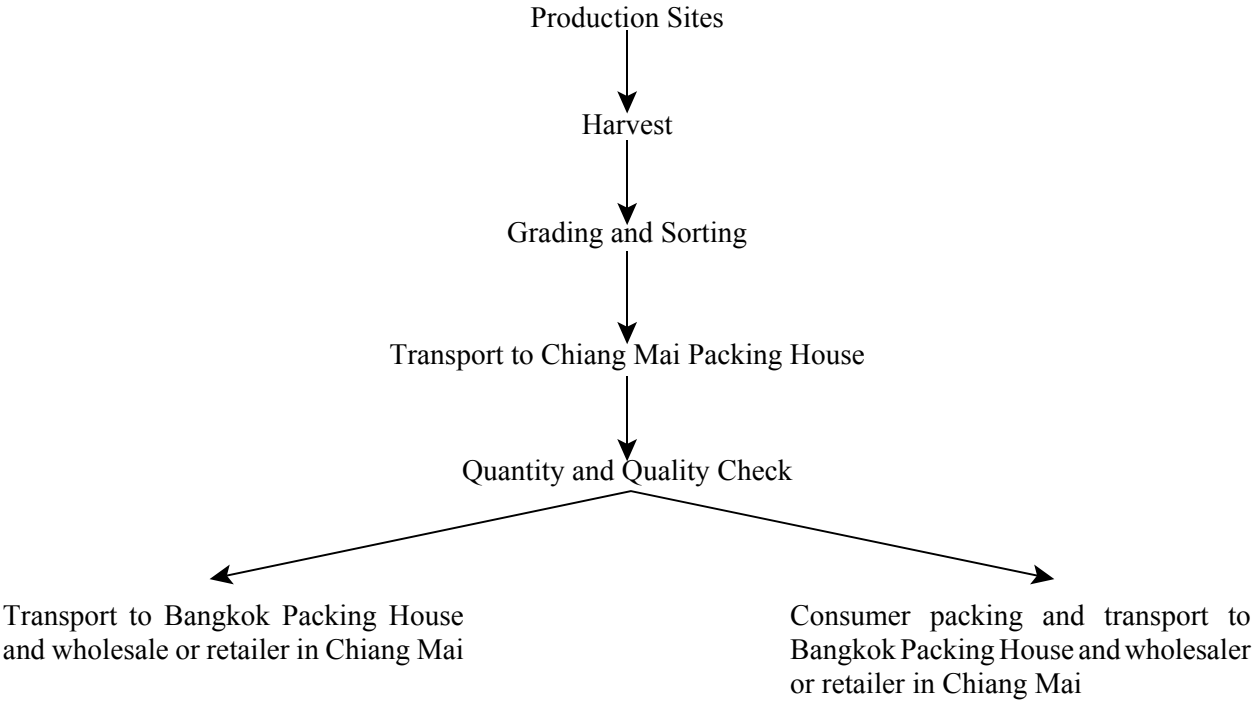

Figure 1. Fruit and Flower Handling System

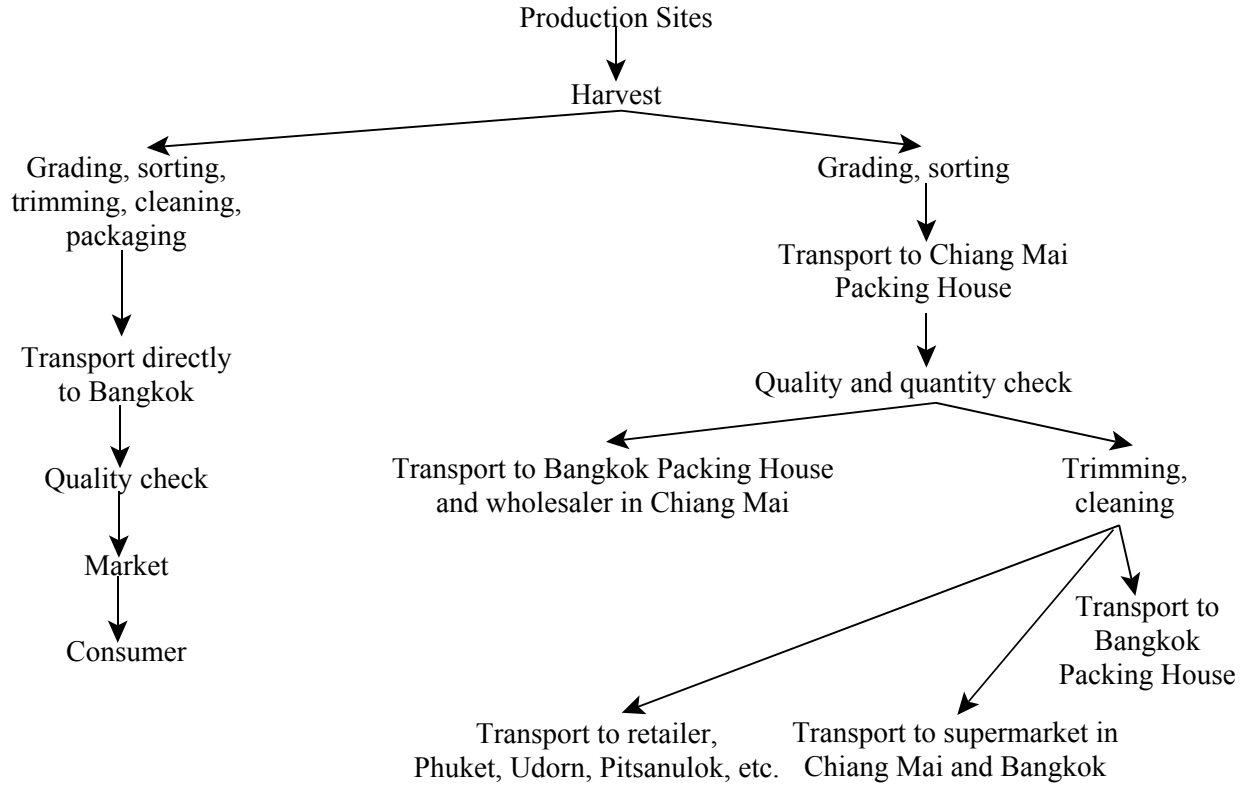

Figure 2. Vegetable Handling System

PACKAGING OF AGRICULTURAL PRODUCTS FROM HILL TRIBES TO INTERNATIONAL MARKETS AND ITS CONSTRAINTS

Fruits Packaging

The Royal Project has designed simple packaging for peach, strawberry and persimmon. The box is made of hardboard with holes, and each box contains four trays. Each tray is wrapped with thin plastic and weighs around 250 g/tray. The box is very strong and is able to protect fruits from bruises and damage during the transport.

Vegetables Packaging

Vegetables are perishable and this makes their packaging more difficult than fruits. They are usually packed in boxes or plastic wrap. Refrigerated trucks are used to transport vegetables from original sites to Bangkok, to preserve and save the quality and freshness of vegetable crops.

Processed Products Packaging

There are two processing units attached to Chiang Mai University: for fruit and vegetable processing and health food products processing. There are a number of packaging materials used for processed products. Plastic bags and paper boxes are used for herbal teas and other health food products.

Problems with Packaging of Products from the Hill Tribes

There is a lack of packaging technology, research and development, since there is only one Packaging Institute in Bangkok. Although there is a small Department of Packaging Technology at Chiang Mai University, it has rather insufficient facilities.

Lack of packaging materials availability is another problem. Packaging materials are sourced from Bangkok, but with the difficulty of obtaining this resource, the hill tribes have depended on the Royal Project Foundation, to organize and supply all this packaging material.

3. PACKAGING OF PROCESSED BEVERAGES

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INTRODUCTION

Increasing competitiveness in the food industries has prompted further development of packaging which is an important factor in presenting the product and increasing the market share. Packaging has been developed for all commodities.

If there are marketing concerns, the producer should minimize the cost. This can be done by reducing the cost of packaging and other related costs. In this presentation, packaging of tea, herbal teas and coffee will be discussed mainly using less packaging material but maintaining the safety, quality of the product including attractiveness, rigid standards of hygiene, protection, use of less expensive materials and environmental friendliness.

Years ago, the processed food industries grew rapidly but packaging lagged behind the development of new products, resulting in low food safety and quality, due to packaging technology which did not match the characteristics of the food contained. For example, tea or coffee was packed in paper or paper bags. Tea or coffee has a short shelf life because it absorbs moisture resulting in loss of flavor and aroma. Later, paper/foil and foil was introduced, this type of material has improved the quality and extended the shelf life of tea and coffee. Nowadays there are multilayer combination materials such as paperboard canister, paper/foil/PE (polyethylene) and OPP (oriented polypropylene) being used.

Nowadays packaging technology is advancing fast. Changes of material have resulted in increasing costs and more environmental pollution. Increasing interest in environment conservation has triggered a search for ways to minimize the amount of packaging materials and maintain environmental cleanliness. Different types of packaging materials and shapes will be compared and selected.

In summary, filter paper, waxed paper and paper/foil/transparent film can be suitable for tea, herbal teas and coffee. However, the types of materials which are selected as packaging for these products, depends on their end-uses and storage time before reaching the consumer. Ideally packaging should be appropriate for the contents, use the minimum materials, be cheap and attractive as well as environmentally friendly.

Packaging plays a very important role for many products, both edible and nonedible. It is essential for the marketing and maintenance of quality of the products in a competitive market. Therefore, the producer and marketing manager have to pay attention to packaging design and materials. Packaging has been developed for all tradable commodities.

Packaging development is based on the characteristics of the product wrapped and properties of packaging materials. Even though packaging has been developed, problems still occur, such as loss of flavor and aroma. For example, tea and herbal teas require moisture and gas barrier materials. Details of packaging of tea, herbal teas and coffee will be mentioned. Apart from selecting suitable packaging materials the cost and environmental pollution must be considered.

Purpose of Packaging

Packaging serves the following purposes:

* It serves as a container for use by distributors, sellers and consumers.
* It protects the contents of the package.
* It describes and advertises the product in a package.

Properties of the Package

* ***Strength***: Whether the food is in bulk or a small retail pack, the container must be strong enough to carry the weight of the contents, as any damage may result in contamination by foreign matter or loss of contents.
* ***Ease of Filling and Emptying***: The packaging must be easily filled and emptied.
* ***Appearance***: The trend is toward simple wrappers and bags, usually glossy paper, transparent or printed film, with attractive designs.
* ***Protection***: This can mean either preserving the condition of the contents inside the wrap, such as prevention from drying out, or acting as a barrier against exterior contaminants. Protection can involve:
  - *Exclusion of light*: as light can promote rancidity and cause fading;
  - *Prevention of access of water vapor and oxygen*: as these can be most damaging and cause stale flavors and/or surface mold growth. If a container is permeable to air, oxygen can enter, resulting in staleness and rancidity, particularly if combined with humid conditions.
  - *Evaluation of contamination of odor* (paint, perfume, soap and strong flavours like cheese) will ruin any food.
  - *Exclusion of the entrance of insects* must be ensured.
* ***Shelf Life***: Shelf life of the product can be extended if the packaging material properties match the behavior characteristic of the product.

Selection of Packaging Materials

A package will be considered as a good one if it is attractive and maintains the quality, safety and extends shelf life of the product. Therefore, the properties of packaging materials should match the characteristic of the product in the package. Table 1 shows the properties of transparent films and their uses.

Packaging Materials for Tea and Herbal Teas

Tea is sensitive to moisture, odor and light. It requires proper packaging which is impermeable to moisture, odor, light and oxygen.

The characteristics of tea can mainly be divided into four types:

* powder: black tea, green tea, oolong tea and herbal teas.
* loose leaves: green tea, oolong tea and herbal teas.
* cake or brick tea: puerh tea.
* instant tea: black tea, green tea, oolong tea, herbal teas and puerh tea.

According to the properties of packaging materials aluminum foil, waxed paper or PVDC (polyvinylidene chloride) have good properties for packaging tea. One type of material alone is not enough to serve as a good barrier, so a multilayer combination must be used to protect the product inside.

Different types of tea require different packaging materials. Tea is packed in different shape and sizes depending on their uses and storage time. The following are examples of packaging materials which are available at present:

* Stand-up zippered LDPE (low density polyethylene) pouch for short time before drinking or short shelf life
* HDPE (high density polyethylene) (for herbal tea)
* Paper/foil
* Paper/foil/PE, foil/PE
* Waxed paper/PE
* OPP/EVOH (ethylene vinyl alcohol copolymer)/OPP used as tea pouch
* Bottles made of PE, polyesters, PET (Polyethylene terephthalate) or glass
* Paperboard can with a tin plate base (paperboard canister).

Table 1. The Properties of Transparent Films and Their Uses

Film	Properties	Permeable to Moisture Gas	Use
PE	Semipermeable to water vapor and gas	Low – High	Outer envelopes for carton; coating of carton board
LDPE	Very flexible	High – High	Use for food wraps and shrink wrapping
MDPE	Better barrier than LDPE, stiffer	Medium – Medium	Outside wraps and pouches
HDPE	Much better barrier and stiffer	Low – Low	Box and carton liners
PP	Clear film, good moisture barrier	Low – Low	Cooked in bag (up to 170ºC); twist wrap and display box
PVC	Partial barrier, attractive appearance	Medium – Medium	For product that require breathing
PVDC	Good barrier, not readily heat sealed	Resistant – Resistant	Suitable for hygroscopic food
Polyamines (nylon)	Good barrier to odor, heat resistant	High – Resistant	Sterilizable packs or cooking bags (up to 140ºC)
Poyester (terylene)	Brilliantly clear, cannot be heat sealable	Low – Resistant	Metallized polyester film
PS	Bright, clear, rigid form	High – Medium	Decorative container and show case
Metallized film	Brilliant sheen rsembling foil; mostly PE, PP and nylon	Partial – Partial	
Laminated film	More than two materials in conjunction	High – High	Shown in Table 2

Source: Bernard W. Minifie, 1985, *Chocolate, Cocoa and Confectionery* (3rd ed.), AVI Book, Van Nostrand Reinhold, www.packagingest.com.0801, www.iff.org.0801.

Notes: MDPE = medium density polyethylene; PP = polypropylene; PVC = polyvinyl chloride; and PS = polystyrene.

Table 2. Laminates and Their Uses

Laminate	Uses	Comments
1. Aluminum foil/heat seal "plastic" or polythene	Moisture-proof, insect-proof wrap for chocolate blocks and covered cookies where close wrap is required.	Low water-vapor permeability when undamaged but fragile. Polythene laminate rather stronger. Good odor barrier.
2. Aluminum foil/waxed tissue of glassine	Close wrapping of chocolate blocks without heat sealing.	Suitable for warm climates, prevents fat staining of outer wrapping, and also protects against odor contamination.
3. a. Aluminum/foil/paper/ polythene or b. Paper/aluminum foil/ polythene	Strong wrap for very hygroscopic products for heat sealing. Suitable for pouches for "complete drinks". (b) is stronger.	With paper on outside, gives well "plimmed" package. Good odor barrier.

... To be continued

Continuation

Laminate	Uses	Comments
4. Paper/PVDC/polythene or paper/polythene/PVDC	Similar to 3. but cheaper. Used for outer wrap of larger packs, e.g., biscuits.	
5. Regenerated cellulose/ polythene	Transparent heat-seal wraps where visibility and tight wrap required.	Fairly good water vapor barrier. Not a good odor barrier.
6. Regenerated cellulose/PVDC	Transparent wrap heat-sealable at high temperatures. Wrappings and bags for hard candy, outside wrapping of cartons.	Very good water vapor, gas, and odor barrier properties.
7. Regenerated cellulose/ PVDC/polythene	As 6. above. But heat-sealable at lower temperatures.	As 6. above. Probably a little stronger.
8. Paper/polythene	Heat-sealed, insect-proof wraps.	Moderate water vapor barrier properties. Poor odor barrier.

Source: Bernard W. Minifie, 1985, *Chocolate, Cocoa and Confectionery* (3rd ed.), AVI Book, Van Nostrand Reinhold, p. 725.

The shape is cylindrical like a metal can. The spiral consists of paper/PE/foil. The bottom of the canister is laminated to provide enough barrier and physical structure for protection.

Key Packaging Materials Used for Tea or Herbal Teas

* Paperboard canister, with a shape developed into cylindrical like metal can.
* Stand-up zippered LDPE pouch for short time before drinking or short time storage on the shelf.
* Tea bag, paper/foil/PE or waxed paper/PE.
* PP, OPP and HDPE for herbal teas.

As mentioned, tea (green tea and Oolong tea) requires a package which consists of materials that are impermeable to moisture, odor, light and oxygen. On the other hand, Puerh tea, which is different from green tea and Oolong tea, cannot be packed in foil or material which is impermeable to moisture and oxygen. Puerh tea requires aeration and moisture for aging. The longer Puerh tea is stored the better quality it is for medicinal purposes. So Puerh tea is packed in *saa*-paper or bamboo sheet which is permeable to moisture and gaseous materials.

Packaging of other teas and herbal teas should be paperboard canister, polyester/foil/PE or waxed paper/PE. Mostly PE is used for the inner layer for the heat seal. Aluminum is good protection material which is impermeable to gas, water vapor and light. The outer layer is paper that serves for printing and advertising the product inside. As aluminum foil is expensive compared to paper; paperboard canister or waxed paper/PE could be a better solution and is environmentally friendly. The uses of laminates are shown in Table 2.

Selection of Packaging Materials for Coffee

Coffee is processed into different types. There are coffee beans, ground coffee, instant coffee and ready-to-drink coffee. Different types of coffee require different packaging materials to maintain quality and safety. For example, roasted coffee requires a barrier to moisture and gases. If the material is non-permeable to gas, the coffee bag may burst, unless the bag is filled after the roasted coffee beans are cold. This is because roasted coffee beans will produce carbon dioxide within 12 hours after processing. Hence packaging has been developed to include an air valve. A bag thus consists of an ultra-seal membrane, with a one-way valve that allows carbon dioxide (a by-product of the roasting process) to escape from the sealed package, without oxygen flowing into the package.This oxygen barrier property will preserve the just-roasted flavor of the coffee.

The coffee bags which are used at present are:

* standard zippered (HDPE or LDPE) pouch
* standard zippered OPP bag for roasted coffee beans and ground coffee
* polyester/foil/PE, polyester/foil/LDPE for ground coffee
* foil/PE
* polyester/foil/polyolefin/PE (polyolefin is use for additional stiffness)
* metallized polyester laminated to LDPE
* waxed paper/EVOH/PE
* PP used for pouches and bottles (PVC and PETG are also used for coffee bottles).

The packaging material for roasted coffee should be multilayer materials of PP/EVOH/PE or waxed paper/EVOH/PE or OPP. However, material selection depends on the purpose of the producer, whether the coffee will be stored and for how long before reaching the consumers. Table 3 shows the advantage and disadvantage of packaging materials.

Environmentally Friendly

An increase in competitive marketing in food industries has resulted in development of their packaging. The changes in materials, however, can result in non-degradable waste disposal problems and increased pollution in the environment. All package designers are influenced to some degree by environmental concerns, which require *green packaging*, good functions, low cost and environmental friendliness.

The environmental problems have their origin in waste disposal practices. There are several ways of reducing the problems:

1. ***Source Reduction***

This means "use less, discard less, save more and reuse more". The source reduction approach attempts to reduce the volume of the weight of packaging material and eliminate packaging which is not essential to the protection of package contents.

2. ***Recycling***

Costly packaging materials such as aluminum have been extensively recycled for years. Paper and glass are also on the list of recyclable materials, as is plastic.

3. ***Incineration***

This is very expensive to install.

CONCLUSIONS

Today, packaging technology has been developed in order to add an attractive appearance and gain more market share for food products. The consequence of using nonessential packaging materials is only to increase the cost. Furthermore, it causes environmental pollution. The packaging should function well in protecting and maintaining fresh quality, be safe and attractive to the consumers, environmentally friendly and use less-expensive materials. In competitive markets, cost is obviously an important factor. This applies to the packaging material and packaging operations, and has resulted in the adoption of plastic containers instead of metal and glass; also flexible, laminated aseptic packs have replaced cans and bottles of juice, at about one-third of the cost. Whatever material is used, the cost can be minimized by considering two components: shape and size of the package. To employ minimum packaging technology which is environmentally friendly, the following are some guidelines:

* Multilayer combinations of packaging materials should be used and food companies should consider individual aspects of packaging and characteristics of the product.
* Cost and material can be minimized if the least necessary materials are employed for any necessary application.
* 'Green' packaging should always be considered in any packaging system.
* Finally, source reduction and recycling should be considered and applied.

Table 3. Advantages and Disadvantages of Packaging Materials

Characteristics	Packaging Materials	Advantages	Disadvantages
A. Tea and Herbal Teas			
Powder	Filter paper	Easy and convenient	Short shelf life, loss of flavor and aroma
	Paper/foil or waxed paper	Easy and convenient; preserves 100 percent of tea; flavor and aroma	Expensive, require extra storage container
Loose leaves	PE, PP and OPP	Shows the product, low cost	Short shelf life, loss of flavor and aroma
	OPP/EVOH/OPP	Shows the product, low cost	Contamination of PE odor and expensive
	Foil/PE and paper/foil/PE	Maintains quality, extends shelf life	Expensive
	Paperboard canister	Attractive, maintains quality	
Cake, brick Puerh	*Saa* paper, bamboo sheet	Attractive, maintains quality, extends shelf life, low cost	Not good protection
Instant and juice/ ready-to-drink	Glass bottle	Attractive, maintains quality and extends shelf life	Easily broken
	Paper/foil/PE	Attractive, maintains quality and extends shelf life	Expensive
	PET bottle	Attractive, maintains quality and extends shelf life and cheap	Shelf life is not as long as kept in a glass bottle
	Paper/foil/PE	Attractive, maintains quality and extends shelf life	Expensive
B. Coffee			
Coffee beans	LDPE, HDPE, OPP	Handy small pack freshly roasted coffee quality, see-through and low cost.	Limited storage time, loss of flavor and freshly roasted coffee aroma
	Foil/PE	Maintains quality	
	Foil/PE with air valve	Maintains freshly roasted coffee quality	Should be packed after 12 hours
Ground coffee and instant coffee	Foil/PE	Maintains quality	
	Waxed paper/PE	Maintains quality	
	Paperboard canister	Maintains quality	
	Glass bottle	Attractive	Easily broken
	Paper/foil/PE carton	Attractive	Easy and convenient
Ready-to-drink coffee	Steel/aluminum can	Convenient	Costly

Source: Somjate Sirivatanapa, 2001.

1. REPUBLIC OF CHINA

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INTRODUCTION

Efficient packaging is a necessity for almost every type of food and is an essential link between the food producer and the consumer. The basic function of food packaging is to identify the product and ensure that it travels safely through the distribution system to the consumer. This does not always fit the present demand by consumers for a wide variety of fresh, minimally processed, convenience foods with the necessary shelf life. If the packaging appears to be overelaborate, it may create the impression that the cost of the food production has been unnecessarily raised by the packaging, which will have a negative effect on sales. Over-packaging of food products risks serious environmental impact by the disposed, non biodegradable waste, and results in more complicated waste management efforts. Therefore, all packages must be minimal in use, easy and safe to handle, simple to open and use, and provide fewer problems in their disposal.

ROLE OF FOOD INDUSTRY IN TAIWAN

Over the past 40 years, Taiwan created an economic miracle, attracting the attention of the whole world. Industry and the whole economy underwent major structural changes:

* The share of total domestic production of the industry sector, including manufacturing, utilities, construction and mining industries rose from 18 percent in 1952 to a peak of 47.1 percent in 1986, then fell gradually to 33.1 percent in 1999;
* The percentage of the total work force employed in the industry sector rose from 24.8 percent in 1952 to a peak of 42.8 percent in 1987, then declined to 37.2 percent in 1999;
* Private sector manufacturing production value rose from 43.4 percent of total manufacturing production value in 1952, to 94.3 percent in 1999; and
* In 1952, the food and textile industry accounted for 30.8 percent and 15.34 percent of the total manufacturing production value, respectively. Since then the various industries' contribution to the production value has changed drastically. In 1999, the production value of electricity, electronic and machinery industry rose to 33.53 percent, basic metal industry to 9.46 percent, and chemical material industry to 7.81 percent, and the food industry declined to 6.33 percent.

Figure 1 shows the production values of total manufacturing industry and food industries in Taiwan between 1993 and 2000. It indicates that food industry has played only a minor role in the production values of manufacturing industries in Taiwan, during the past 10 years. The major markets for processed food products are domestic and absorb 90 percent of the production.

Recent Changes in the Processed Food Industry

According to the classification of Ministry of Economic Affairs (MOEA), food processing industries include 21 subgroups and several related industries. Those are: dairy products; canned foods; frozen foods; dehydrated foods; preserved foods; sugar confectionery; bakery products; edible oils and fats; grain milling; rice husking; granulated sugar; monosodium glutamate; edible salt; soy sauce; other seasonings; wine and liquor; ale and malt; soft drink and carbonated waters; noodles; tea preparations; and other food products.

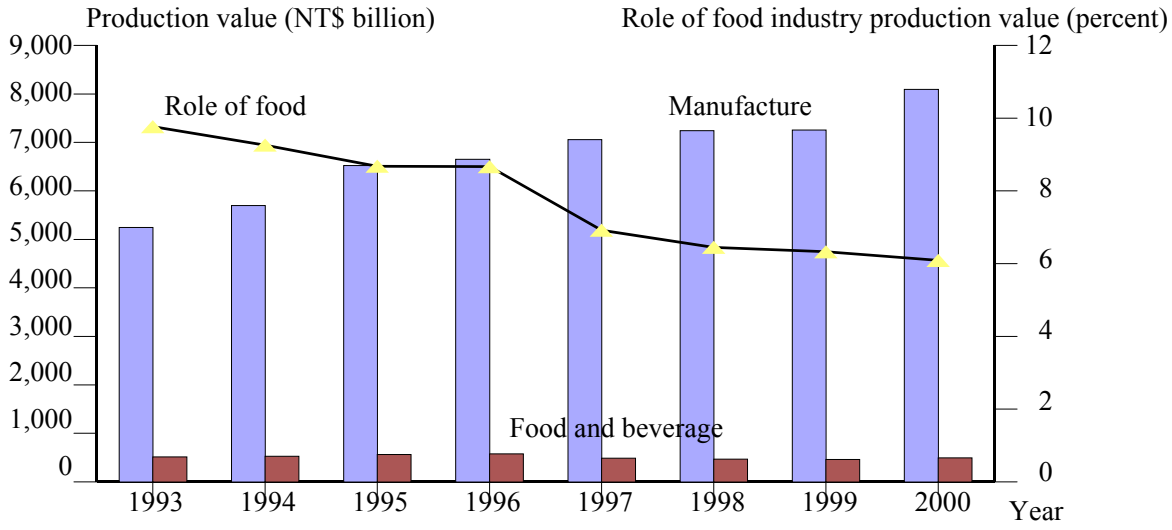

Figure 1. Production Values of Total Manufacturing Industry and Food Industries in Taiwan between 1993 and 2000

Food-related industries include food additives, food machinery, food packaging materials, food serving, and food transportation. Figure 2 shows the indices and annual changes for food and beverages industrial production in Taiwan during 1991-2001. Table 1 shows the production value of food and beverage industries in Taiwan and the change (percent) between current and last year's period during 1991-2001. It shows that the production value of food and beverage industries increased yearly from 1991 to 1996, but it gradually decreased after 1996 (Figure 2). The production value of food and beverage of industries was NT$493 billion in 2000, making it the fifth largest manufacturing industry. The major food industries are soft drinks and carbonated water, rice milling, frozen foods, grain milling, wine and liquors, ales and malt, and dairy products. The changes in their production values between 1993 and 2000 are shown in Figure 3.

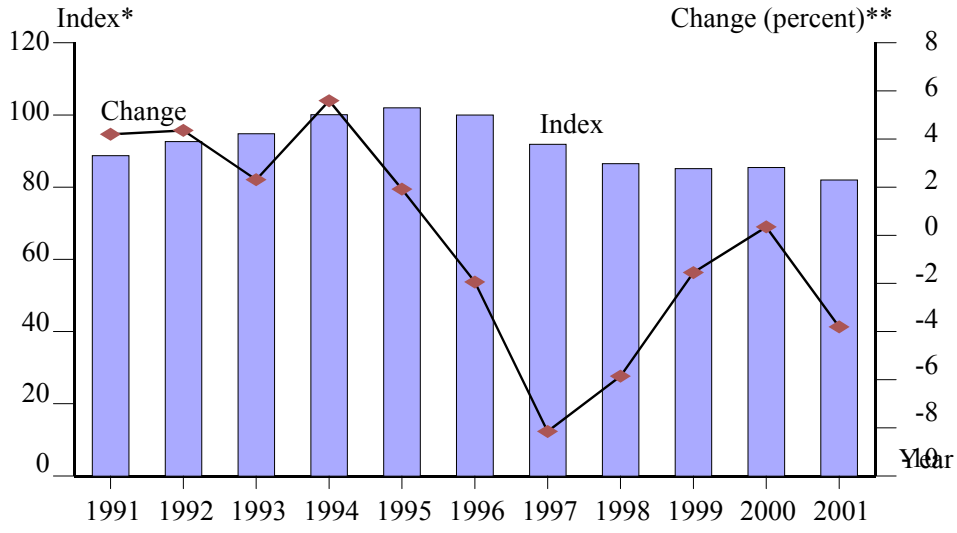

Figure 2. Indexes and Annual Change in Indexes of Food and Beverages Industrial Production in Taiwan during 1991-2001

Notes: * Fixed indexes, base: 1996 = 100; and ** + - percent change from the same period of last year.

Table 1. Production Value of Food and Beverage Industries in Taiwan and Change between Current Year and Last Period During 1991-2001
(Unit: Production value = NT$ million; and change = percent)

Year	Dairy Products	Canned Foods	Frozen Foods	Dehydrated Foods	Preserved Foods	Sugar Confectionery	Bakery Products
1991	16,177 (7.36)	11,187 (19.74)	47,500 (17.88)	4,247 (15.94)	5,477 (-0.02)	5,823 (19.67)	13,496 (14.74)
1992	17,548 (8.47)	9,734 (-12.99)	60,968 (28.35)	4,448 (4.73)	4,848 (-11.48)	6,988 (20.01)	13,708 (1.57)
1993	19,060 (8.62)	9,466 (-2.75)	70,637 (15.86)	4,004 (-9.98)	4,924 (1.57)	6,168 (-11.73)	14,748 (7.59)
1994	18,985 (-0.39)	10,059 (6.26)	71,248 (0.86)	2,813 (-29.75)	3,467 (-29.59)	5,827 (-5.53)	17,175 (16.46)
1995	19,418 (2.28)	9,319 (-7.36)	83,214 (16.79)	3,384 (20.30)	3,518 (1.47)	5,271 (-9.54)	17,986 (4.72)
1996	18,977 (-2.27)	8,593 (-7.79)	81,847 (-1.64)	4,489 (32.65)	3,846 (9.32)	5,608 (6.39)	18,591 (3.36)
1997	20,164 (6.25)	8,853 (3.03)	48,221 (-41.08)	3,467 (-22.77)	3,128 (-18.67)	5,605 (-0.05)	19,174 (3.14)
1998	22,323 (10.71)	8,767 (-0.97)	36,768 (-23.75)	3,054 (-11.91)	4,158 (32.93)	6,937 (23.76)	18,594 (-3.02)
1999	21,344 (-4.39)	7,981 (-8.97)	34,565 (-5.99)	2,946 (-3.54)	4,316 (3.80)	6,646 (-4.19)	20,068 (7.93)
2000	21,565 (1.04)	7,694 (-3.60)	34,503 (-0.18)	3,488 (18.40)	3,480 (-19.37)	6,476 (-2.56)	18,455 (-8.04)
2001*	8,536 (9.04)	2,913 (-8.97)	13,060 (-13.04)	1,692 (27.89)	1,700 (14.25)	2,397 (-12.29)	6,537 (-15.94)

Year	Edible Oils and Fats	Grain Milling	Rice Husking	Granulated Sugar	Monosodium Glutamate	Edible Salt	Soy Sauce
1991	12,401 (12.18)	21,635 (-8.28)	41,298 (5.31)	9,654 (-17.51)	5,792 (17.48)	1,210 (0.50)	2,628 (-2.92)
1992	11,445 (-7.71)	22,041 (1.88)	35,707 (-13.54)	11,629 (20.46)	5,579 (-3.68)	1,484 (22.64)	2,936 (11.72)
1993	12,539 (9.56)	22,701 (2.99)	38,675 (8.31)	10,462 (-10.04)	4,779 (-14.34)	1,416 (-4.58)	2,995 (2.01)
1994	14,468 (15.38)	22,884 (0.81)	32,587 (-15.74)	11,421 (9.17)	4,977 (4.14)	1,455 (2.75)	3,175 (6.01)
1995	15,607 (7.87)	24,971 (9.12)	45,968 (41.06)	9,854 (-13.72)	4,981 (0.08)	1,419 (-2.47)	3,587 (12.98)
1996	14,648 (-6.14)	30,641 (22.71)	45,715 (-0.55)	8,815 (-10.54)	5,086 (2.11)	1,596 (12.47)	3,597 (0.28)
1997	14,477 (-1.17)	29,151 (-4.86)	44,154 (-3.41)	8,387 (-4.86)	5,365 (5.49)	1,563 (-2.07)	3,805 (5.78)
1998	18,290 (26.34)	25,903 (-11.14)	42,365 (-4.05)	7,062 (-15.80)	4,751 (-11.44)	1,520 (-2.75)	3,900 (2.50)
1999	16,071 (-12.13)	24,912 (-3.83)	43,464 (2.59)	6,768 (-4.16)	4,785 (0.72)	1,702 (11.97)	4,118 (5.59)
2000	14,541 (-9.52)	25,073 (0.65)	44,509 (2.40)	5,621 (-16.95)	4,714 (-1.48)	1,725 (1.35)	3,823 (-7.16)
2001*	5,562 (-7.19)	10,144 (-2.66)	18,343 (1.30)	4,323 (-18.66)	2,013 (4.63)	766 (3.79)	1,629 (4.69)

... To be continued

Continuation

Year	Other Seasonings	Wine and Liquor	Ale and Malt	Soft Drink and Carbonated Waters	Noodles	Tea Preparation	Other Food Products
1991	2,288 (3.06)	26,189 (-1.25)	22,479 (-0.02)	32,789 (19.08)	7,474 (-4.06)	4,315 (-1.95)	57,086 (7.94)
1992	2,414 (5.51)	30,052 (14.75)	22,299 (-0.80)	41,148 (25.49)	7,731 (3.44)	3,647 (-15.48)	50,515 (-11.51)
1993	1,736 (-28.09)	29,223 (-2.76)	23,314 (4.55)	47,809 (16.19)	8,822 (14.11)	3,547 (-2.74)	48,282 (-4.42)
1994	1,734 (-0.12)	28,809 (-1.42)	22,987 (-1.40)	56,909 (-19.03)	9,672 (9.64)	4,335 (22.22)	43,220 (-10.48)
1995	2,481 (43.08)	24,272 (-15.75)	21,060 (-8.38)	51,388 (-9.70)	10,393 (7.45)	2,973 (-31.42)	50,092 (15.90)
1996	2,775 (11.85)	24,695 (1.74)	20,500 (-2.66)	48,417 (-5.78)	11,618 (11.79)	2,976 (0.10)	54,080 (7.96)
1997	2,849 (2.67)	24,957 (1.06)	20,485 (-0.07)	49,211 (1.64)	13,762 (18.45)	2,787 (-6.35)	49,988 (-7.57)
1998	3,190 (11.97)	23,238 (-6.89)	23,596 (15.19)	49,781 (1.16)	13,304 (-3.33)	2,511 (-9.90)	43,247 (-13.49)
1999	3,725 (16.77)	23,995 (3.26)	22,835 (-3.23)	48,087 (-3.40)	13,214 (-0.68)	2,550 (1.55)	41,814 (-3.31)
2000	3,678 (-1.26)	23,956 (-0.16)	22,176 (-2.89)	45,163 (-6.08)	14,794 (11.96)	2,510 (-1.57)	46,494 (11.19)
2001*	1,530 (-1.61)	8,883 (-21.99)	7,904 (-0.52)	18,073 (1.28)	4,443 (-13.69)	1,137 (8.29)	18,732 (-1.52)

Note: * January-May.

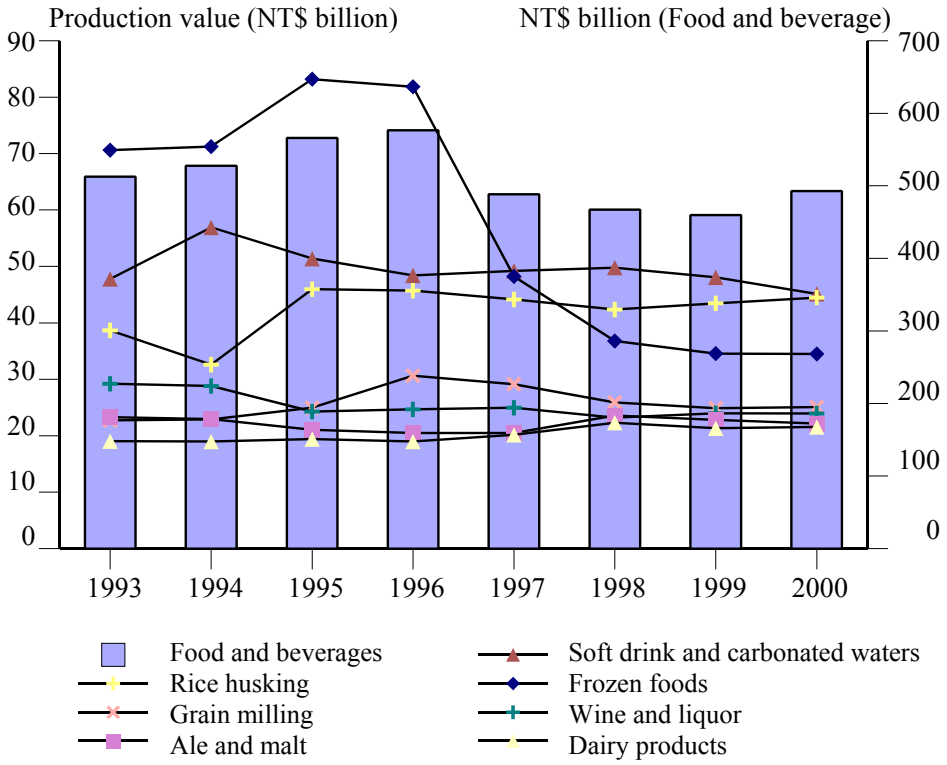

Figure 3. Changes in Production Values of Major Subgroups of Food Industry in Taiwan between 1993 and 2000

Although food industry is not a major contributor to the manufacturing production value in Taiwan any more, it remains the most important industry in Taiwan. Over the past 15 years, the relatively stable unit of families, where women were housekeepers, men the breadwinners, and grandparents frequently lived with their children, has changed dramatically. Many women are working outside the home, leaving little time for them to buy food or prepare meals. Over 60 (percent) women aged between 25 and 49 years old are now working (Figure 4). The average household size has decreased to 3.63 person in 1999 and single parent families have increased (Figure 5). As a result, the number of people eating in restaurants and other institutions has sharply increased. At the same time, convenience foods or home meal replacements, which are easily converted to tasty, nutritious, edible products, have been widely created by food processors, to respond to these demographic and sociological changes.

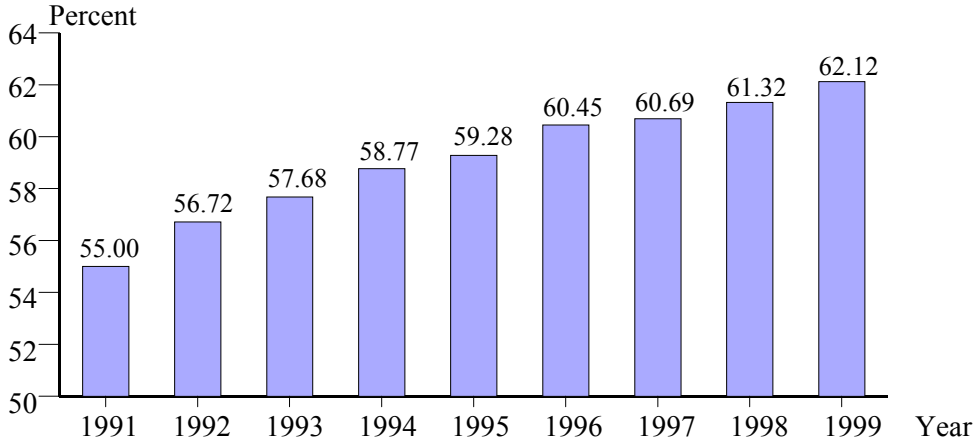

Figure 4. Percentage of working Women (25-49 years old) in Taiwan

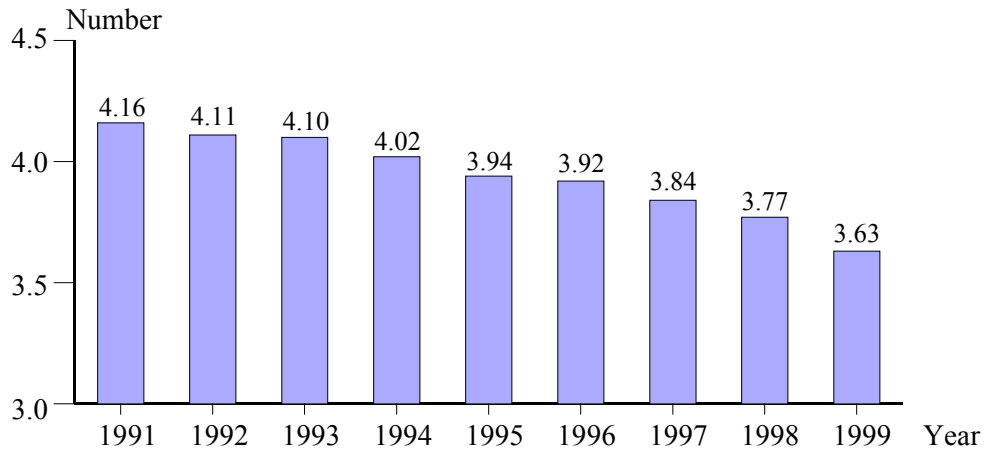

Figure 5. Number of Each Family in Taiwan

Major Issues Affecting the Packaging of Processed Foods in Taiwan

The changes or modifications to food packaging, such as light, strong packaging materials, attractive package shape, small-size package, or resealable package, are the most efficient ways to convey to consumers a new image for food products, even when the same formulation and processing are used. To meet the increasing requirements for minimum packaging of processed foods due to sociological changes, new packaging materials and suitable packaging machinery are studied and developed continuously. Since the beverages and soft drinks industry is the largest subgroup of food industry in Taiwan (Table 1) it is also one of the big subgroups required optimal packaging, thus any changes in the production of beverages and soft drinks, significantly affect the packaging of processed foods in Taiwan. Table 2 shows the marketing sales values of beverage and soft drinks in Taiwan (1999 and 2000) and it indicates that tea preparation products are the largest selling products, followed by carbonated soft drinks and fruit/vegetable juices. Based on the table of monthly sales amounts of beverages and soft drinks in Taiwan (Table 3), Polyethylene Terephthalate (PET) bottles are the most common and are mainly used for drinks, followed by (aluminum) cans and tetra-pack. Figure 6 shows the structural changes of packaging materials for beverages and carbonated water in Taiwan during 1997-99. Although the total production of the food industry has not significantly growth in Taiwan, the requirements for packaging have increased, resulting from the increased demand for minimum packaging in food markets. The recent progress of major packaging industries used for foods and beverages in Taiwan is discussed as follows.

Table 2. Marketing Sales Values of Beverage and Soft Drink in Taiwan, 1999 and 2000

Type	1999		2000		Growth Ratio
	Sales Value (NT$ billion)	Percent	Sales Value (NT$ billion)	Percent	
Teas	12.50	28.4	11.30	26.9	-9.6
Carbonated water	9.02	20.5	8.50	20.2	-5.8
Fruit/vegetable juice	6.64	15.1	6.50	15.5	-2.1
Coffee	5.10	11.6	5.30	12.6	+3.9
Bottled water	4.17	9.5	4.20	10.0	+0.7
Sport drink	3.39	7.7	3.70	8.8	+9.1
Health drink	1.90	4.3	1.50	3.6	-21.1
Others	1.28	2.9	1.00	2.4	-21.9
Total	44.00	100.0	42.00	100.0	-4.5

Table 3. Monthly Sales Amount of Beverage and Soft Drink in Taiwan, December 2000

Type of Package / Type of Products	Sales Amount (mt)										Yearly Sale (2000) (000 mt)
	Glass Bottle	Can	Tetra-pack	PET Bottle	Paper	PP Bottle	Other Plastic	Others	Bulk	Total	
Teas	0	4,100.1	20,107.9	5,782.6	6,221.7	855.3	180.0	8.0	1,586.1	38,841.7	400.0
Carbonated water	384.5	8,767.2	0	12,506.6	0	0	0	0	4,848.1	26,506.4	342.9
Fruit/vegetable juice	6.7	4,362.4	5,726.5	1,311.3	3,135.5	2,335.9	126.9	101.7	0	17,106.9	240.8
Sport drink	0	2,934.1	1,365.0	1,400.6	0	0	0	0	4.2	5,703.9	144.6
Coffee	0	9,137.2	1,293.9	0.1	0	0	355.3	110.0	0	10,896.5	117.9
Health drink	246.9	552.4	110.6	234.8	0	0	0	0	0	1,144.7	21.7
Traditional drink	0	1,337.3	624.9	1,821.2	346.2	6.2	0	0	0	4,135.8	64.3
Others	182.8	206.5	594.0	0.1	23.1	0	0	0	0	1,006.5	12.4
Bottled water	0	0	0	16,131.0	0	0	772.5	0	0	16,903.5	248.7
Flavored water	0	13.3	0.8	1,395.4	73.2	0	0	0	0	1,482.7	21.2
Total	820.9	31,410.5	29,823.6	40,583.7	9,799.7	3,197.4	1,434.7	219.7	6,438.4	123,728.6	1,614.5

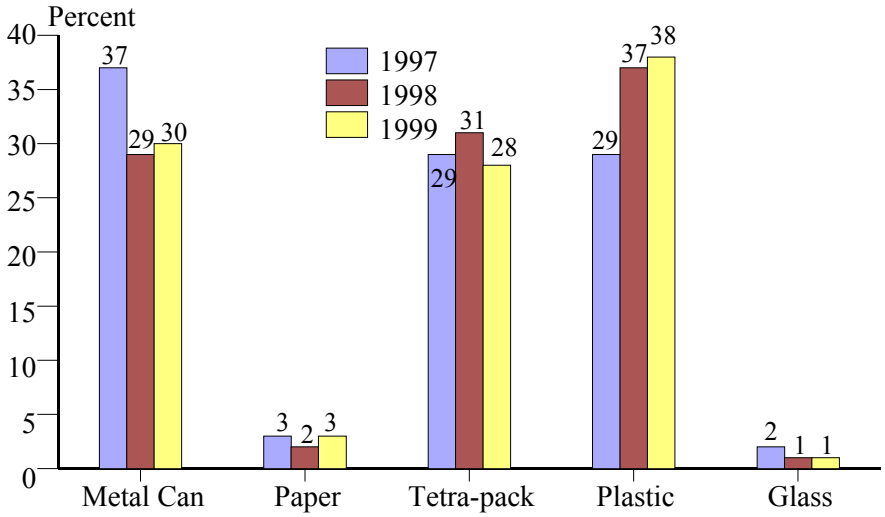

Figure 6. Structural Changes of Packaging Materials of Beverage and Carbonated Water in Taiwan during 1997-99

1. ***Metal Packaging***

It was the earliest and most developed material for the canning industry in Taiwan. The market share of metal cans in beverage and soft drink industries decreased about 6 percent over a recent five-year period because of old canning machinery and little progress in packaging technologies for canning, during the last 20 years (Table 4). The utilization of aluminum cans also declined since 1996, due to the declining production of beverages and carbonated water. Export of canned goods peaked in 1993, the major markets being mainland China and Japan for metal cans and aluminum cans, respectively (Table 5).

Table 4. Production and Sales of Metal Cans in Taiwan during 1992-97

Production/Sale	1992	1993	1994	1995	1996	1997
Production for Food/Beverage (billion pieces)	5.13	6.25	6.16	5.82	5.54	4.85
Metal can	2.80	3.50	3.20	2.65	2.25	2.07
Aluminum can	1.5	1.7	2.1	2.25	2.11	1.79
Sales amount	5.17	6.03	6.12	5.78	5.46	4.92
Export (mt)	14,230	31,595	21,450	15,551	11,352	10,501
Metal can	12,673	29,512	17,034	8,975	6,708	5,486
Aluminum can	1,557	2,083	4,416	6,576	4,644	5,015
Import (mt)	1,626	412	350	456	275	225
Metal can	167	249	155	214	72	75
Aluminum can	1,459	163	195	242	203	150

Table 5. Sales of Metal Cans for Food, Beverage and Soft Drink in Taiwan during 1992-99

(Unit: Billion pieces)

Type	1992	1993	1994	1995	1996	1997	1998	1999
Metal Can	2.80	3.50	3.20	2.65	2.25	2.07	1.94	1.92
Beverage and soft drink	2.10	2.24	2.30	1.95	1.59	1.50	1.41	1.40
Food	0.40	0.46	0.50	0.50	0.46	0.41	0.40	0.36
Export	0.30	0.80	0.40	0.20	0.20	0.16	0.13	0.16
Aluminum Can	1.50	1.70	2.10	2.25	2.06	1.95	1.96	1.80
Beverage and soft drink	0.70	0.80	0.95	1.03	1.06	1.02	1.12	0.98
Beer	0.68	0.75	0.83	0.72	0.65	0.58	0.63	0.60
Export	0.12	0.15	0.32	0.50	0.35	0.35	0.21	0.22

2. ***Paper-based Packaging***

Table 6 shows the amount of paper containers used for food, beverages and soft drinks in Taiwan during 1994-99. Tetra-pack is now the major paper container used for beverages and soft drinks, being about 30 percent of the packaging market for beverages and soft drinks. Paper containers are only about 10 percent of packaging market for beverages and soft drinks. However, the amount of tetra-pack used for beverages and soft drinks sharply decreased in 1999, due to fresh juice being preferred by consumers.

Table 6. Paper Containers Used for Food, Beverage and Soft Drink in Taiwan during 1994-99

(Unit: Billion pieces)

Type	1994	1995	1996	1997	1998	1999
Tetra-pack	2.39	2.55	2.27	2.52	2.79	2.41
Beverage and soft drink	2.20	2.19	1.98	2.10	2.40	2.03
Dairy products	0.17	0.29	0.20	0.31	0.28	0.26
Others	0.02	0.07	0.09	0.11	0.11	0.12
Paper	0.70	0.65	0.60	0.64	0.64	0.69
Beverage and soft drink	0.30	0.25	0.25	0.27	0.26	0.31
Dairy products	0.40	0.40	0.35	0.37	0.38	0.38

3. ***Glass Packaging***

Glass as a packaging material has the advantages of chemical inertness, clarity, rigidity, resistance to internal pressure, heat resistance and low cost. Therefore, it owes its specialty nature to particular products, such as alcoholic beverages. Although its disadvantages such as fragility and heavyweight may not be convenient or economic for processors and consumers, it is hard to replace it with other packaging materials, for these specific food products.

4. ***Plastics***

The use of plastics in packaging has increased markedly over the last few decades, particularly for foods and drinks. Plastics have the advantage of low cost, a wide range of properties, large scope in form and shape, have lightweight coupled with strength, and are easily disposed of after use. Over 30 percent of food packaging is now plastic in Taiwan, the most important plastic being used for beverages and drinks is PET bottles. Table 7 shows the production of PET bottles for food, beverages and soft drinks in Taiwan during 1993-99. It had 28 percent and 18 percent growth in 1998 and 1999, respectively. The major growth is driven by opportunities in bottled water, flavored water and carbonated soft drinks. Besides, market demand for the small-sized PET bottles (500 ml or 300 ml) for single-serve also increased the growth of PET bottles in food packaging. The low deposit fees for beverages and soft drinks (NT$0.5 per bottle) since 1 July 1999, encourages food processors to replace PVC (polyvinyl chloride) bottles by PET bottles. The complete replacement of PVC bottles by PET bottles is forecast when some of PET packaging techniques such as thermal stability and molding is improved.

Table 7. Production of PET Bottle for Food, Beverage and Soft Drink in Taiwan during 1993-99

(Unit: Million pieces)

Type	1993	1994	1995	1996	1997	1998	1999
Carbonated water	-	-	115	120	125	148	133
Bottled water	-	-	40	80	90	170	285
Soy sauce	-	-	85	86	87	87	87
Thermal type	15.5	77.4	123	95	95	95	70
Perform	-	-	50	100	150	200	200
Total	286	346	413	481	547	700	805*

Note: * Included 30 million bottles used for edible oil.

PET advantages in packaging include being lightweight, also having clarity, design flexibility and a sound environmental profile. Over the past several years, consumers have increasingly acknowledged the

importance of environmental protection. In order to respond to the 4Rs of environmental awareness (Reduce, Reuse, Recovery, and Recycle), consumers have increased usage of PET material for containers primarily used for packaging of water, drinks, edible oils and a wide range of liquid household products.

Packaging Machinery in Taiwan

The packaging machinery industry is well-established in Taiwan, but the scale is usually small. Table 8 shows the production, export and import values of packaging machinery in Taiwan during 1993-2000. The trend of production values is usually similar to export values, except in 1998. This was influenced by the financial crisis of Southeast Asia in late 1997. Table 9 shows the top five countries which import packaging machinery from Taiwan. The major export markets for packaging machinery are still in Asian areas. Based on the production, export and import values of packaging machinery in Taiwan, production of packaging machinery in Taiwan is mainly dependent on the export market, while the import of packaging machinery is mainly dependent on domestic need.

Table 8. Production, Export and Import Values of Packaging Machinery in Taiwan during 1993-2000

(Unit: NT$ million)

	1993	1994	1995	1996	1997	1998	1999	2000
Production value	2,534	3,049	3,265	3,694	3,954	3,554	3,427	3,608
Export value	2,654	3,001	3,595	3,781	3,870	2,957	3,121	3,788
Growth of export (%)	-	13.1	19.8	5.2	2.4	-23.6	5.5	21.4
Import	2,831	2,998	3,828	2,969	3,079	4,039	4,415	4,351
Growth of import (%)	-	5.9	27.7	-22.4	3.7	31.2	9.3	-1.4

Table 9. Top Five Export and Import Countries for Packaging Machinery in Taiwan during 1996-2000

	1996	1997	1998	1999	2000
Export					
1	Hong Kong	Hong Kong	Hong Kong	Hong Kong	Hong Kong
2	Japan	Thailand	U.S.A.	U.S.A.	U.S.A.
3	U.S.A.	U.S.A.	Japan	Japan	Japan
4	Thailand	Japan	Thailand	Malaysia	Thailand
5	Malaysia	Malaysia	Malaysia	Philippines	Malaysia
Import					
1	Japan	Japan	Japan	Japan	Japan
2	Germany	Italy	Italy	Italy	Germany
3	Italy	U.S.A.	Germany	Germany	Italy
4	U.S.A.	Germany	U.S.A.	U.S.A.	U.S.A.
5	Sweden	Sweden	Netherlands	Sweden	France

Future Prospects of Packaging of Processed Foods

Growth in demand for food containers is driven by expanding newly developed products, higher value-added packaging and consumer interest in convenient, highly packaged prepared foods. In order to meet the demands of the packaging market for the food industry in Taiwan, research and development (R&D) on new packaging materials, and suitable packaging techniques for specific food products, is always in demand by food processors. Future prospects for packaging of processed foods in Taiwan include:

* ***aseptic PET packaging for low acidic liquid products***: Recently, a few food manufacturers established the aseptic PET packaging process for shelf-stable low acidic liquid products, such as tea drinks. The potential contamination of packaging materials (i.e., bottle, cap) and the sealability of cap and packaging materials, still need to be closely investigated.
* ***aseptic hot filling PET packaging for food products containing highly nutritious components or particulates***: Most perishable foods need to be completely sterilized for their safety, when processed

as a shelf-stable product. Good thermal properties of PET materials and the good heat transfer and pressure-resistant bottle design, should be developed before applying it to food products.

* ***active packaging of foods with flexible packaging materials based on films and foils***: Active packaging is a type of packaging that changes the condition of the packaging to extend the shelf life or improve safety or sensory properties while maintaining the quality of the food. Among the important active packaging concepts are, e.g., O_2 and ethylene scavenging, CO_2-scavengers and emitters, moisture regulators, antimicrobial packaging concepts, antioxidant release, release or absorption of flavors and odors. There are different types of active packaging concepts with respect to mechanism of action, effectiveness and the effects on foods. Suitable active packaging should be developed for specific foods, especially for traditional Chinese foods.
* ***biodegradable packaging materials, or materials easily recycled***: The rapid development of Taiwan's petrochemical industry and the public's emphasis on convenience, have led to large quantities of plastic bags or containers being consumed on a daily basis. Statistics indicate that over 30 percent of solid waste are plastics; these numbers suggest that plastic usage has created a very large environmental burden. Because plastic materials do not easily degrade, they are harmful to the environment and greatly complicate waste management efforts. The R&D of replacement materials (such as biodegradable plastics) used for packaging are encouraged and promoted by government. Besides, completely recyclable packaging materials not producing toxic compounds to hazard human health, such as PET, are environmentally friendly materials, that should be chosen for use.

2. FIJI

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FOOD INDUSTRY

The food industry in Fiji is developing fast, catering to local requirements and also for exports. The major food classes are fruits and vegetables, grains, pulses, poultry, fish and meat. The local government and city councils assist farmers through their vegetable markets, to organize marketing of their fresh produce. The farmers bring sufficient produce, lasting only 2-3 days, to always keep a supply of fresh stocks. Fresh green garden vegetables like bean pods, cluster beans, snow beans, okra, drumstick, taro leaves, chilies, bringel; root crops like taro, yams, ginger and turmeric. Fruits like paw paw, mangoes, and melons are exported. If more facilities for processed food packaging are made available, there would be more value-added to the vegetables for exports.

LOCAL FOOD ITEMS

Apart from sugarcane and copra, the people have the freedom to trade freely, with any of their cultivated crops. The production of food crops in Fiji is not sufficient for its own population for local consumption, hence almost all items on the food list are imported in various quantities, to meet the local requirements.

IMPORTED FOOD ITEMS

Meat, poultry and dairy produce, fruits, vegetables like potatoes, onions, garlic, lettuce, tomatoes, apples, pears, oranges, jams and cereals are imported from Australia and New Zealand. Spices, grains and pulses are imported from various countries like Thailand, Australia, India and China.

METHOD OF DISTRIBUTION

The method of distribution of all the food items is generally very organized, through the supermarket shelves, which are adequately stocked and supplied with stocks. Modern display and storage facilities like coolers, fridges and shelves have controlled the wastage and increased shelf life of all food items. The people of Fiji are becoming a little sophisticated, so food items are generally accepted only when in good and hygienic condition and presentation. Cooked food outlets supply foods in standard disposable cardboard cartons with waxed lining, thermocool or plastic containers. These are mostly items for same day consumption. Short-term storage items in the supermarket shelves such as flour, rice, grains, spices and like, are all well-labeled with packing and expiry dates, and are monitored by the manufacturing or distributing company on a regular basis.

CURRENT TREND IN FOOD PACKAGING

Recent developments, that have started in a big way, are in the confectionery group of products that are stored in the fridge, like ice blocks with different flavors, nuts and fruits, coated with sugars, creams or chocolate. These are packed in leak-proof form filled flexible, plastic or poly bags with beautiful labels and

description of the contents. Cultural and traditional habits are still around and certain packaging has been rejected. A good example of this is packets of the ground spice *masala*. If this is not packed in see-through polythene bags, it does not sell. Some good packaging has failed, as consumer's acceptance is based on wanting to see the product inside.

BEVERAGES

The beverages industry is experiencing rapid growth, providing more varieties. Prepared drinks are packed mostly in PET bottles and glass bottles. The high cost of glass bottles packaging is eliminating glass bottles fast. Carlton Brewery manufactures and markets beer in Fiji, known as "Fiji Bitter". This Australian company has two breweries, which meets the total requirements and exports to the nearby countries. Beer is not canned, it is packed in bottles. The sugar industry produces molasses which is the raw material for the only distillery set-up, near the largest sugar mill in Lautoka. It prepares its own formulation and also blends drinks under license.

FOOD PACKAGING INDUSTRIES

Most of the food packaging industries are developing only at the retail level. The only items that can be classified for long-term storage are the fish and meats that are deep frozen, either for the export or for the food processing industry.

The seafood processing company has introduced the latest Quick Freeze Technology (QFT). The fish through this system is instantly frozen at -20ºC to -30ºC and then stored in the deep freezer for long-term storage. Fish is drawn from these stocks and packed in poly bags for export, as unprocessed fresh fish, or supplied to the processing department for canning.

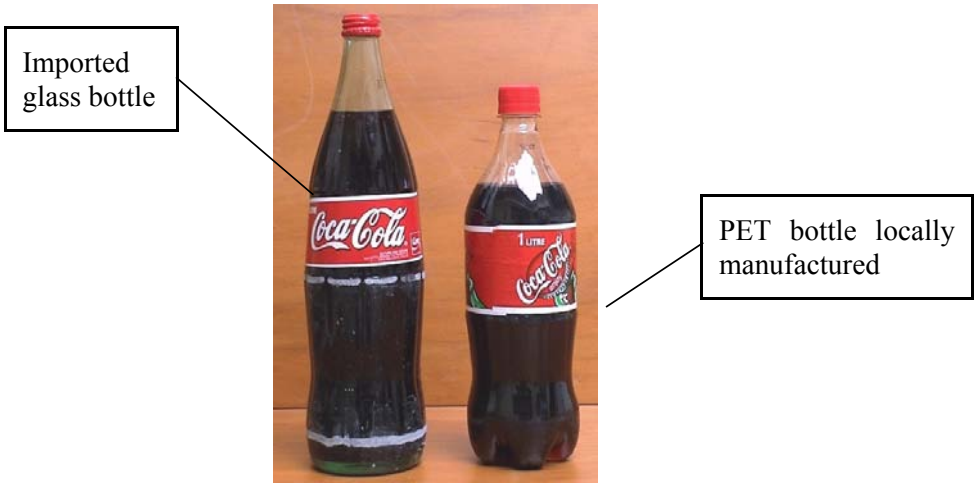
There are three major can manufacturing companies which manufacture cans for non-food products. The food processing industries imports the semifinished cans and assembles them for packaging of fruits and vegetables whole, sauces, jams and like, fish, meat, and biscuits. Fiji does not have any glass bottle manufacturers, all the glass bottles and jars required for food industry are imported. These are generally for honey, jam, peanut butter and alcohol.

RECENT CHANGES AND GROWTH

The major changes in packaging recently are the replacement of glass bottles in the dairy industry by tetra-pak. This new packaging is easy to handle, economical, has longer storage and is hygienic as well. Tetra-pak packaging material is formed into ready-to-use boxes, very basic. The latest tetra-pak developments have not yet been introduced in Fiji.

The flexible packaging film industry caters only to dry biscuits, confectionery and snack foods. The polythene bag industry is yet to be fully developed. The overprinting on the polyethylene bags is very common but the printing between two layers of plastic is yet to be introduced. Packaging materials for wet foods consists of standard disposable cardboard cartons with waxed lining. Thermocool and plastic containers are all imported.

Plastic and paper bags have replaced ordinary newspaper; formerly used for wrapping food parcels, pop corn, confectionery and takeouts. Fiji does not have paper or cardboard laminating facilities. Packaging materials are imported from Singapore. Plastic containers are an ideal and inexpensive packing material for cakes, ice cream and the like. Liquids and wet foods packed in cups and sealed with paper, or plastic, by heat welding, is not practiced in Fiji. Polythene bag packing, after nitrogen flush under vacuum, is yet to be introduced. The idea of globalization has a great impact through the TV. The influence of the developed countries is tremendous as far as changes are concerned. The total packaging presentation, distribution and consumer demand have taken a new and commercial approach. From the profitability and fast service point of view also, recent changes are coming fast. One of the most recent changes in Fiji is the packaging and distribution of soft drinks by the multinational company Coca Cola. The drinks were sold in glass bottles until recently. Glass bottles were reused/recycled. The collection of empty bottles and cleaning them for refill was a very expensive process, involving about 2 percent of bottles damaged. These have now been changed and replaced by PET (polyethylene terephthalate) bottles.



There are six companies that have introduced advanced PET bottling. They have sophisticated machines to manufacture bottles. The PET resin is generally imported from Japan and Korea. The PET bottles are not refilled, but the plastic is recyclable.

The legislation coming about in Fiji is due to the pressure from the international organizations and the demand from the consumers. The Ministry of Commerce and Industry and the Ministry of Health look after the entire food industry and has the systematic implementation of the regulations. Due to modern life styles, processed food is becoming more popular. The introduction of the microwave oven has made cooking easier. These trends of processed food use are changing traditional food habits.

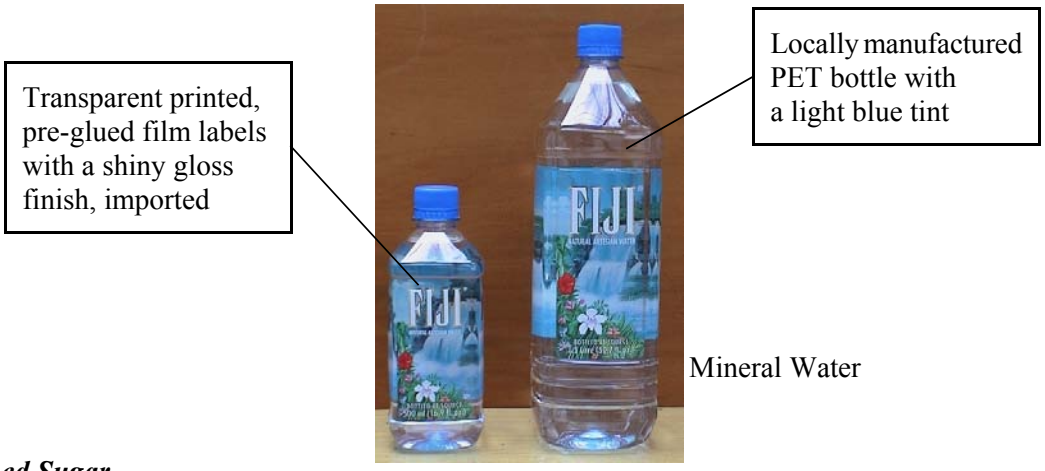
The number of processed food items is increasing every day. In order to have better hygienic control, the authorities keep upgrading and enforcing the legislation. Compared to the past, food labeling is now compulsory. There are available simple printed labels on paper, but other labels on plastic or metal and pre-glued labels are all imported. The challenges in the food packaging industry, sometimes create problems as well. It is now the most important requirement in Fiji to refine the existing food standards. The other problems faced in this industry are limited resources for packaging industries, which are not freely and readily available. The government does not have any institution, which could provide the necessary information to the ordinary person. The Agriculture Department limits its studies mainly to production aspects. Individuals and entrepreneurs who wish to get into the food industry have to do their own research and look for assistance in nearby countries, mainly Australia and New Zealand. The consultants who are hired for such services are very expensive. The high cost of technology transfer is also one of the reasons for slow progress. The prospects of business in processed food industry will have to be analyzed.

LUCRATIVE PROSPECTS

The production of agricultural produce as farm raw materials for processing, will have to be encouraged through government and cooperatives. The government should introduce an advisory unit to assist the food processing and packaging industry and make available the necessary information on technology and marketing. Incentives and encouragement by the government should give this industry a boost. It would be a big substitute to the import of processed food in Fiji. The areas of development, that should take place and increase business and revenue are as follows:

1. ***Mineral Water***

A mineral water company is currently engaged in supplying its natural water to U.S.A. valued in excess of US$50 million. There are two more companies that have the consent of the Fiji Government for mineral water business. One of the companies is obtaining its technology from Germany. Both the companies are likely to be in business next year.



Mineral Water

2. ***Refined Sugar***

Fiji exports cane sugar to Europe, China and America, in the form of brown sugar. The sugar can be further refined and packed in small retail packs then exported for more revenue earnings. Labeling would need to match markets.

3. ***Honey***

The unpolluted and disease free environment and green vegetation is an ideal situation for the honey farms. Honey from Fiji is exported and is regarded as a superior quality product. It is a known fact that not many countries have disease-free bees.

4. ***Starch***

The climate of Fiji is suited to tapioca growing. Tapioca is a very good source for starch, for which there is huge market. Boiled tapioca is a regular item on a food plate in Fiji.

5. ***Seafood***

The seafood resources have not been well tapped around Fiji, which has clean unpolluted sea, a tropical climate and plenty of fish and other seafood like bêche-de-mer, etc. Countries such as China, Korea and other Asian countries take fishing rights in the Pacific and catch fish, which is processed in their country then re-exported to the Pacific island countries. Fiji could do the same. There is one company in Fiji which does fish canning, but the fishing contract is with an American company, which fishes and supplies to the Fiji Fish Canning Company. Fiji does not have professional fishermen. Fiji exports about 160 containers of fish every year worth about US$4 million.

6. ***Processed Fruits and Vegetables***

There is a long list of fruits and vegetables that can be processed, preserved, and sold to the countries that do not have a tropical climate and need such items. There are fruits and vegetables on the market that can be grown in Fiji, but are imported. Adequate facilities for storage of agricultural and horticultural produce are not available. Simple farm produce preserving technology is required to be introduced. Fiji does

not have the necessary packaging and processing facilities. There is room for profitable packaging materials manufacturing businesses.

GLOBALIZATION

Satellites have made it possible to transmit TV signals across the world, hence through the TV, people are getting educated and learning about many different countries, their people and their needs. Advertisements on TV have expanded the ideas about food and food habits. Their want creates business.

Traveling Population

With the introduction of faster and bigger airplanes, the population travels and eats in foreign lands and when the traveler is back in the home country they wish to try similar foods. They look for processed, imported foods.

Export for Foreign Earnings

Exports of processed food items is a revenue earner and increases foreign exchange earnings.

Trade Zones

The trend is growing, where neighboring countries get together to form groups for trade and economic relations. Countries in Europe have got together and have the single currency of the Euro, to do maximum trade within their own group. The Melanesian Spearhead Group is a grouping of Melanesian countries, which get together for economical benefits and trade. Such trade zones are established on agreements to keep trading arrangements in place. The changing trade environment is always a factor. The monopoly in trade will be disturbed by more and more competition to reduce costs to consumers and at the same time improve quality. Sometimes imported food items compete with the local products which need protection, especially when the successful companies have surplus goods, which they start dumping. This also includes some low quality products at cheap prices.

Fiji being disease-free and having a clean environment, has very big prospects for a meat industry. With permanent vegetation and by developing big cattle farms, the meat industry could grow and have big earnings from export, as some countries are facing drastic failure in the industry, due to foot-and-mouth disease. The fish processing factories also are doing a very good business, and Fiji should invest in more fish factories for either canning or exporting fresh fish.

SOLUTIONS

Fiji is a country endowed with fertile land and adequate climate; it is uniquely suited to agriculture. It is necessary that the initiative of individuals be diverted in the right directions and proper goals set. In order to assist the food industry to flourish, it would be necessary to introduce a separate unit in the Ministry of Commerce and Industry, to handle the total food industry. Like other countries, the education system and commerce must go hand in hand. It is very important to design a faculty, teaching curricula and technology in the local university to suit the food industry. In order to increase productivity and produce more processed food, there should be better utilization of land for more agricultural produce. In order to encourage more people to enter the food industry, the government should introduce extra incentives. By producing more export could increase and would be a substitute for imports. It will also be necessary to join international organizations to keep abreast with developments and the needs of the people globally. Generation of more public awareness of opportunities available is necessary.

CONCLUSION

Fiji has yet to develop various food industries and needs to attract investors to exploit the packaging industry which has room for further development. There is a very high potential in Fiji for the processing of food rather than just importing in bulk and repacking.


Plastic ice-cream container, locally manufactured
Form filled flexible plastic film imported in rolls
Baking powder packed loose in re-sealable imported tin
Locally manufactured plastic bottle for cordial
Jelly crystals internally packed in HDPE bag (imported) and then in cardboard box, Fiji made
Imported glass jam bottle
VANILLA
Creamy
PASSIONFRUIT
Rolled Oats
Twisties
Tuckers
CHOCOLATE ICE CREAM
HALF CHICKEN
Smooth
UFOs

3. INDIA

Badrul Hassan
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FOOD PROCESSING INDUSTRY IN INDIA

The Indian economy was well developed in its own way, since the village, the primary unit of development was almost self-sufficient and self-sustaining. The Indian farmers produced only for subsistence level, or at the maximum for the village needs. During colonial rule in India, Indian farmers were forced to produce for the market, to feed the needs of the industrial revolution. The farm sector not only was forced to produce for the market but a lot of changes also occurred in the pattern/kind of agricultural produce. Emphasis was shifted from food grains to commercial crops like jute, cotton, indigo, tea, coffee, etc.

India became a deficit state in terms of agricultural produce by the time of independence. Thanks to the current emphasis laid down by our planners to agriculture, India is now not only self-sufficient in terms of food grains, but has emerged as a major exporter to developed as well as developing nations of the world. The per capita availability of food grains which was stagnating at 395 g per person per day in the early 1950s has increased to the present level of 467 g per person per day, which is comparable to nutrition standards set by FAO.

The trend in food grains production has also induced manifold growth in horticulture, dairy, poultry and meat products. Now, Indian farmers produce more for the market than for subsistence. In earlier times, since production was for home consumption or for the village, the only need for packaging was in storage. Traditional storage methods such as storage bins, continued to be used for a long time. In modern times since the world has become a global village, with the consumer as king, food packaging has to be market- and consumer-oriented, necessitating drastic changes in packaging.

Although India is one of the largest producers of agricultural raw materials, the food industry itself is extremely underdeveloped. Less than 2 percent of fruit and vegetable production is processed in the country, compared to 30 percent in Thailand, 70 percent in Brazil, 78 percent in Philippines and 80 percent in Malaysia.

In the last decade, India has moved from an era of scarcity to one of plenty. The production of fruits and vegetables is now 66 percent of the total quantity of food grains. By the year 2010, it is estimated that the production of fruits and vegetables would be 80 percent of the quantity of food grains produced in India. The yield of these crops in India is about 30 percent of that in other countries, so we can imagine the sort of spurt that is possible in the sector.

In the situation that prevails in India, 90 percent of fruits and vegetables produced are marketed by the farmers, as compared to less than 20 percent of cereals. This shows that the main challenge the food sector is going to face in the coming decade will be one of marketing, which hitherto has been a major constraint in its growth, so it is here that the thrust of policy will have to be.

In this scenario, food processing becomes critical. This could absorb surpluses at farm level and ensure fair prices for the producers. It would also ensure availability of the produce at reasonable price for the consumer. In addition, the employment generation potential of this sector is much higher than other sectors, i.e., 54,000 persons get direct employment per billions of rupee investment in the food sector, in comparison to 48,000 in textile and 25,000 in paper industry. There is also a fourfold generation of indirect employment in the ancillary and downstream activities, on account of the investment in food sector. Furthermore, 60 percent of the employment generation is in small towns and rural areas.

The primary reason why the food processing sector has not developed is that agriculture has largely been for subsistence and not market-driven. This has not yielded adequate surpluses for processing and was

coupled with the low yield of crops. The lack of awareness about the processable variety of raw materials and the non-availability of suitable raw materials in terms of size, color, texture, etc., has contributed to the lack of volume and economy of scale. Present tax factors also drive a wedge between branded products manufactured in the organized sector and products from the unorganized sectors. In fact, the tax in India on processed food is amongst the highest in the world, and has been a major single impediment in attracting investments, both locally and from abroad. This is coupled with the fact that investments in the processing industries are in any case at high risk and yield low return. Investment are further depressed because despite the apparent advantages of hygiene and quality, the price-sensitive Indian consumer has stayed away from the high-priced, packaged foodstuffs. Further, consumer preferences in India are largely towards fresh food. However, with the growing urbanization and increasing middle class of late, there has been some shift towards processed food.

PROBLEMS AND CURRENT STATUS

Problems/Issues Affecting Food Packaging

The major problems/issues affecting the packaging of processed foods lie in the nature of the produce itself. Most of the food products have the following peculiarities:

1. ***Large Volumes***

Raw food products require large storage space, as the requirement of food processing industry for storage is high. This remains true even for finished products.

2. ***Perennial Requirements***

Most industrial products are long-lasting in terms of consumption, i.e., they are required to be purchased a few times during the entire life span of a person. The requirement for food products remains almost the same throughout the year. They have to be purchased either on day-to-day basis or required to be stored at home for daily consumption.

3. ***Spoilage***

Almost all farm products are prone to spoilage either by atmosphere or by the presence of insects/pests and rodents, microbes and by natural breakdown.

4. ***Handling Losses***

Farm products are bulky in nature and vary in size, thus heavy losses in terms of weight/quantity can occur during handling and transportation.

To overcome these inherent problems, packaging has to suit the needs of individual items depending on their production time, place of production, and the volume of the produce.

CURRENT STATUS OF FOOD PACKAGING IN INDIA

It is estimated that India produces nearly 300 million mt of food products which comprise grain, cereals, pulses, fruits and vegetables, meat, fish, poultry and marine products. Most of these are marketed fresh in and around the producing center. Even then around 30-35 percent of fruits and vegetables, valued at Rs.30 billion go to waste each year, due to lack of postharvest facilities and the absence of linkages to the processors and markets. Nearly, 10-20 percent of grain are spoiled due to inadequate transportation and storage facility.

It is in this context that packaging and distribution play a key role in the growth of the food processing industry. Packaging forms an integral part of food manufacture, providing the essential link between the processors and consumers. The packaging line generally occupies up to 50 percent of the floor space, while the packaging and the related areas absorbed about 60 percent of the five million labor force employed by the Indian food industries. It is estimated that presently, the money spent on food packaging materials alone amounts to nearly Rs.20 billion per annum. At least another Rs.10 billion is spent on packaging operations and related activities, making a total of Rs.30 billion. This constitutes nearly 1 percent of the total value of the primary processed foods (about Rs.1,000 billion) and 15 percent of the value of the secondary and tertiary

processed foods (Rs.120 billion) produced in the country. This could nearly double over the next five years at the current pace of growth.

In view of the projections for the production of various foodstuffs with large quantity reaching the market during coming years and considering the future plans for their packaging, the food category outlook for packaging material and forms are shown in Annex I. For food grains, milled goods, sugar and jaggery, only 1-2 percent of the grains, 20 percent of the milled products and a negligible quantity of sugar are packed in consumer packs. It is envisaged that the latter two products will find greater use for consumer packaging in the next five years.

In terms of handling, it is likely that the present headload of 100 kg has to be reduced to 50 kg as per the recommendations of the ILO. The capacity of grain and sugar bags has to be reduced to 50 kg. This would require 25 percent more packaging material of poly-jute or woven plastic sacks made of polypropylene (PP), which have adequate strength for 50 kg. In mechanized handling, use of intermediate bulk containers of 50-kg capacity would be not only economical, but also would conserve packaging materials.

Jaggery and other type of goods which are presently packed in mat baskets and leaves, are difficult to package and need more hygienic and economical packages for storage and distribution, especially in coastal regions where the relative humidity (RH) exceeds 86 percent.

Nearly 30 percent of the total production of fresh fruits and vegetables are transported in bulk packs of jute or hessian, and woven baskets for marketing. Less than 0.1 percent is prepackaged and moves are being made to market more in this form. This is likely to increase 30-fold, requiring large quantities of polythene-based film and corrugated fiber board (CFB) boxes.

As regards processed fruits and vegetables, bag-in-box or drum aseptic packaging system, and larger cans (A-10 size and above) will find greater use, thus affecting the small-scale canning units. It may have further impact as efforts are being made by major importers to carry concentrates in aseptic tanks and even containers. About 80 percent of edible oils and fats (*vanaspati*) is packed in bulk containers. Already blow-molded polyethylene (PE) containers and multilayered containers of more than 5-kg capacity, have entered the market to cater to institutional needs. The remaining 20 percent of the oils and fats is packed in consumer units, mostly plastic bottles and jars or flexible pouches. Though the expected use of 5-layer co-extruded film for public distribution of edible oils has not come through due to high costs, the requirement for composite multilayer film is likely to go up by about 250 percent.

The packaging outlook for liquid milk is that a large increase in the volume of packet milk is expected, and vending machines are likely to be introduced due to cost effectiveness. Sterilized milk packed in tetra-hedral and brick type aseptic packs are likely to find greater use, especially in big towns and cities. Infant foods, milk powder and malted milk foods are expected to grow faster and hence also their packages – glass bottles, tagger top cans, made of tin plate.

For bakery goods, almost all types of biscuits are either bulk packed or consumer packed, but only 30 percent of bread and buns are in packets. At present, consumer packs account for only 31 percent. In coffee and tea, consumer packaging for instant and ground coffee is increasing, with the availability of vacuum and gas packaging facility and good barrier film structures for pouches. At present, only 12 percent of cashew kernels and 2-5 percent of other nut species are in consumer packs. This will increase by over 33 percent as groundnut species and their blends are increasingly coming in the market as consumer packs.

There will be about a 40-percent increase in consumer packaging of snacks, Indian sweets and savoury items. Most of the consumer packs in this category are of glassine paper, PE or PP films. Use of multilayer films for these food products with vacuum or gap packaging has just started.

Convenience foods in the country are in consumer packages and are produced mostly by tiny cottage and small-scale units. Their packaging is in PE or PP pouches for short shelf life requirements. Occasionally multilayer films are used, or attempts are made at marketing ready-to-eat foods in retort pouches. Some have been made in the case of liquid beverages, though the traditional glass bottle holds its place, although tetra-pack cartons are now used to a considerable degree. Packaging in multilayer film pouches is likely to increase as single-use pouches eliminate adulteration and polyethylene terephthalate (PET)-containers for some liquid products may become popular.

The proportion of meat and poultry products packaged in bulk and consumer packs is 8 percent and 15 percent, respectively, with dressed poultry forming the major portion of the latter. Over the next five years, more of the dressed poultry is likely to be packaged in shrink pack with multilayer pouches. With fish

and fish products, not much shift in the packaging style is expected, except that more dry fish will be prepacked in PP or PE pouches and a greater quantity is likely to enter the market.

Tinplate, in spite of competition from plastic, continues to occupy a dominant position in packaging foodstuff, which could be due to the severe climatic and sanitary conditions in India. Its estimated annual compound growth rate (10 percent) is, however, lower than that of plastic (13 percent). Glass bottles, which form only 3.6 percent by value of the total packaging material used, may maintain a growth rate of 12 percent, indicating that the advances of plastics have not hindered their demand. In the case of plastic the overall growth will be 80 percent over the next five years, and the maximum growth will be in composites/ multilayers (162 percent) which have the ability to partially replace tinplate.

The CFB box emerges as the predominant exterior transport package, with an annual growth rate of nearly 12 percent. In the case of traditional packaging materials, use of wood will further decline, bamboo and mat baskets will increase and the overall demand will slightly increase. Woven plastic, multi-wall papers and plastic sets will register the highest growth rate if they are allowed to compete with jute sacks without restriction. They could increase their share in food packing from only 0.43 percent to 14.4 percent in value, surpassing jute sacks. On the whole, the growth of food packaging during the next few years will be 76 percent by value but only 46 percent by quantity. This is due to the expected shift towards the use of more efficient packaging material.

Proper packaging can prevent food grains wastage. FAO surveys indicate that average postharvest wastage in India ranges between 10-26 percent in respect of various food products. For fruits and vegetables, the figure varies between 18-33 percent and for roots and tubers between 12-26 percent. Also a huge amount of food grains is lost every year due to improper packaging and storage. About 5-10 percent of grains are lost in rural storage structures and about 2 percent are lost in transit and storage under their procurement operations. According to a paper presented on the application of plastics in postharvest agriculture during 'Agro-Tech', it was observed that in a country like India where over 30 percent of population is below the poverty line, half of the battle against hunger could be won if we could prevent this enormous wastage, by introducing proper packaging during storage, transport, distribution and retail sales.

The experts were of the opinion that the major causes of wastage were: inadequate storage facilities, improper packaging during storage and transfers, and human factors, including carelessness. Notions such as processed and packaged foods do not remain fresh, processing reduces the food value, packaging is only for aesthetics and advertisement, and other myths had also led to this wastage.

Hence, the objective of packaging is to overcome the problems of storage, spoilage and spillage and also to increase the shelf life of the products for consumption. The packaging should be cost-effective and attractive to consumers, having ornamental value as well as practicality, to capture the consumer market.

FUTURE PROSPECTS IN PACKAGING

The food processing industry consumes large quantities of different varieties of packaging material. This offers excellent opportunities to the packaging industry sector for innovation and development.

Modern technology and changes in consumer demand for convenience and packaged foods have been given a boost in the development of new packaging materials. Consumers prefer foods that are perishable to be perceived as fresh and hygienic. This has led to the development of new technology for extension of shelf life, without sacrificing the quality based on packaging.

There is an increase in the demand for new, specific and innovative packaging technology, like "narrow neck press and blow" for lightweight glass bottles, high barrier co-extruded plastic structures, high performing non-foil laminated structures, computer-aided design softwares, and hard fillable plastic containers. Thin wall aluminum cans, PET bottles and tetrabricks have been introduced in place of glass bottles, for packaging of soft drinks and liquid beverages. Paper-based packages are used for export due to environmental friendliness. Metal packages will continue to account for a substantial share of packaging of thermally processed products. Lightweight heat-sterilizable glass bottles are also used for packaging of fruits and vegetable products, meat products and baby foods. Use of plastic packaging materials is fast growing in the Asian region, and growth prospects are strengthened by the availability of popular resins.

Specific key products and technology needed for globalization of packaged food products are as follows:

Metal Containers

The metal containers used for food products and beverages are made out of tinplate, tin-free steel and aluminum. The metal container industry in India has responded to the needs of the consumer for convenience, health, hygiene and safety aspects: by use of better technology, innovation and improvement in the quality of canned food products. The liberalization process in India is leading to the availability of world class products, and is increasing competitiveness in the buyer's market. Technological upgradation, innovation and cost-effectiveness of indigenous equipment and processing have been brought about. With these developments, the Indian can-making industry can compete well in the global market.

The Tinplate Company of India Ltd. (TCIL) and state-owned Steel Authority of India are planning a modernization program for its electro-tinning lines. With the availability of indigenous raw material and reduction in import duties, the local tinplate manufacturers will attract more Indian market share and also will be in a position to capture the export market.

Glass Containers

Food processing in glass bottles has been successfully conducted by many canners in the developed countries. In most of these countries, about 40 percent of the processed food is packed in glass containers, as against 50 percent in cans and 10 percent in plastic containers. About one-third of the total production of glass is used for beverages and other foods.

Foods for processing are packed in heat-sterilizable lightweight glass jars which are 20-40 percent lighter than ordinary glass bottles and are more durable. Hermetic lug-caps are used in glass containers used for packaging of processed and semiprocessed food products. For packaging baby foods in glass containers a "press-on twist-off" cap has been developed, then extended to a number of heat-processed food products. Such caps can be twisted off and also resealed. A few food processing units in India have introduced glass containers for packaging of export vegetables, including mushrooms.

The major technological developments in glass containers are a reduction in weight, an increase in strength and varied shapes. The combination of lightweight glass bottles and a preprinted shrink sleeve in vinyl polychrome or in expanded polystyrene is the future potential for glass containers in food packaging.

Plastic Packaging Materials

Plastic packaging materials are fast growing in the Asian region and growth prospects are strengthened by the availability of popular resins. In rigid form, they dominate for packaging of fruit juices, soft drinks, mineral water, edible oils, spice products and alcoholic beverages. Flexible packages are available in the form of sachets, pouches, blisters and skin-wrap, and bag-in-box.

The planners in India are well aware of the need of proper packaging specifically for foodstuffs. The government has established a separate Ministry to look after the needs of the food processing industry. A number of institutions like Central Food Technological Research Institute (CFTRI) and Indian Institute of Packaging are already in existence to suggest suitable measures to help the industry in its growth to meet the challenges of global competition. Indian exports in foodstuffs have been increasing at a regular pace. Indian exports were of the order of Rs.297 million in 1994-95, which rose to Rs.710 million by 1997-98, showing an almost 250-percent increase within a span of three years (see Annex II). This could be achieved only when Indian exporters could adhere to global world standards in packaging.

The Indian Government has also enacted laws to take care of quality standards, covering all aspects of marketing of raw food, as well as processed foods, which includes packaging. Standards have also been fixed for the particular kind of packaging required to be undertaken, depending on the product to be packed. Some of the laws enacted are as follows:

- The Standards of Weights and Measures Act 1976 and the Standards and Weight and Measures (package commodity) Rules 1977 (SWMA)
- The Prevention of Food Adulteration Act 1954 and the Prevention of Food Adulteration Rules 1955 (PFA)
- The Fruits Products Order 1955 (FPO)
- The Meat Food Products Order 1973 (MFPO)
- The Agmark Rules.

Some of the salient features of various enactments are found in Annex III.

The enactment of rules and regulations is not an end in itself. The various departments involved with the food industry maintain a constant vigil to ensure that requisite standards are maintained.

CONCLUSIONS

The driving force in the internalization of packaging may be attributed to the rapid growth in information technology, communication and transportation. Operation in a global market place requires an understanding of the needs of global customers and knowledge of competitors addressing similar issues. The active promotion of packaging as an industry has to be pursued by accelerated training and professionalism, effective information sharing and dissemination among different countries. Asia is going to influence global marketing strategy and will continue to be an attractive area for continuing growth of the packaging industry. Globalization of products is not possible without packaging. Both have a common objective of bringing products from one place to another in sound condition at an affordable cost.

Food Category Outlook for Packaging Materials and Forms

Packaging Material		Major Commodity
Food Grains and Milled Products:		
Jute sacks		
Woven plastic sacks		Grain
Textiles		
LDPE, HDPE[a]		Milled products
Sugar and Gur (Jaggery):		
Jute sacks		
Woven plastic sacks		Sugar
LDPE, HDPE		Sugar
Mat baskets (million pieces)		Gur
Fresh Fruits and Vegetables:		
LDPE liners/bags		
PP boxes, crates		
CFB		Fruits
Jute sacks		Vegetables
Bamboo baskets (million pieces)		
Processed Fruits and Vegetables:		
Tin (open top sanitary [OTS]) cans		
Glass bottles		Jams and jellies
PP/PVC[b] bottles/cups + composites, multilayer		Aseptic bags
CFB		
Edible oils and *vanaspati*:	Tin (KOT 18 I)	
	Tin (OTS) cans	Oils
	HDPE/PP/PET bottles	*Vanaspati*/oils
	Composites, multilayer	Oils
	Tetra-pack	*Vanaspati*/oils
	CFB	
Milk and Milk Products: (liquid milk, milk powder, infant foods and ghee)		
Tin (KOT 18 I)		Ghee
Tin (OTS) cans		Infant foods
Glass bottles		Milk powder-based
LDPE/HDPE pouches		Liquid milk
HDPE crates		Liquid milk
Compositions, multilayer		Milk powder-based foods
Paper/board cartons		Ghee
Multi-wall paper sacks		Milk powder
Aluminum cans		Liquid milk
CFB		
Bakery Goods and Confectionery:		
Tin (KOT 18 I)		Biscuits
LDPE pouches		Bread/bun
PP pouches		
Composites, multilayer		Biscuits and confectionery
Paper/board cartons		Biscuits
CFB		
Thermo-forms		Confectionery

... To be continued

Packaging Material	Major Commodity
Meat, Poultry and Products:	
Tin (OTS) cans	Canned meat
LDPE liners/PP pouches	Poultry
Paper/board cartons	
CFB	
Fish and Fish Products:	
Tin (OTS) cans	Canned fish
LDPE liners/PP pouches	Frozen and dry shrimp
Composites, multilayer	Fish products
Paper/board cartons	Marine fish
CFB	
Baskets (million numbers)	Inland fish
Liquid Beverages:	
Tin (OTS) cans	Beer
Glass bottles	Soft and alcoholic drinks
HDPE crates	Soft drinks
Alcan composites, multilayer	Fruit and alcoholic drinks
Tetra-pack	Fruit drinks
Paper/board cartons	
CFB	
Wooden crates (million numbers)	
Coffee and Tea:	
Tin (OTS) cans	Instant coffee
Glass bottles	Instant coffee
PE/PP pouches	Ground coffee
Composites, multilayer	Instant coffee
Paper/board cartons	Tea leaf
CFB	
Jute sacks	Coffee seeds
Multi-wall paper sacks	Tea leaf
Plywood tea chests	Tea leaf
Spices and Cashew Kernels:	
Tin (OTS) cans	Cashew
Tin (KOT)	Cashew
PE/PP pouches	Spices
Composites, multilayer	Cashew and ground spices
CFB	
Jute sacks	Whole spices
Textile bags	
Snacks, Flakes, Puffs, Papads, Vermicelli, Noodles, Poha Murmura and Indian Sweets:	
LDPE/HDPE/PP pouches	Snacks, etc.
Paper/board cartons	Sweets
CFB	
PE lined jute bags	Poha and murmura
Convenience Foods (instant mixes and ready-to-eat foods):	
PE/PP pouches	
Composites, multilayer	
Paper/board cartons	
CFB	

Source: *Profile on Food Packaging* compiled by Ministry of Food Processing Industries, Government of India, published in 1995, pp. 6-8.

Notes: [a] Low density polyethylene and high density polyethylene; [b] polyvinyl chloride.

Annex II

Agri Commodities Export

(Unit: Rs. million)

	1994-95	1997-98
Fresh fruits and vegetables		
1. Fresh onions	2,046.1	2,053.7
2. Other fresh vegetables	441.3	1,140.7
3. Dried nuts	606.4	572.1
4. Fresh mangoes	450.3	732.5
5. Fresh grapes	408.5	664.0
6. Other fresh fruits	380.1	721.2
Sub-total	4,332.7	5,884.2
Processed fruits and vegetables		
1. Dried/preserved vegetables	1,465.2	4,729.6
2. Mango pulp	807.1	1,233.1
3. Pickles/chutneys	497.5	790.7
4. Other processed fruits and vegetables	712.3	874.6
Sub-total	3,482.1	7,628.0
Livestock products		
1. Buffalo meat	3,243.7	7,294.6
2. Sheep meat	660.3	615.7
3. Poultry products	88.8	857.7
4. Dairy products	401.1	119.4
5. Animal casings	77.1	115.6
6. Processed meat	12.8	18.7
Sub-total	4,483.8	9,021.7
Other processed foods		
1. Groundnuts	1,013.2	5,609.0
2. Guar gum	1,428.2	5,452.3
3. Jaggery and confectionery	165.1	1,141.6
4. Cocoa products	71.5	87.4
5. Cereal preparation	688.9	1,122.5
6. Alcoholic beverages	462.1	704.4
7. Milled products	41.5	219.9
8. Miscellaneous preparations	278.7	366.8
Sub-total	4,149.2	14,703.9
Floriculture	308.4	785.9
Vegetable seeds	247.7	560.9
Non-*basmati* rice	3,404.0	15,520.8
Basmati rice	8,653.9	16,838.0
Wheat	422.3	424.5
Other cereals	280.3	130.1
Total	29,764.4	71,498.0

Annex III

PACKAGING LAWS AND REGULATIONS

The packaging laws and regulations affecting food products are mainly covered under:

1. the Standards of Weights and Measures Act, 1976 and the Standards of Weights and Measures (Packaged Commodities) Rules, 1977 (SWMA)
2. the Prevention of Food Adulteration Act, 1954 and the Prevention of Food Adulteration Rules, 1955 (PFA)
3. the Fruit Products Order, 1955 (FPO)
4. the Meat Food Products Order, 1973 (MFPO)
5. the Agmark Rules.

As it is beyond the scope of the articles of this kind to elucidate all the packaging rules that come under the above laws, the following paragraphs essentially present an overview.

SWMA

The packaging regulations under SWMA are applicable to all kinds of commodities including foodstuffs, their emphasis being on regulating quantities to be packed and related declarations.

1. ***Standard Packages***

One of the most important rule under SWMA is that commodities for retail sale should be packed in standard specified quantities as given under the rules.

2. ***Errors in Packed Quantities***

The maximum permissible errors in quantities packed for various food commodities and package sizes as per stipulations.

3. ***Label Declarations***

The SWMA requires certain declaration to be made on every retail package, which includes common/ generic name of the product, net quantity, retail sale price, unit sale price, month and year of manufacturing or prepacking, and name and address of the manufacturer or the packer.

4. ***Product Name***

The common/generic name of the product cannot be a coined or fancy brand name and it should be intelligible to all.

5. ***Net Quantity***

The net quantity should be expressed in standard units of weight, measure or number or a combination of weight, measure or number as would give as accurate and adequate information to the consumer, with regard to the quantity of the commodity contained in the package. The declaration of the quantity should be in terms of:

- mass, if the commodity is solid, semisolid, viscous or a mixture of solid and liquid;
- length, if the commodity is sold by linear measure;
- area, if the commodity is sold by area measure;
- volume, if the commodity is liquid or is sold by cubic measures; or
- number, if the commodity is sold by number.

Wherever it is necessary to communicate to the consumer any additional information about the commodity, such information should also appear on the same panel in which the other information, as required by the rules, have been indicated. Additional information like the following is necessary to be given.

- in the case of a concentrate, the dilution ratio of that concentrate.
- in the case of a dehydrated commodity, the reconstitution ratio of that commodity.
- in the case of a package containing, say *gulab jamun* mix, the number of *gulab jamuns* that maybe obtained for the mix and the weight of each *gulab jamun*.

6. ***Retail Sale Price***

Retail sale price is the maximum price at which the commodity in packaged form may be sold to the ultimate consumer and declaration should carry the words `maximum retail price ... inclusive of all taxes'. It should include all taxes local or other wise, freight, transport charges, commission, etc.

7. ***Unit Sale Price***

Unit sale price, the price per specified unit of weight, measure or number should be given if the packed quantity is not a standard package size. Also, the declaration is not required, in case of package of those commodities which are not specified in the Third Schedule and the Sixth Schedule related to the standard package sizes. Further, it is not required in case of commodities not specified in the Third Schedule but packaged in quantities of 100 g, 200 g, 500 g, 1 kg, 2 kg, 5 kg, or in multiples of 5 kg or in 100 ml, 200 ml, 500 ml, 1 liter, 2 liter, 5 liter, and in multiple of 5 liter.

7, ***General Guidelines on Giving Declarations***

As far as practicable, all declarations required to be made under SWMA should appear on the principal display panel.

Prevention of Food Adulteration (PFA)

The PFA Act is basically intended to protect consumer's health and safety. Under these rules, an article of food is termed adulterated if it has been prepared, packed or kept under insanitary conditions whereby it has become contaminated or injurious to health, or if the container of the article is composed, whether wholly or in part, of any poisonous or deleterious substance which renders its contents injurious to health.

1. ***Product Name***

Every package of food should carry the name, trade name or description of food contained in the package. In case of proprietary foods which have not been standardized under PFA, the name of the food or category under which it falls as per these rules, should be mentioned.

2. ***Ingredients***

The names of ingredients used in the product should be listed on the label in descending order of their composition. In case of artificial flavoring substances, the chemical names of the flavors need not be declared, but in case of natural flavoring substances or nature-identical flavoring substances, the common names of the flavors should be mentioned. Ingredients falling in certain classes such as edible oils, spices and condiments, permitted preservatives, flavors, etc., can be listed using their class titles. However, packages weighing 20 g or less and liquid products marketed in bottles which are recycled for refilling are exempt from the requirement of ingredients declaration.

3. ***Name and Address***

The name and complete address of the manufacturer or importer or vendor or packer should be declared on the label.

4. ***Net Quantity***

The label should carry the declaration of the net weight or measure or number of the contents, except in the case of biscuits, breads, confectionery and sweets where the weight may be expressed in terms of either average weight or minimum net weight. In case of packages containing large number of small terms of confectionery, each of which is separately wrapped, PFA has similar provisions as those under SWMA. Also, in case of carbonated water containers and packages of biscuits, confectionery and sweets, containing more than 60 g but not more than 120 g. Particulars of net quantity need not be given as per rules of PFA.

5. ***Batch Number***

Declaration of Batch Number or Code Number or Lot Number which is a mark of identification by which the food can be traced in manufacture and identified in distribution, is mandatory under PFA rules. However, this rule is exempted in case of carbonated water containers and packages of biscuits, confectionery and sweets, containing more than 80 g but not more than 120 g food packages weighing not more than 60 g, and packages containing bread and milk including sterilized milk.

6. ***Month and Year***

The month and year in which the commodity is manufactured or prepacked should be given for all food products except in case of: (i) any bottle or package containing liquid milk, liquid beverage having milk as

ingredient, soft drink, ready-to-serve fruit beverages or the like which is returnable by the consumers for refilling except in case of sterilized or ultra heat-treated (UHT) milk; (ii) any package, containing bread and any uncanned package of (a) vegetables, (b) fruits, (c) ice cream, (d) butter, (e) cheese, (f) fish, (g) meat, or (h) any other like commodity; and (iii) any package of food where the net weight or measure of the commodity is 20 g or 20 ml or less.

7. ***Nutritional Food***

When the food product is claimed to be enriched with nutrients such as minerals, proteins or vitamins, the quantities of such added nutrients should be mentioned.

8. ***Infant Foods***

Infant food under PFA rules means any food which may be used for partial or total replacement of breast milk, commonly called breast milk substitute and includes infant milk food, infant formulae and any food suitable as a complement to breast milk, to meet the nutritional needs of the infant after four months of age, commonly called "Complementary Food", "Breast Milk Supplement" or "Weaning Food", several restrictions are imposed on the use of words or pictures on labels of infant foods.

Fruit Products Order (FPO)

The FPO is concerned with fruit and vegetables products including synthetic beverages, syrups, sherbets and vinegar. The objective of this law is mainly to regulate the quality and hygiene of these products.

The important labeling rule under FPO is that all labels should have the approval of the authorities concerned, and carry the license number allotted. When a bottle is used as the package, it should be so sealed that it cannot be opened without destroying the license number and the special identification mark of the manufacturer should be displayed on the top or neck of the bottle. The batch/code number along with the date of manufacturing should also be declared.

Meat Food Products Order (MFPO)

MFPO, similar to FPO, requires the licensing and labeling of all meat products. All labels have to be approved by the licensing authority and the license number and category or manufacturer should be declared on the label.

The name of the product, always a common name understood by the consumer, should be given along with net quantity. Trade names should have prior approval of the licensing authority. When any preservative or coloring agent is used, a statement to that effect should be given. When permitted artificial flavoring agent is used, the words "Artificially Flavored" should appear on the label in prominent letters and in continuance of the name of the product. The list of ingredients should also be given.

Agmark Rules

Agmark rules relate to the quality specifications and needs of certain agricultural products to be eligible for Agmark certification. They also specify the type of packages that can be used for various products and labeling declarations that have to be given. Some of the food products that have been covered under these rules are edible nuts, ghee, honey, pulses, spices, condiments and vegetable oils.

4. INDONESIA

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INTRODUCTION

Indonesia is one of the countries with an abundance of tropical fruits. Among the most important and well-known fruits in the market is Salak Pondoh (*Salacca Pondoh*).

Over the last decade, postharvest losses of fresh fruits have been very high, around 20 percent, due to bruised, misshapen, and rotten fruits. This has resulted from improper handling after harvest, lack of knowledge about good packaging, and the fruits being quite delicate in nature. More recently the losses due to bruising have been decreasing. This is particularly because of quality packaging usage, which provides the fruits with sufficient protection and meets international market needs and standards.

Packaging for Export

The Indonesian Government also realizes the importance of packaging and at the same time has been providing indirect promotion, over the past two decades.

Nowadays the packaging used consists of traditional bamboo baskets, wood boxes, plastic boxes and corrugated carton boxes. These corrugated carton boxes are considered to be most suitable for export packing, especially for tropical fruits, as they can be made in suitable sizes, formed in a die-cut process, clearly labeled and made in various desired strengths.

For this development to be carried out, the Federation of Packaging of Indonesia and the Institute of Packaging of Indonesia have been assigned to carry out research and development of export fruits packaging.

Their main task is to improve packaging standards and at the same time to promote Indonesian products overseas, with one principle, namely; "the customer will not be satisfied with any product they really do not want and need, even though the products have been perfectly produced".

Information on market requirements and fruit characteristics is collected for a database on packaging development. Laboratory tests of prototypes should be done before transportation testing. Another important aspect is graphic design, accompanied by specifications of the new package development. Then finally the package development should be promoted for wider usage.

Prototype Development

Prototype development involves package structure development, where the protection against mechanical damage constitutes the main function. In general, structural development is known as any choice of adequate packaging materials, as well as development styles and dimension of packaging, in units of strength and usage efficiency.

Between the storage room, handling and transportation, there are three main points to be observed:

1. ***The Material Used and Packaging Type***

The corrugated carton boxes are chosen from various materials for prototype development, because of their easy availability, easy workability, attractive formability and ability to be recycled. However, corrugated carton boxes will lose their strength due to humidity. Therefore, the materials used should have a water absorption limit of <100 g/m^2. The packaging type which is suitable to use for Salak Pondoh is die-cut, through an interlocking system, as it constitutes an active packaging type where some ventilation can be given without decreasing its strength.

2. ***Package Dimensions and Its Graphic Design***

A package will match needs if a market survey has been done, based on quality function development where the customer's need becomes the main factor. Attention should be paid to the size of boxes, the popular size being 120 x 100 cm. The relevant sizes for the said package are around:

a) 60 x 40 cm
b) 50 x 30 cm
c) 40 x 30 cm
d) 50 x 40 cm

The height of the boxes is not standard, but varies in accordance with the type of product and its weight.

3. ***Mechanical Strength of Packaging***

The main characteristic for fruit boxes is package composition and strength. The first consideration, which influences the essential strength of composition, is the height to which the boxes will be arranged. In a shipping container, the height of the composition is not more than 2.2 m, where the said boxes must also be resistant to vibration and humidity.

Testing

As an initial step, a laboratory scale test helps considerably in deciding the quality of packaging, because the packaging quality can be measured by using small samples. Then the damage can be observed based on one of the standards, such as ISO (International Standard Organization), ASTM (American Society for Testing Materials), JIS (Japanese Industrial Standard), BS (British Standard), etc. The said packaging quality can be improved immediately. Some tests normally used are:

1. ***Compression Test***

In general, a dynamic vertical compression strength, which can be directly connected to specification of packaging effectiveness. Another clue to quality is on the basic of resistance to compression power, determined in advance by the constant speed of the packaging box.

2. ***Drop Test***

This involves a choice of the distance and the field in which the box can be dropped, giving a test result approaching an accurate one.

The test method regarded as approaching the true one is one of the standard ISO recommendations, in which the distance is measured by reducing weight from the box in kilogram units after dropping the filled box from a height of 70 cm, formulated in duplicate.

3. ***Vibration Test***

This test is used to know the influence of vibration during the handling under commercial transportation conditions. Hence the strength of the said packaging can be known.

4. ***Transportation Test***

In addition to the laboratory work, a trial delivery is actually made using newly designed boxes which have been recommended, to make sure of the test result, before making a decision on final package specifications. This step involves a high cost and requires good planning.

Close cooperation with exporters and importers is needed.

Graphic Design and Promotion

The main function of graphic design of boxes is to provide information by making symbols for the labels. This gives information on handling and transportation and identifies the product, as well as the company's name that is responsible for the product and its sale.

In general the information should cover as the following:

* Brand image and product name, printed with clear letters and colors
* Ingredients listing
* Net weight
* Product address
* Expiry date
* Symbol for recycling or reuse.

If the packaging is well designed, it will be an indirect promotion for the packed product.

CONCLUSIONS

Over the last decade, fruit packaging has increased especially in the export sector in Indonesia. Today, the main advantage resulting from the improvement of packaging is reducing losses from mechanical damage.

In the future, it is hoped that modern packaging techniques will be used more, to lengthen the storage duration of fruits and keep the quality of nutrition as well as their interesting external appearance.

The raw material for packaging should be made from material that is easily recycled, does not contain heavy metals and does not bring about environmental contamination.

5. ISLAMIC REPUBLIC OF IRAN

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Challenges in Food Packaging

The two main problems faced by the food packaging industry in Iran are that of equipment availability and of packaging raw material availability. The fact that these are both imported has led to very high prices for local producers. In addition the constantly changing technologies require replacement of equipment on a regular basis.

In order for the food industry to achieve in the newly globalized economies, there is a need to upgrade quality and to identify and meet the market needs.

For example, a local mineral water factory bought a Polyvinyl Chloride (PVC) bottle-making machine from France over 12 years ago. After four years, however PVC was banned for use with mineral water. Then the Polyethylene Terephthalate (PET) bottle was introduced. Meanwhile the factory was besieged by problems of environmental pollution and the factory will now be closed.

In terms of raw material costs, sometimes the packaging is more expensive than the food product it contained. Iranian artisans have of necessity had to copy imported machinery at this stage in the country development.

Overall the food processing and packaging industry involves high volumes and low 'benefits' (or profits), which also raises challenges in regard to transportation and storage costs.

Recent Changes in Food Packaging

Industrialization over the past century has had considerable impact on lifestyle in Iran. People have to face time shortages as they live and work under quite difficult conditions.

The introduction of improved technologies such as food packaging, has been addressing these needs. Food producers and suppliers could only remain in business if they adjusted to the changing situation. In particular food packaging is a key factor in making food easily available and improving its availability in line with these changes.

For example, fresh fruit juice is less readily available, as it is packed in tetra-pack these days. Similarly, soft drinks which were filled into returnable glass bottles, are now packed in one-way disposable (or recyclable) PET bottles and cans.

In regard to meat products, people prefer to buy packaged meats in place of raw meat. The food producers are increasing the use of plastic styrene trays and translucent plastic film with vacuum packaging, for the quality market.

A large range of crops are grown in Iran and these range from cereals (wheat, barley, rice) to oilseeds, potato, onion, pulses, sugar beet, and sugarcane. All of these when processed will have packaging needs that must be met by the food industry.

In recent years there has been quite considerable investment in the food industry particularly in the rural areas. Food is regarded as quite strategic in the country and attention is being paid to improved shelf life and ready transportability of packaged products.

Once food is able to be stored in a safe and stable condition, packaging takes on key functions including:

* central role of packaging for preservation.
* secondary role of branding, styling, product quality and information.
* tertiary aspects of installations, delivery, credits, product warranty, sales conditions.

The secondary role has taken on more significance in the eye of the consumer and marketer, as this enables better services to be provided to the users. Other aspects arise such as trade marking and speciality packaging.

It should not be overlooked however, that the primary role of packaging is to provide protection for the food for a known period. In addition, its ability to enable transportation, storage, prevention of mechanical damages, distribution and convenience in final use, is still vital.

Quality assurance in food packaging has an important role to play, especially in the storage of food products, whether under refrigeration, dry storage, cool storage, etc.

Naturally the attractiveness and convenience of the packaging is important in marketing. Not only should the package attract the buyers, but also be suitable for use by the retailers and distributors. Apart from practical design, the package design and appearance need to be kept modern.

Food in its own natural packaging is attractive such as the orange or the egg. These are beautiful creations but not fully practical and humankind has found ways to supplement this natural packaging with food packaging, providing added protection.

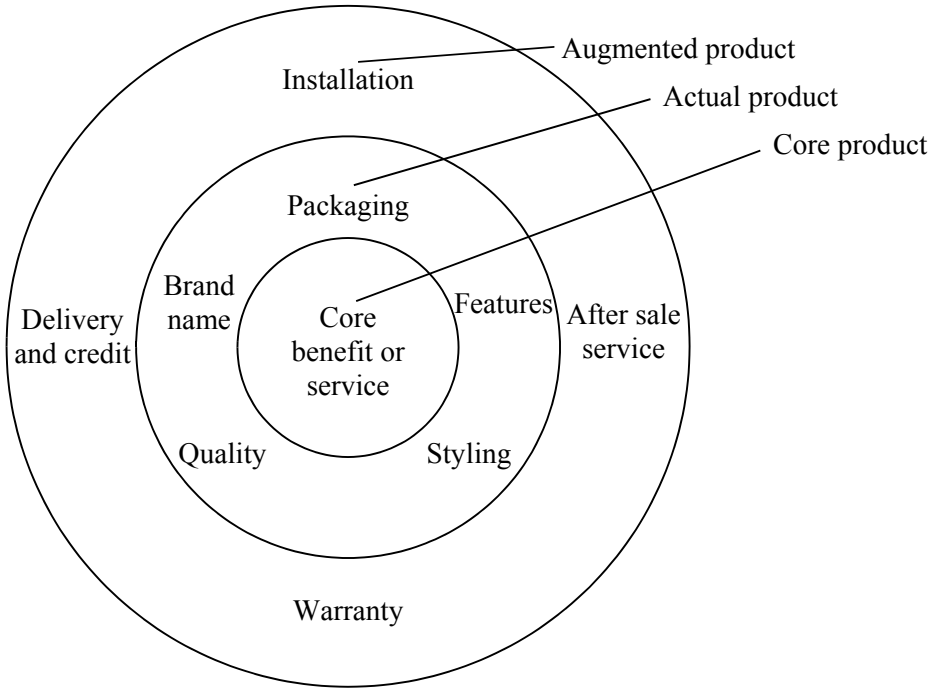
The food packaging industry has become more important and yet is still susceptible because:

* there are so many processed foods which should be packed in better ways.
* food is easily spoiled by infection, changing formulation, and healthy packaging could prevent the early expiry of many products.
* even personal or family food packaging can have messages how to keep it safe for the users.
* food should be seen inside the packages, to reassure the customer.

Producer companies should continue to improve their food packaging in the following ways:

* Establish a known trademark in the market.
* Decide on the types of products to be packaged, potential customers, market situation and transportation system.
* Consult the customers as to their choice of packaging and its convenience in use.

Hence by continuous upgrading of food packaging in Iran, coupled with better design and functionality, Iran will ensure the wider acceptability of its products in other markets.



Three Levels of Product

6. MALAYSIA

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INTRODUCTION

Changes in lifestyle, resulting from urbanization, as well as income and population growth in Malaysia, have increased the demand for processed food generating changes in food eating habits, food purchasing and consumption patterns. Malaysia's food processing industry is dominated (in terms of numbers) by small- and medium-sized entrepreneurs. Over the last five years, there has been an average 9 percent growth in local manufacturing output, with 60-70 percent of goods manufactured locally, for the domestic market. The balance of goods exported are mainly for the ASEAN market. About 70 percent raw materials consumed by the industry are imported (wheat, raw sugar, milk powder, maize – for animal feeds).

Table 1. Number of Applications Received for Establishment of Manufacturing Projects by Industry, 1996-2000

Industry	1996	1997	1998	1999	2000
Food manufacturing	37	64	34	50	79
Beverages and tobacco	4	8	4	4	5
Textiles and textile products	32	30	44	67	48
Leather and leather products	2	1	5	6	-

Source: Malaysian Industrial Development Authority (MIDA), 2001.

However, this increase has not been able to match with domestic demand, resulting in increasing imports especially during 1990-2000 period. Food imports in 1999 stood at RM11.0 billion, compared to RM10.0 billion in 1997 (with the exclusion of animal feeds, food imports would be lower, i.e., RM9.0 billion in 1997 and RM9.6 billion in 1998).

Major food imports include wheat, rice, maize, sugar, dairy products, fish, vegetables, fruits and meat products. The increasing deficit between domestic demand and local production is expected to continue. The recent financial crisis has highlighted the need to pursue more aggressive policies, to enhance food security through expansion in domestic food production and less dependence on imports.

It is also not in the long-term interest of the country to be increasingly dependent on external sourcing for food, as there is an uncertainty in its long-term international supply. However, economic factors limit Malaysia's capabilities in enhancing domestic supply to fully meet her total food requirements.

THE PROCESSED FOOD INDUSTRY

The Malaysian food processing industry is fragmented and largely dominated by small- and medium-sized enterprises (SMEs), many of which are family-owned. There are more than 9,000 food processing factories in Malaysia, of which 95 percent are classified as SMEs. A recent survey conducted by the Ministry of International Trade and Industry showed that these SMEs are the majority group when compared to other SMEs as follows: food processing (18.4 percent), followed by apparel (16.0 percent), fabricated metal products (12.0 percent), furniture and fixture (8.4 percent), wood products (6.7 percent), and industrial machinery (4.8 percent).

Table 2. Malaysia's Per Capita Processed Food Consumption

(Unit: kcal)

Type	1981		1995	
	Amount	Percent	Amount	Percent
Meat	187	27.6	250	30.0
Vegetable oil	148	21.8	198	23.7
Sweeteners	175	25.8	197	23.6
Milk	70	10.3	73	8.7
Vegetable	50	7.4	58	7.0
Others	48	7.1	58	7.0
Total	678	100.0	834	100.0
Growth per year (percent)	1.90		2.08	

Source: Food and Agriculture Organization (FAO), 1996.

These SMEs play a very important role in the Malaysian economy, especially in terms of traditional processed food production and generating employment. They also have a favorable impact on income distribution in the country, and serve as a training ground in developing the skills of industrial workers and entrepreneurs. Thus, this paper will focus on the role of SMEs in the processed food industry.

SMEs are defined as those which have full-time employees not exceeding 150, and/or annual sales turnover not exceeding US$6.6 million. However, most SMEs are family-owned and consist of less than 50 full-time employees. Food processing companies are generally perceived as agro-based industries, which have strong backward linkages. However this is not the case in Malaysia, where it is estimated that over 70 percent of the raw materials used in food processing are imported (Ministry of International Trade and Industry, 1993).

PROFILE OF SMALL-SCALE FOOD PROCESSING INDUSTRY

Small- and medium-sized food processing industries are usually organized as a family business, or have a single proprietor. However, as the industries expand, a partnership normally evolves, leading eventually to the formation of a limited company. The location of the SMEs tends to be evenly distributed. They are found in both rural and urban areas, although some have already relocated in industrial areas. Many small- and medium-sized food processing enterprises operate under a simple organizational structure, consisting of the manager-owner assisted by a few workers. The products are generally relatively cheap and of rather low quality. Marketing is done directly or through agents.

CURRENT STATUS OF FOOD PROCESSING INDUSTRY

Almost all small- and medium-sized food processing enterprises are agriculturally-based industries which include: meat processing, dairy products, fish products, vegetables, root crops, fruits, coconuts, spices and cereal products.

Meat Processing

Malaysia has more than 32 companies which are involved in meat processing. The major products are sausages, canned chicken and canned pork. Long-life cooked meat dishes in pouches are processed for both domestic and export markets. In a small-scale processing operation, meat is made into various traditional food products such as meat floss, dried curried or spiced meats, and meatballs. Meat used in this industry is imported from India or Pakistan as frozen meat because it is cheaper compared to local meat. There are more than 50 small-scale entrepreneurs actively involved in these small-scale industries.

Dairy Products

The dairy product industry is largely dependent on imported dairy milk powder. At present, Malaysia's imports of dairy products show an annual growth rate of 11.5 percent. Milk powder is normally re-packed

or processed further into products such as sweetened condensed milk, ice-cream, yoghurt and flavored drinks. Malaysia is also producing some fresh milk for local consumption. This is either sold as fresh milk or processed into '*dadeh*', a traditional yoghurt drink flavored with, e.g., cocoa or rosewater. These activities are being carried out under the supervision of the Veterinary Service Department of Malaysia, which has processing facilities at its milk collecting centers in various parts of the country. These centers also act as marketing outlets for the fresh milk produced by small-scale dairy farmers, who own a few dairy cows.

Fish Products

On the coast of Peninsular Malaysia, especially in the states of Kelantan, Terengganu and some parts of Pahang, fish are processed into snacks called '*keropok*' (dried fish crackers). More than 100 small-scale processors are engaged in this business. Other popular products made from fish are fishballs, salted dried fish and fermented fish. These activities are mostly located near fish landing sites. Anchovies are dried and sold as dried anchovies, for which there is a very good market demand in Malaysia. In some areas, anchovies are processed by fermenting the fish in a saturated solution of salt for six months to make fish sauce. This product is sold in bottles of various sizes, usually in local markets.

Vegetables

Most vegetables are grown for fresh consumption. However there is some processing of vegetables, such as pickled chili peppers in vinegar, drinks made from ginger, and pickled amaranthus. The main problem in vegetable processing is the shortage of raw materials. Chili peppers are also being used in the preparation of various kinds of chili sauces.

Many small- and medium-sized food processing industries who process chili-based products have to depend on imported dried chilies from India or China. Similarly, the tomato puree, which is used in tomato sauce factories, is imported from abroad. Soybeans imported from U.S.A., China and Canada are widely used to make soy sauce, tofu (bean curd), soy milk and other products. Soybean processing has become a very lucrative business. Today, total sales of the soy sauce industry alone account for more than US$41 million each year, and this is increasing.

Root Crops

The two root crops which are being extensively processed into snack products are cassava and sweet potato. Sweet potato is grown in the tailings left after tin mining, while most cassava is grown in clay loamy soils.

Small- and medium-sized food processing industries are normally involved in the processing of snack products from cassava. Much of it is being carried out by groups of women under the Department of Agriculture, the Rubber Smallholders' Development Authority, and other government agencies which are involved in the eradication of poverty in Malaysia.

In some places, cassava is being processed into snacks by grating it and mixing it with flour and other ingredients. The mixture is then molded into 2-5 cm diameter cylinders, steamed, cooled and dried in the hot sun or mechanically dried before being deep fried. This type of product is available in various flavors and colors.

Fruits

Many different kinds of fruits are grown in Malaysia, except pineapples which are mainly grown on a small scale. Pineapple is normally processed into canned products such as pineapple cubes in syrup. Small-scale food processors mainly use pineapple for dried products, pickles, jelly, confectionery, fruit juice and cordial drinks. Fruits such as jackfruit and guava are processed by being dried, pickled, or made into jam and fruit drinks. Bananas are widely used in snack food production and packed in plastic. Products of this nature are normally processed by women's groups, under the supervision of various government agencies involved in improving the livelihood of rural people. This type of venture tends to expand as time passes, particularly in terms of technological improvement, product diversification and market coverage. Banana snacks available in plastic packs of various sizes, are normally graded into various categories based on shape, size and color, in line with market requirements.

Coconut

Coconut palms are found abundantly throughout Malaysia, and are grown on plantations as well as by smallholders. Coconut meat is processed into desiccated coconut, instant coconut milk powder, and instant coconut cream powder. These products are being manufactured on a large scale to cater for local and export markets. Products from small-scale food processors are limited to a few product lines such as coconut candy, bottled coconut sap and palm sugar. These products are sold domestically. The scale of such processing is small, and methods of production are traditional and very laborious. Other products from coconuts are canned green coconut milk, *nata de coco*, various hard candies, copra, vinegar and '*kerisek*', a local product made by roasting grated coconut meat and grinding it into a paste. *Kerisek* is widely used in traditional cooking.

Spices

At present there are more than 150 small-scale processors of spices, most of whom produce around 100-200 kg of finished product per day. Ground pepper and curry powder are common spices, but each processor produces more than one product line and the products are packed in plastic. Marketing is normally confined to the local community. Malaysia's spice industry is worth more than US$12 million per year, and is continuing to expand. The technology for producing spice powders is very simple. Coarse grinding is followed by fine grinding. In some factories, a more advanced grinding machine is used. The preparation of mixed spices has undergone some changes quite recently. In place of the traditional dry powders, many consumers prefer various forms of paste. These are relatively new products, and are more convenient to use. These products are packed in glass bottle. The spice industry in Malaysia is heavily dependent on imported raw materials such as dried chili peppers from China and India, and cloves from Indonesia. Tumeric, coriander seed, cumin seed, cinnamon and other spices are also imported.

Cereal Products

Wheat is the major grain used in the manufacturing of biscuits, bakery products, noodles, cookies and snack products. Malaysia is an importer of wheat grain, which is milled into wheat flour and processed in various ways. Bread is widely consumed in Malaysia, and is produced by more than 1,000 bakeries throughout the country. Most of these are small, and make cakes and pastries as well as bread. The capital cost for setting up a bread factory is around US$70,000-80,000. Supermarkets, minimarkets and retail shops are the usual market outlets for this type of product.

Rice is used in the manufacture of vermicelli, pastries and various snacks. These products are made by small processors in both urban and rural areas. Wet products made from rice are numerous, including traditional cakes and buns.These products are packed in plastic and sold at food stalls, school canteens, restaurants and markets.

MAJOR ISSUES AFFECTING THE PACKAGING OF PROCESSED FOOD

Many food products which are processed by small-scale entrepreneurs are highly acceptable to consumers. These products have the potential to expand their market size, however the establishment and successful operation of small-scale food processing enterprises face several constraints such as insufficient supply of good quality raw material, low level of technology, quality problems, competetive market and lack of finance.

Insufficient Supply of Quality Raw Materials

Vegetable production in Malaysia is mainly on a small scale. Mixed cropping is practiced, and farmers grow crops mainly for fresh consumption. There are usually insufficient surplus vegetables for processing.

Meat produced locally is not economical to use in the meat processing industries. Therefore, the meat processing industries have to import frozen meat from India and Pakistan which is much cheaper compared to the local meat.

Fruits are normally seasonal and perishable. Malaysia lacks a proper postharvest handling system for fruit except on commercial farms. Since fruit is grown on many small scattered farms, collection is inefficient and quality is inconsistent. Some raw materials such as soybean and dried chili peppers are imported, since it is cheaper to import them than produce them locally. Thus, an insufficient supply of good quality raw

material prevents the food industry from operating on a larger-scale production or making a bigger investment in packaging and processing machinery.

Low Level of Technology

Small-scale food processing enterprises generally use traditional methods of processing such as pickling and snack food production. This is because of financial constraints, which means that they cannot afford sophisticated machinery and lack technical information. In addition, SMEs cannot afford the cost of maintenance for such machinery. Sometimes repairing is time consuming due to the lack of spare parts which need to be imported.

Research and Development

Most SMEs have no research activities undertaken at factory level due to lack of food technology know-how and financial constraints. Therefore, product improvement or new product development also do not take place at the factory level.

Competitive Market

Many small-scale food enterprises are all processing much the same type of products, such as sauces, snacks, beverages and bakery products. These items require a low initial capital investment and a low level of technology. Because of the number of firms involved, they face tough competition in terms of market share. Therefore, the SMEs cannot grow properly due to low turnover. However, some entrepreneurs are able to expand their enterprises, because they are innovative and have an aggressive market strategy.

Quality Problems

Although some products produced by small-scale food enterprises taste better, compared to products prepared by large manufacturers, the product quality is inconsistent, due to lack of quality control facilities or awareness of the need. Therefore, packaging the product in better packaging material is not economical on its own.

Lack of Finance

This is a common problem facing small-scale food entrepreneurs. Many SMEs start their food manufacturing business without considering the real financial needs of the project. Hence they realize the financial constraints only midway through the project. Financial institutions have more confidence in big industries, while small-scale industries have little collateral. They also have problems in preparing a project proposal to show the viability of their business and its future plans.

THE DEVELOPMENT OF PROCESSED FOOD PACKAGING

To support the growth of food processing enterprises, an Industrial Master Plan was introduced in the 1980s. This was followed by the Second Industrial Master Plan (IMP2) 1996-2005, which charts the strategic directions and strategies for industrial development for the decade, sets in place policies and programs to further develop and integrate the domestic SMEs. These are the critical and strategic link in the development and strengthening of industry cluster formation, and increase domestic value-added, thus ensuring that Malaysian products can compete in globalization and changing trade environment. It also aims at achieving a balanced development of agriculture and industry, with improved integration of the two. Government incentives to develop agriculture will lead to increased efficiency in the food processing industry. The government's commitment to assist in the healthy growth of the private sector is seen in its implementation of the IMP, which sets the framework and guidelines for the establishment of new industries. This represents an important measure taken by the government to attract private investment to areas offering greater comparative advantage.

For food processing, the specific development objectives of the IMP are as follows:

1. To develop a modern food processing industry, meeting Malaysia's food needs, in conformity with modern hygienic standards;

2. To establish export-oriented as well as import-substituting products; and
3. To develop industries which utilize more local raw materials and substitute for imported raw materials.

The Malaysian Government has various policies and incentives to assist SMEs, in order to sustain and maintain their competitiveness. These include Pioneer Status Incentives, finance and credit facilities/funds, Human Resources Development Fund and research and development facilities. In addition many government agencies such as Federal Agricultural Marketing Agency and Malaysia Agricultural Research and Development Institute (MARDI) are also involved in supporting the SMEs by providing technical expertise and marketing assistance.

THE FUTURE PROSPECTS OF PROCESSED FOODS PACKAGING

The packaging materials used can be broken down into the following standard areas: glass, laminates, metal, plastics, paperboard, of which about 60 percent are utilized for the food and beverage packaging industry. In Malaysia, there is a dependence on products which utilize domestic resources, primarily plastics, glass, paperboard and aluminum tin cans. As the economy improves and matures and the consumer market becomes more affluent, a trend toward greater use of glass and laminates will be more evident. Plastics and glass are the major materials used for food and beverage packaging by SMEs. Almost all SMEs use these two types of packaging materials since these are very popular, easy to use, cheaper, and easily available. The use of plastic is very common because this packaging can be made into different sizes, suitable to the need of SMEs, which buy these types of packaging at any minimum quantity needed from sundry shops or at the supermarket.

Plastics are used in traditional snack food industries, meat floss processing industries, bakery, biscuits, and beverage industries use plastic bottles. Glass bottle are widely used in food industries that need hot filling packaging, such as in chili sauce production, soy sauce production, fish sauce production, jam and jelly, spices paste and some other industries such as salted fish, fruit and vegetable pickles. The wide use of glass in food industries in Malaysia is because it is easily available, low priced and easy to use. By using plastic and glass there is no need for sophisticated machinery and packaging can done manually. However, larger food manufacturers' patterns of food packaging are strongly tied to consumers' preferences and the particular manufacturing set-up. Lighter and more compact packaging is being improved with polyethylene terephthalate (PET) and high density polyethylene (HDPE) replacing plastics while aluminum is replacing steel and tinplate. Laminated packages are benefiting from demand for snack foods, convenient meals and long-life dairy products. Extending shelf life is emerging as a priority at the retailer. Unfortunately for the SMEs, they cannot follow what the big manufacturers are doing because of financial constraints. Laminated packaging, aluminum foil packaging, retort pouch or tetra-pack packaging is very expensive. The SMEs cannot buy these types of packaging in small quantities and the packaging needs sophisticated machines which SMEs cannot afford.

CONCLUSION

The food industry has great potential for development in view of the growing population, change of lifestyle and eating habits, particularly when problems such as supply of raw material are resolved and consumers' prejudices are reduced. Modernization of packaging material, equipment and methods will proceed, while technological improvements will continue to be introduced into the industry. Small-scale food enterprises will continue to play a very important role in the Malaysian economy, particularly in terms of employment generation, better income distribution and as a training ground for entrepreneurs before they invest in larger enterprises. Small-scale food enterprises also have important linkages to related industries such as the manufacture of machinery, food packaging materials, and suppliers of food ingredients. It is envisaged that small-scale food enterprises will continue to expand in line with policies and incentives introduced by the government. The establishment and successful operation of small-scale food processing enterprises face several constraints such as insufficient supply of good quality raw material, low level of technology, quality problem, competitive market and lack of finance. Plastics and glass are the major

materials used for food and beverage packaging by small-scale food processing enterprises. However, for larger food manufacturers, their patterns of food packaging are strongly tied to the particular manufacturing set-up and consumer preferences. A lighter and more compact packaging is being improved with PET and HDPE replacing plastics, while aluminum is replacing steel and tinplate. To maintain industrial growth, the Malaysian Government has various policies and incentives, applicable to food processing industries. Many government agencies are also involved in supporting the development of small-scale food processing enterprises by providing technical expertise, financial and marketing assistance.

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7. MONGOLIA

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PRESENT STATUS OF FOOD PRODUCTION AND PACKAGING INDUSTRY IN MONGOLIA

The traditional Mongolian diet is made up largely of meat and dairy products, the nomadic peoples of the steppes being self-sufficient in these commodities. Other than candles and flour, there is little that the steppe dweller requires from his urban counterpart. The flush of milk from the summer pasture growth is turned into products such as yoghurt, butter, cheese, and dried curds that could be stored for the winter. The nomad is helped in this by Mongolia's dry, cold winters.

Under central planning the national herd was collectivized and produce was purchased by the state. With the move to a market economy all restrictions on private livestock ownership were removed. A percentage of the milk and meat produced is still marketed through the recently privatized milk and meat processing plants, where hygienic control and some degree of packaging is maintained, but increasingly private livestock and dairy producers sell directly into retail markets in urban areas.

Meat and milk are delivered to urban markets by private producers, untreated and unpackaged. Milk is frequently sold by individual producers directly to the end-consumer from 40-liter bulk churns. The buyer either drinks the milk at the point of purchase from a bowl provided by the seller, or takes the milk home in his/her own container. There are obvious public health implications. Meat carcasses are displayed uncovered and unprotected in markets. After purchase meat will usually be packed in a plastic bag which may be provided by the seller. Often the buyer provides a plastic carrier bag. Similar practices can be observed with locally produced flour, vegetables and imported fruit rice and sugar. All are displayed in bulk and weighed at the time of purchase.

At the same time, a wide range of imported food products in western style packaging are sold in markets, retail shops and street kiosks. Imported cakes, biscuits, beers, soft drinks, dairy products, pasta, noodles, tinned meats and fish, preserved vegetables, jams, confectionery can all be found. Many of these products are likely to appeal to younger buyers, and point to the way in which the demand for food products and packaging in Mongolia is set to develop.

Mongolia has a young population, 60 percent of the population is under 24 years of age. The prevailing taste in terms of music, dress and lifestyle in this group is clearly western influenced. Young Mongolians dress in the same clothes as their American and European counterparts, western youth music plays in discos and bars in Ulaanbaatar where young people drink imported beers and soft drinks. American league basketball is screened nightly on Mongolian television. This interest in Western style, sport and leisure activities is likely to be accompanied by increasing demand for Western style packaging and presentation of food products. If this demand is not met by Mongolian food producers it will be met by imported food products. This market for Western style packaging and presentation is likely to grow quickly relative to other markets in Mongolia, and Mongolian food producers, processors and packers need to be ready to meet this demand if they are to maintain market share in the face of competition from imported products.

Food Packaging in Mongolia

Current shortages of packaging materials from local manufacturers, and the need to import from China or Russia, encourages food industry business managers to want to set up their own primary packaging manufacturing operations. Packaging material production is an industry where there are considerable economies of scale, and food industry business managers need to understand that their products can only be competitive against imports if their packaging is competitively priced. This is unlikely to be the case if all packaging manufacture is on a small scale, by individual non-specialist companies.

Table 1. Production and Imports of Food Products

Agricultural Production (/person)	2000	Food Products Imported	2000
Meat (slaughtered) (kg)	119.9	Vegetable oil (piece) (bottle)	9.1
Milk (liter)	152.1	Sugar (kg)	34.7
Butter (kg)	6.1	Rice (kg)	29.1
Eggs (piece)	117.9	Fresh fruits (kg)	15.5
Cereals (kg)	246.1	Beer, soft drinks (bottle)	32.2
Potatoes (kg)	63.2	Preserved vegetables (piece) (cans/jars)	64.8
Vegetables (kg)	30.1	Noodles (kg)	34.2

Wood-based Packaging

1. ***Wood***

Small wooden crates locally manufactured are used in a range of industries from baking, fruit and vegetables. These crates would appear to be generally adequate, although some users complain that they are relatively easily damaged when transported outside of Ulaanbaatar, and are unsatisfactory for delivery purposes. This wooden crate packaging is now being used by a limited number of vegetable and bakery producers.

2. ***Paper and Board***

No manufacturer of packaging paper from pulp is operational in the country. Some companies (that are mostly engaged in producing dairy and confectionery products) order their paper packaging from small-sized printing companies. But the printing houses import the print and wrapping paper mostly from China, Russia and Finland.

"Monpak" is the only company that serves as a supplier of carton. It imports sheet carton and board material from China, and cuts, folds and prints sheet material into a range of packing boxes. "Monpak" has tended to concentrate on smaller packs for confectionery, cosmetics and dried curds. There is only one company in the country that has been invested in tetra-pack. It also supplies in the market the paper fruit juice container (200 cc). They import the paper box from China in a sheet format and cut and fold in Mongolia.

Plastic-based Packaging

There are few plastic converters in Mongolia, and they have only been operating for the last two years. They all import their material from China and also have Chinese equipment for blow molding plastic bottles. These companies are producing plastic bottles on a self-sufficiency basis in order to bottle water, juice and soft drinks that they produce themselves.

Glass

No operating producer of glass packaging exists in Mongolia currently. There was one factory in the country that was producing glass bottles, but had to cease operations in 1993. The principal reason for the closure was said to be high production cost (fuel), and inability to compete with imported Chinese glass. Substantial quantities of the glass bottles and jars are now imported from China or Russia. APU (the biggest brewery producer in the country) alone imports 2-3 million bottles annually. Some big and small brewery and vegetable companies collect and recycle the glass bottles and jars by buying from consumers.

Metal-based Packaging

Other than Makhimpex, the former meat processing plant, no large-scale user of tinplate is operational. They import tinplate from Russia and re-form it on German equipment they possess for production. Given the economies of scale in can production and rising prices of tinplate and alternatives, there is no potential for the establishment of further can production or filling operations.

FUTURE NEEDS TO IMPROVE PACKAGING INDUSTRY IN MONGOLIA

There is potential to add value to Mongolian processed food products through improved packaging. This in turn should lead to economic and financial benefits through import substitution, increased export potential, employment creation and potential savings in public healthcare services.

Potential developments in packaging industry in Mongolia include:

* preserved vegetables in glass bottles
* vacuum packing equipment for meat and cheese
* plastic bottles and carton packaging for milk and dairy products
* form, fill and seal equipment for packaging dairy products
* plastic bottles for pharmaceuticals
* upgrading of label printing technology
* production of egg trays, paper trays and fruit packaging from waste paper.

Interest expressed by company management in specific packaging technology is summarized below in Table 2.

Table 2. Interest Expressed by Company Management in Specific Packaging Technology

Type of Companies	Technology Needed
Flour companies	Paper and propylene sack, shipping cases
Dairy companies	Vacuum packing in plastic, plastic bottle, paper containers, plastic jar, shipping cases
Brewery companies	Glass bottle, beer can, plastic case, plastic bottles, juice paper container
Agro-vegetable companies	Glass bottle, glass jars, plastic case, vacuum packaging, shipping cases
Meat companies	Vacuum packing in plastic/aluminum, shipping cases, plastic shrink wrap for shipping packaging
Pharmaceutical companies	Small plastic bottles, wrapping paper, plastic blister packs

Source: D. Kherlen, 2001.

Mongolia has clearly gone through difficulties in the transition from a centrally-planned to a market economy. These difficulties are reflected in the weak packaging and food processing sectors, as in other sectors of the economy.

The prevention of food losses is of vital concern to small- and large-scale producers, and various measures can be applied at all stages between producer and consumer in order to reduce wastage, improve food security and generate income and profit. Use of appropriate packaging is one of these measures and when properly applied can have dramatic effect on reducing losses.

Furthermore, proper packaging needs to take place as quickly as possible if Mongolian food products are to compete against imported food products, in particular in self-service stores that are now increasingly beginning to appear in Ulaanbaatar.

8. NEPAL

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PRESENT STATUS OF PACKAGING INDUSTRY IN NEPAL

It is obvious that the private sector can play a vital role in the application of packaging technologies in Nepal. The distribution of wholesaling, retailing of packed foods and development of the infrastructure facilities, such as technically-trained manpower, computer-based packaging information system and adequate rules and regulation to monitor qualitative packaging systems, are not satisfactory. Every country today is in the pursuit of upgrading technologies to improve quality and productivity. Raw materials are explored from different sources, namely; natural, mineral and synthetics with emphasis on renewable materials and energy. Nature-based materials enjoy an edge, and packaging, too, is in the pursuit of the same goals. Developing countries like Nepal together with the private sector also, intend to progress towards new packaging technology. New technology as regards to packaging machinery and materials are not available in the country, so, it has to be imported from other countries. The new technologies adopted by the private sector for processed foods are instant noodles, biscuits, milk foods, processed fruit products and beverages. The packaging technologies for processed foods, at a global level, are highly improved. The neighbors, China and India, are also following the global trends in packaging technology. As Nepal is landlocked and has limited marketing potential, it could not reach the level of new technology. However, the private sector is moving towards introducing the new technology in packaging.

Problems of Packaging Industries

At present, there are two governmental agencies directly or indirectly concerned with packaging. They include: (i) Food Research Laboratory under the Ministry of Agriculture; and (ii) Department of Standards under the Ministry of Industry.

These two organizations are centering their attention only on the contents of the packaged foods. They do not pay much attention to the quality and type of packaging. This is because the normal consumer, whose purchasing capacity is relatively low, does not think as much about packaging than about the contents. In our neighboring country, India, there is a separate institution "Indian Institute of Packaging (IIP)" established for the development of a packaging industry. It is the right time to establish a separate institution in Nepal for packaging, with the initiative of the private sector. Government has to play a catalytic role to establish such type of institution. Packaging materials as well as packed products have been normally imported from foreign countries. Nepalese Government has a big task to dispose of the waste products from this including packaging materials. A recycling system has not yet been started, either by government or by the private sector. Rather the task of waste management has been so far done by the government. Some of the challenges are:

* lack of adequate clear cut government policy
* lack of educational institutions on packaging design and engineering
* lack of information about new technology
* lack of adequate technically trained manpower
* inadequate access to the credit facility
* limited marketing areas.

Industrial development is picking up after the restoration of democracy in 1990. The previous state-guided economic system has been replaced by a more liberal economy. During the period of state-guided economics, most of the entrepreneurs faced a lot of problems. The fate of the packaging industries was not different.

Future Needs

As Nepal is a developing country, the per capita income of Nepalese people is very low. Consumers as well as manufacturers are unaware of the importance and utility of good packaging. Manufacturers have less knowledge, skill and attitudes about packaging technology, except that good and attractive packaging hides weak points of their goods. They are lacking information about different marketing tools. On the other hand, there is a lack of appropriate technologies in packaging at a local level, which could protect the goods from damages. At present, most of the packaging is made of plastic, or paper which directly affects the environment. Therefore, it is necessary to develop new technologies on minimum packaging which do not pollute the environment and can be reused.

CONCLUSIONS AND RECOMMENDATIONS

The world is coming closer, with the help of satellites and audio-visual communications and innovations in computer science. Technology transfer has become a common phenomenum. Nepal would not be very far from the adaptation of new technology in packaging, with the availability of a wide range of new packaging materials, simultaneously changing its packaging operations from manual to automatic. There is a considerable demand from ultimate users for quality packaging. Information about new technology, especially marketing aspects should be given due consideration. In the context of Nepal, easy access to the technology, market and finance for the entrepreneurs could be a significant contribution towards the sustainable development of the packaging industry. The Government of Nepal should initiate seriously the formulation of specific policy for the development of packaging technology. Private sector organizations as well as enterprises will boost themselves towards global trends in packaging technology.

9. PAKISTAN

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FOOD PROCESSING INDUSTRY

Packaging plays an important role in marketing by the agricultural producer. Modern packaging techniques not only protect the products from exposure to damage, but can also increase the income of the producers. In Pakistan, the marketing of agricultural products suffers from the lack of facilities and modern, advanced technologies.

As far as packaging technology used for processed food is concerned, it is practiced at a very small level. Most of the fruit at the peak harvest season goes to waste, because of very low prices in the market, due to a glut in supply. If produce is processed at peak harvest season and canned properly, it can enhance the growers' income as well as increase the shelf life of the product. There are more than 150 processing establishments in the country, which process some of the fruits and vegetables to convert them into jams, jellies, marmalades and canned vegetables. These establishments are not only meeting the domestic requirement but also exporting some of their products to the Middle East. The leading establishments are: i) Mitchell Fruit Farm Ltd.; ii) Ahmed Food Industries; and iii) Nestle Pakistan Ltd. According to an estimate, about 33 beverage establishments operated in Punjab province during 1996-97, whereas there were only 22 during 1982-83, showing an increase of 50 percent within a period of 15 years period. The production of both soft drinks and fruit juices is recorded as 34.8 million bottles and 4.9 million packs, respectively, during 1996-97, which shows respective increase of 89 percent and 175 percent over the production of 1982-83.

The marketing of fruit juices presents a great future, but with the advancement and development in packing systems, any increase in the cost of production is an important element. Major quantities of citrus, mango, apple, guava and tomato fruits are consumed in fresh form. Those consumed largely in processed form are juices, jams, jellies, squashes and pickles, etc. At present, fruits are processed at various places both by organized and unorganized industries. It is estimated that about 15 percent of citrus, guava and mangoes and about 25 percent of tomatoes are processed by the industry. Data on agro-based industries installed in different parts of the country can be seen in Table 1.

The food processing industry in Pakistan can be broadly classified into two different categories: i) traditional and conventional industry; and ii) non-traditional or food industry based on the latest technology. The traditional type of food industry manufactures beverages, cigarettes, sugar, dairy products, confectionery products, marine products, edible oils and ghee. The non-traditional food industry mainly manufactures food concentrates and dehydrated foods.

The food industry includes such industries directly or indirectly associated with processing of food items. These include Rafan Maize Products, Lever Brother Ltd., Wazir Ali Industries, Fauji Cereals, Glaxo, Sunfo Chemical Ltd., Bari Rice Mills, Sugar Industries Ltd., Dittu and Naurus Ltd., etc.

Table 1. Number of Agro-based Food Industries with Value of Production

Industries	Number of Establishment	Value of Production (Rs. million)
Food manufacturing	858	62,235
Dairy products (except ice-cream)	14	1,462
Canning of fruits and vegetables	14	595
Canning of fish and seafood	7	881
Vegetable ghee	54	12,774
Cotton seed oil	83	1,154
Vegetable oils	17	1,366
Rice milling	208	1,298
Wheat and grain milling	259	11,794
Refined sugar	54	19,473

Source: Agricultural Statistics of Pakistan, 1999-2000.

DEHYDRATED FRUITS AND VEGETABLES

In Pakistan at present, fruits are dehydrated using the traditional method of sun-drying in the open. As a result the quality of fruits so dehydrated do not meet international standards. According to modern technology, fruits can be dehydrated with the help of mechanized dehydration methods.

The original moisture content in most of fruits is between 80-90 percent after which dehydration reduces it to around 7 percent. The advantage of the mechanized method is that the taste, color, shape and flavor of dehydrated products is more consistent. Due to low moisture content, the fruits are not wasted by the activity of microorganisms and these products can be kept for a longer duration for consumption during off-season. There are better prospects of exporting mechanized dehydrated fruits, as they will provide reasonable returns and incentives to the growers.

The dried fruits are mostly used in the urban areas and also by the armed forces. Dried fruits are also used for food industries making confectionery and other food products. At present there are numerous dehydration plants in the country that process various vegetables. The installed capacities of dehydrated vegetable plants are not yet sufficient to meet the present and future requirements of the Defense Forces, Pakistan International Airlines (PIA) and five-star hotels in the country.

Mainly tomato, onion, garlic, cabbage, carrots and spinach are dried and used in these organized sectors. If the demand of the general public is taken into consideration, the requirement of dried vegetables would be more than 10,000 mt. Attractive packing of the dried fruits can further increase its demand in the domestic as well as international market.

Introduction of new packaging technology is very important for enhancement of processed fruit in the country. The introduction of new packaging systems should not be introduced without considerable research into the role of packaging within the marketing system. It is normally assumed that packaging improvements could reduce the losses, but at the same time it may cause increases in cost of production.

It is often assumed that the quality of packaging is the cause of postharvest problems, but this may not be the case. More important may be how the packaging is handled in the marketing chain. Existing packaging may be overfilled, poorly stored or mishandled. In Pakistan most of the vegetables are transported in jute bags from the farm gate to the consuming market. These vegetables include potatoes, onions, turnip, brinjal, ladyfinger (okra), *Arvi* and many others, while most of the fruits are packed in wooden crates of 12-20 kg by unskilled labor. The transporters and market authorities do not take care of these fruits and vegetables during the handling at loading and unloading. Secondly, the transporters and the market authorities charge on a per piece basis rather than on a weight basis. This practice results in overweight jute bags and crates. The overweight bags and other poor packaging practices results in damage of the fruit and vegetables.

Many factors need to be taken into account in developing appropriate packaging. The packaging should be developed according to the requirements of the fruits and vegetables. These relate to the type of the produce to be marketed and the effect on it, to any postharvest treatments to be applied, i.e., cold storage, the distance from market, the type of transport and the weather condition on the route to the consumer

market. New packaging proposals may note the current type of packaging in use, the market performance, the size of container required, and whether the containers will be disposed of or reused. Packaging must complement the handling system and method of transport and storage used.

Containers produced from locally available materials will normally be more appropriate than those from imported materials. In Pakistan, in the last decade the exporters of fruits especially mangoes and citrus, used the lightweight cardboard cartons for the fruits. This type of packing has shown higher demand in the international markets. This means that modern technology in packaging will not only increase the life of fruit and vegetable, but also increase the income of producers and/or exporter.

IMPORTANCE OF PACKAGING

Most fresh produce ready for market is in bulk form, large numbers of units of similar size, moved in quantities conveniently handled by one person. This is best achieved by using containers of capacities from 3 to 25 kg up to dimensions of about 60 x 40 x 30 cm. Some commodities, e.g., potatoes may be marketed in 25-50 kg sacks, and other large items, such as whole bunches of bananas, are moved without packaging. Leafy vegetables can be sold loose or tied in bundles, e.g., spinach, turnip, radish, etc., which is the normal practice in Pakistan.

Most developing countries use traditional baskets, sacks and trays to carry produce to markets. These are usually of low cost, made from readily available materials such as dried grass, palm leaves or bamboo. They serve the purpose for fresh produce carried over short distances, but they have many disadvantages in big loads carried over long distances.

Large commercial quantities of produce need better packaging in order to minimize losses and achieve the most economical use of transport. The aim is to protect the produce from damage during handling, transport and storage, also to provide easy handling and countable containers of uniform size. Packages of standard sizes can reduce the need for repeated weighing and can facilitate handling, stacking and loading. A wide variety of package types is fabricated from paper and paper products, compressed cardboard and corrugated cardboard (also called fiberboard), wood and wood products (sawn timber and compressed chips) and plastic material both pliable and rigid. Each type must be considered in terms of its utility, cost and capacity to enhance the value of the produce.

Economy in packaging is always a desirable goal. Improvements in the design and manufacture of indigenous containers might, in the context of the small-scale growers, prove to be a better solution.

10. PHILIPPINES

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INTRODUCTION

One of the most dynamic and important industries in the Philippines is the food processing industry. It plays a strategic role in the nation's economic development as it converts most of the agricultural produce of the country to new value-added products. In 1998, the food processing industry reportedly accounted for 37 percent of the total manufacturing industry (Capanzana, 1998).

At present, the local food industry is estimated at more than 200,000 processors, 300 (or 1.5 percent) of which are active in exports (Tanchanco, Sr., 2000). It is dominated by a handful of large, multi-product, vertically integrated companies (1-2 percent) and a few medium-sized companies, but the bulk is comprised of micro-, cottage- and small-sized companies (90 percent). In terms of geographic coverage, the food processing companies can be found nationwide, with 80 percent located in Metro Manila and major urban centers. Most firms primarily supply the fast growing domestic market, but a few, primarily the large processors are involved in the export of fresh and processed foods. Traditional items like coconut, pineapple, bananas and tuna dominate the country's food exports. On the other hand, export of non-traditional products like ethnic foods (sautéed fermented fish, *kare-kare* mix and other sauces) is slowly gaining wide acceptance in the international market, particularly in areas where a large number of Filipinos reside.

CHANGES/GROWTH IN THE PROCESSED FOOD INDUSTRY

From 1996 to 2000, total food export of the Philippines (Table 1) generally showed a declining trend at an average of 4.2 percent, from US$1.55 billion in 1996 to US$1.29 billion in 2000 (Bureau of Export Trade and Promotion [BETP], 2001). The export market, however, reflected a turn-around from 1999 to 2000 as it slightly increased by 9.32 percent in 2000. Of the total food exports, processed foods (excluding marine products) accounted for 40-percent share in 2000 followed by marine products (fresh and processed) with 31 percent and fresh foods with 29 percent. Among the major processed food exports are prepared/preserved pineapple, desiccated coconut, centrifugal sugar and pineapple juice concentrate. Tuna, on the other hand, dominates the marine product exports (BETP, undated).

Greatly influencing the growth of the food processing industry in the Philippines are the worldwide economic crisis and political problems that have resulted in the fluctuating value of the peso against the dollar, affecting most manufacturing companies including the food processing industry. The economic and political instability has caused domestic and foreign investors to shy away from the country, as well as forced some food companies to either shut down their operations, streamline product lines, or sell out to bigger companies.

The lack of agricultural produce to sustain both domestic and export demand, is another factor that has affected the growth of the local food industry. The seasonality of agricultural crops and the impact created by unfavorable weather conditions, such as the El Niño and El Niña phenomena, have resulted in poor production of agricultural crops, leaving processors with no raw materials to process.

Table 1. Summary of Processed Food Exports by Major Product Groups

(Unit: US$ 000, FOB value)

Major Food Category	1996	1997	1998	1999	2000
Processed Foods*	632,330	589,729	520,019	491,988	512,520
Processed fruits	198,828	195,814	180,378	179,063	201,377
Nuts and coconut products	93,572	96,643	82,346	99,090	80,592
Sugar and sugar preparation	162,549	120,282	118,351	89,673	85,501
Cereal and flour preparation	21,325	36,542	25,501	34,369	29,564
Sauces, spices, mixes and condiments	18,602	18,385	17,564	17,921	19,481
Beverages	14,755	15,732	13,863	12,625	14,214
Dairy production and bird eggs	1,849	1,162	1,244	2,013	13,805
Cocoa and tea preparation	20,798	19,317	16,977	11,037	8,197
Processed vegetables	5,275	4,284	3,697	4,302	3,548
Coffee (processed)	3,319	3,201	1,374	888	1,757
Meat and meat preparation	218	1,095	515	937	1,615
Margarine, shortening, vegetable fats and oils	563	550	537	120	135
Animal feeding stuff	72,835	64,900	45,902	27,358	31,247
Miscellaneous edible preparations	17,842	11,822	11,770	12,592	21,487
Marine Products	431,696	432,433	441,993	370,192	398,246
Fish (live, fresh, chilled or frozen)	14,963	17,579	24,811	21,510	38,589
Shrimps and prawns	153,353	129,036	130,365	127,718	144,825
Tuna	173,931	169,971	203,095	136,634	127,288
Crabs, lobsters and other crustaceans	18,534	23,376	21,856	20,304	25,119
Mollusks	49,310	69,657	49,781	49,563	45,679
Milkfish	528	373	519	525	663
Fish fillet (fresh/chilled/frozen)	5,488	5,436	6,503	9,764	10,214
Other fishes (processed)	15,589	17,005	5,063	4,174	5,869
Fresh Foods*	480,410	408,930	310,595	320,932	379,981
Live animals for food	490	560	67	136	15
Meat	20	10	-	-	12
Cereals	2,490	3,500	470	489	658
Fruits	339,700	320,640	280,233	297,468	354,143
Vegetables	-	-	23,526	21,526	23,669
Nuts and coconut products	-	-	2,789	698	483
Coffee (fresh)	1,290	1,220	1,453	461	430
Cocoa, tea and spices	140	260	2,057	154	571
Dairy products and bird eggs	80	30	-	-	-
Sugar and honey	136,200	82,710	-	-	-
Total Processed Foods	1,544,436	1,431,092	1,272,607	1,183,112	1,290,747
Total Exports	20,542,550	25,227,720	29,496,353	35,032,670	38,077,951

Source: National Statistics Office, 2001; processed by Bureau of export Trade and Promotion.
Note: * Excluding marine products.

Another factor that has affected the growth of the local food processing industry is the opening of the domestic market to foreign competition, as a result of trade liberalization. The influx of imported food products that are priced cheaply, has posed a big threat to the local food processing industry, because consumers are given more choices of the best and cheapest food items. As a consequence, locally processed food products face tremendous pressure as market competition grows tighter in the domestic market.

The entry of various imported food products into the country has likewise brought about changes in consumer preferences, demands and lifestyles. Market-wise, there has been an increase in food products with improved nutritional values and overall quality, as consumers become more health-conscious and quality-conscious. A fast growing segment in the local food industry are food products fortified with vitamins and minerals such as snack foods, noodles, fruit juices, milk, sardines, and cooking oil. Food products that are sugar-free, fat-free, additive-free, or are low in salt and fat contents are likewise becoming popular among consumers.

The increasing percentage of working women and changing consumer attitudes have likewise created a demand for convenient foods, home meal replacements, and ready-to-eat foods such as microwavable foods, instant foods, and single-serve foods. The proliferation of fast food chains and the increasing number of supermarkets, department stores and warehouse clubs, have likewise created a demand for food products in institutional packs, refillable packs or "economy" packs.

STATUS OF THE PHILIPPINE PACKAGING INDUSTRY

The Philippine packaging industry is characterized by the presence of a very limited number of large-, a few medium- and several small-sized companies. The number of companies engaged in packaging was estimated at 300 firms (Board of Investment [BOI], 1999). The types of packaging materials prevalent in the country are glass containers, paper and paperboard, metal cans, rigid plastics and flexible packaging materials.

A profile of the packaging industry (Yam, 2000) showed that from 1997 to 1999, the market share of paper and paperboard packages, glass and rigid plastics remained the same at 34, 14 and 12 percent, respectively. During this period, however, the market share of the flexible packaging industry grew from 17 percent in 1997 to 20 percent in 1999, as it captured the 3-percent loss in market share once held by the metal container industry. The decrease in market share of the metal container industry was attributed to the closure of the National Steel Corporation, the only company converting baseplate to tinplate supplied in the local market.

Expected to exhibit a fast growth rate in the coming years are flexible packages, aseptic paperboard packages, aluminum cans and polyethylene terephthalate (PET) containers. Processed food and beverages such as bottled soft drinks, have started to shift from glass containers to PET containers and aluminum cans, while fruit juices which used to be packed in tin cans are now packed in stand-up pouches or aseptic packages. Condiments such as vinegar, soy sauce and other seasonings have likewise shifted from glass bottles to flexibles.

PROBLEMS/ISSUES AFFECTING THE PACKAGING OF PROCESSED FOODS

Problems associated with packaging materials can be found across all industry classifications. Heavily affected, however, are the food and beverage industries, using roughly 60 percent of the total output of the packaging industry (BOI, 2001).

In a 1998 survey of the food processing industry in key areas of the Philippines, it was reported that about 47.7 percent of the food processors surveyed had problems related to packaging (Capanzana, 1999). Among the problems raised by food processors were difficulty in sourcing out packaging materials, limited options of packaging materials to choose from, variance in pricing, lack of education on packaging, lack of awareness on packaging regulations, and inadequate awareness on the need for quality assurance of packaging materials.

Difficulty in Sourcing of Packaging Materials, Limited Options and Variance in Price

Difficulty in sourcing of packaging materials of good and consistent quality poses a problem to small-sized end-users, who are typically more aggressive in pursuing the export market. Most manufacturers of packaging materials usually require minimum orders which small- and medium-sized end-users are unable to comply with, due to their limited requirement and resources. As such, small-sized end-users only have a limited range of options of packaging materials to choose from, with no choice but to use packaging materials

that are either generic in nature, or of lesser quality, making them unable to respond to current trends in packaging.

Another problem related to the above is the variation in price of packaging materials that are available in the local market. Because of the limited volume of packaging materials needed by small-sized end-users, they are unable to get the same volume discounts given by packaging manufacturers to companies with high volume requirements. As a result, small-sized end-users usually pay for their packaging materials at a higher cost than larger counterparts, making it more expensive than imported packaging materials. Some food companies resort to importing their packaging needs, but often have to contend with other problems, such as long delivery time and large outlays for opening letters of credit.

To supplement the needs of small-sized end-users, the government has allowed the import of packaging materials as well as opened the doors to international packaging material manufacturers. Many local packaging companies have likewise gone into joint ventures with foreign companies to avail of new and emerging packaging technologies.

With respect to quality, the Packaging Institute of the Philippines (PIP) has pushed all packaging plants to get ISO 9000 certification, to enable them to meet the increasing competition both in the domestic and international market. The PIP is a national organization of suppliers, manufacturers and users of packaging materials, equipment and services, which work together to promote recognition of packaging as a science and profession. Packaging firms have been encouraged to strictly implement quality control measures, to enable them to produce good quality packaging materials of consistent quality. End-users, on the other hand, should continuously demand high quality packaging materials.

Low Awareness on Packaging Regulations

There is generally a low awareness on local packaging regulations and other packaging requirements of importing countries, especially among the small- and medium-sized end-users of packaging materials. Most food exporters usually depend on their buyers from importing countries for information on packaging standards, labeling requirements and food contact regulations, due to the lack of local information on these packaging regulations. It is also a common practice among small- and medium-sized companies to copy whatever packaging material or labeling information currently in use by other food companies, only to realize that these are not applicable to their intended market. This need is addressed through the conduct of food packaging and labeling workshops offered by government institutions like the Food Development Center (FDC) and the Philippine Trade Training Center, in cooperation with the Department of Science and Technology.

Inadequate Awareness on the Need for Quality Assurance in the Use of Packaging Materials

There is a weak concern for quality and standards among small- and medium-sized end-users due to the lack of awareness on the need to evaluate the quality and performance of packaging materials for food use. With the exception of large food companies, many small- and medium-sized end-users suffer from lack of education about the many aspects of packaging, particularly on the areas of product-package compatibility, shelf life extension and quality evaluation of packaging materials. Poor buyer information also persists due to the lack of knowledge of available standards for testing and evaluating packaging materials, as well as a lack of testing facilities particularly in the provincial areas.

The concern on the lack of education is expected to be addressed through the conduct of more training courses related to quality evaluation of packaging materials. These courses could also provide updates, on new packaging technologies and packaging trends, on the international front. Efforts to formalize packaging education in the Philippines have likewise been started, with the integration of packaging subjects in the curriculum of some schools like Adamson University and Mapua Institute of Technology.

FDC's Role in Addressing Needs of the Food Industry

To address the training needs of the food industry, the Food Development Center of the National Food Authority (FDC-NFA) prides itself as one of the few agencies engaged in the conduct of training courses, related to testing and evaluation of packaging materials for the food industry. Package testing courses are offered by the Center on a regular basis, with the main objective of teaching R&D and QA personnel from the food industry on how to check and evaluate the quality of their packaging materials. Packaging courses

so far developed include the testing of flexible packaging materials and paperboard packages, metal cans, glass containers and metal containers. Consultancy services are likewise provided by the Center on packaging problems, upon request of food industry clients.

In addition to package testing, the Center is also equipped with modern testing facilities for chemical, microbiological and micro-analytical, physical and sensory evaluation; a pilot plant for use in the development and improvement of various food products; and training facilities for use in seminars and workshops related to the various aspects of food processing and packaging. Seminar-workshops offered by the Center focus on areas of food preservation, food safety and quality evaluation.

FUTURE ASPECTS OF PACKAGING PROCESSED FOODS IN THE LIGHT OF GLOBALIZATION AND CHANGING TRADE AND ENVIRONMENT

It is known that the development in the packaging of processed foods is dependent on technology and consumer preferences. As consumers shift buying habits, tastes and lifestyles, a demand for a wider range of packaging products is created. In the Philippines, the packaging of processed foods is still influenced by the needs of product manufacturers and retailers, as they try to meet consumers needs for low price and high quality products.

In the light of increasing globalization and changing trade environment, the packaging of processed food, in this new millennium in the Philippines, will be greatly influenced by the following factors:

Consumer Behavior

Shifting purchasing patterns and demanding complexities of living. The cyber consumers will be discriminating, experimental, mobile and more concerned with their environment.

* There are now more small households; more one-parent families
* Less formal eating at home
* Increasing market for ready prepared, convenience foods
* More and more women go out to work
* Health-conscious consumers
* More desk lunches in offices
* "Grazing": small amounts of food several times a day.

Resulting Packaging Trends

* Size of food packs must cater to smaller household sizes; economic flexible packs
* More ready prepared, convenience foods; growth in take-home foods
* More microwavable packaging
* More health food snacks, particularly yogurt, "*taho*" (soy bean curd), gelatin with fruit bits and slices, in rigid plastic containers with peel-off foil laminate covers
* More health juice drinks and concentrates packaged in PET bottles and glasslite bottles (glass bottle with thinner walls)
* Visible tamper-evident safety features for bottles and containers
* Easy-to-open, reseal and store packaging
* Vacuum packaging for processed meat and marine products
* Modified atmosphere packaging for minimally processed fruits and vegetables
* Aseptic packaging for fruit juices, drinks and foods with particulates
* Retortable packaging for ready-to-eat food
* PET bottles for high temperature filling for hot-fill products
* Plastic squeezeable bottles for sandwich spreads.

Environmental Issues

Main issues affecting packaging are depletion of resources, waste management, pollution.

– Emphasis on the 3Rs environmental criteria: Reduce, Reuse and Recycle.

Resulting Packaging Trends

1. ***Reduction of Materials Used in Packaging***

* Glass bottles are being replaced by plastic bottles, and flexible cans are being replaced by flexibles
* Products are made more concentrated to use smaller packs, doing away with secondary packs, if possible
* Up to 30 percent reduction of materials used, ex: PET bottles, glass bottles, corrugated boxes.

2. ***Reuse of Packaging Materials or Containers***

* Reusable package design, containers such as ice-cream plastic containers, powdered milk cans, powdered juice drink plastic jars
* Growing market for refillables, such as water refilling stations where you can bring empty water bottles.

3. ***Recycle of Packaging Materials/Containers***

A number of companies now recycle packaging materials/containers. For example, glass bottles/jars are broken into cullets again to serve as the raw materials in making new glass containers.

Changes in Distribution

The retailing scene has been transformed in this century from the general store of the 1800s to the earliest supermarkets in the 1960s and the supermarkets and hypermarkets of today.

* We now have superstores and warehouse clubs and even specialty stores, each with a totally different distribution and packaging needs
* The emerging global marketplace in which successful new brands leap international borders will tend to enhance the variety of new products
* Supermarket house-brands are now fast gaining popularity and acceptance by the consumers because of their lower prices.

Resulting Packaging Trends

* Design innovation and attractive packaging graphics are used to make the packages stand out in supermarket shelves
* Emergence of cross-border design; more universal graphics, food packages that are informative and descriptive of contents for consumers, with different cultures and diverse languages, e.g., our ethnic food products now have English descriptive names aside from the local names:
  - *Piaya* - purple yam pie
  - *Balaw-Balaw* - sautéed fermented shrimps.

Legislations and Laws

Packaging shall conform to legislations and laws of other countries in order to be acceptable and competitive in the global arena. For example, nutrition information table is mandatory on food packaging when exported to the U.S.A.

CONCLUSIONS

In this present times of globalization, packaging, which was once an unnoticed commodity has established itself in center stage, as more Filipino consumers become discriminating in the selection of food items to buy. Packaging, whose original function is mainly to contain, protect and preserve, now plays an increasingly important role of selling the product it contains. This is true for that portion of the Philippine population that has moved up the economic ladder and is exposed to food products packaged in different ways from other countries.

The future of packaging processed foods will still be influenced by the needs of product manufacturers and retailers, as they try to be meet local consumer needs for low price and high quality products. As such, there is a need for the local packaging industry to be proactive, to catch up with fast changing packaging technologies and packaging regulations.

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11. SRI LANKA

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Food may broadly be divided into two categories, viz., natural and processed, both of which may further be divided into two, i.e., perishable and stable. Natural foods such as fruits and vegetables are among the most important foods of mankind as they are not only nutritive but are also indispensable for the maintenance of health. Preservation of such foods in one form or the other has been practiced all over the world since time immemorial, though scientific methods for the same have developed only about a hundred years ago.

METHODS OF FOOD PROCESSING AND PRESERVATION

Food processing refers to any changes made in plant, animal or any other material used for food, whether these are brought about in the home or in a commercial establishment, including food preparation, or minimal processing, making food ready for immediate consumption; while food preservation preserves the food for future consumption. The methods or procedures employed in bringing about such changes in food are referred to as the techniques of processing. Food is processed in order to:

* improve its nutritive value and availability to the body
* improve its digestibility, making it easier for the body to break down the food while it is in the stomach
* improve its sanitary quality, making it safer to eat by killing harmful microorganisms
* create desirable flavors which are pleasant to the taste
* preserve it to allow it to be kept over a period, saving time and energy.

To achieve the above mentioned traits, food processing sometimes causes certain desirable qualities in foods to be lost.

Methods used in the preparation and processing of foods are:

* separation and subdivision
* combination or mixing
* heating and irradiation
* cooling and freezing
* use of chemical compounds or preservation
* use of microorganisms or fermentation.

Here, the discussion will be limited to commercial and industrial type of food processing.

FOOD INDUSTRY

Industrial food processing is an integration of production of agro-products at farm level, then processing, preserving and adding value. By conserving easily perishable surplus food, the food preservation industry prevents wastage and plays a very important role in our national economy. Its existence avoids or at least minimizes fluctuations in the prices, and caters to all year-round requirements. Supermarkets also contribute towards the development of the food processing industry.

Processed foods have been the principal derivatives of agro-products used in most countries of the world. With the advancement of science and technology and industrialization the way of life of people in the modern age has changed radically. People at present find very little time to spend in the kitchen, as they spend much of their time in the factory, office or in the field. In view of the changed circumstances, people from all walks of life prefer ready food rather than cooking in the kitchen. Processed food is playing an important role in modern society, its use is progressively increasing day by day and gaining popularity amongst all sections of people. Food processing is the largest sub-sector accounting for 15 percent of total industrial output.

Food processing industry in Sri Lanka is comprised of three groups, namely; primary, secondary and tertiary. Whilst primary processing involves the lowest form of skill and technology, different degrees of sophistication have been attained at the secondary and tertiary processing levels. These operations are carried out on the home, cottage, small, medium and large scale, including several multinational enterprises. Some of these are owned and managed by the owners or managers with trading, business or agriculture background, having had very little exposure to modern management theory and practices. The result is that proper planning, organization, coordination and control are not given due consideration in the majority of these industries. Management practices in these industries are mostly of a routine type, rather than being dynamic.

Increased generation of different kind of wastes, underutilization of resources (man, machine and money) and lack of innovative thinking are common problems in these industries.

There are a number of food processing operations, having quite large business turnover, taking place in the unorganized sector, especially in the processing of a traditional range of foods like papadams, boiled grams, deep fat fried products, pickles and chutneys, sweets, and ice lollies.

Traditionally, Sri Lanka has exported food products like tea, spices, nuts and coconut in their primary state. During the past decades, higher domestic incomes, globalization and the open market policies of the government have fostered an increase in value-added manufacturing of primary products for export, and processed foodstuffs for the domestic market.

The current composition of the food manufacturing industry is as follows: bakery products, coconut products, milk and dairy products, milled grain products, processed meat and fish, processed teas, milled and refined sugar, vegetable/animal fats and oils, animal feeds, beverages, ice-cream, ice candy, pickles, chutneys, salted and sweetened cashew nuts, confectionery items, canned fruits and vegetables, jams, jellies, dehydrated fruits and vegetables, sliced mushrooms, mineral water, tomato paste, potato chips, and miscellaneous food products.

The domestic demand for most of these products increased due to effective advertising and efficient distribution methods that enhanced the popularity of these products among the urban population. Continuous research carried out by major manufacturers to assess consumer needs helped to improve product quality. Manufacturers also introduced a range of new products on the basis of those research findings. These industries have invested substantially in upgrading technology and installing new machines.

Research is one of the public services that are of special importance to the processed food industry. The research effort is being undertaken by a large number of government agencies. The initiatives pursued by the government include several public services that complement private sector and the NGOs involved, in the research, promotion and marketing of processed foods.

Regulating the quality of processed food products passing through the food chain is an important responsibility of the government. In recent years, government food hygiene standards have been reviewed and tightened. The Sri Lanka Standards Institute, a government agency, sets quality standards and inspection services. A national network of inspection laboratories are being developed to improve access to food quality inspection services. The implementation of laws relating to food packaging and labeling and the Food Act provision is the responsibility of the various government agencies. The government, in both its public education system and through an array of technical and vocational training efforts, attempts to supply skilled personnel for the local processing industry.

The government has taken many initiatives in the marketing of processed food products locally and internationally through various government institutions. It has encouraged and provided infrastructure for *e*-commerce. Many industrial parks with well-established infrastructure facilities are available for setting up food processing industries.

The available market opportunities for Sri Lanka's food products are great despite heightened international competition and a formidable set of production constraints. Within the food, beverages and tobacco products category, the most important sub-sector is food processing, which is closely linked to primary production. To a considerable extent, its future growth would depend on the rate at which food production (crops and as well as livestock) expands. Here again, the creation of an enabling environment comes into play, since the two sub-sectors are inextricably linked. The bottom line is that, to hold its place as the second largest industrial category, the food, beverages and tobacco sub-sector will have to expand rapidly over the next few years, in terms of investment and output.

CONSTRAINTS AT INDUSTRY LEVEL

* ***Labor intensive operations***: procurement, handling, processing, storage and distribution.
* ***Low level of annual operation***: the annual working days of the units ranges from 100 to 250 days indicating low utilization of installed capacity ranging from 35 to 85 percent, as a result of handling seasonally produced agro-commodities, which are highly perishable in nature.
* ***Diversity of agricultural produce*** with reference to variety, species, size, shape, physical characteristics and so on.
* ***Wide variations of the raw produce*** such as in variety, shape, class, botanical characteristics, physico-chemical parameters, etc., which make it difficult to process a wide range of products in a single plant. On the other hand processing of all these commodities in one unit means increased capital investment for processing equipment for each class of fruits, vegetables, spices, tubers, animal, fish, grams, grains, etc., as the case may be.
* ***Mechanization is of a low order***, especially in the small-scale sector and hence, productivity is low.
* ***Non-availability of appropriate equipment*** for suitable handling and processing operations. Prototype development has cost, time and competence needs.
* ***Low capital investment and lower volume of business***: encouragement is given by the government for food processing. To set up processing facilities for lower volumes of business in small- and medium-scale sector, the capital requirement for creating infrastructure facilities to produce quality products is relatively high. As a result the end-product has to be priced high and this affects marketing strategy.
* ***Marketing constraints*** limited advertisement and sales promotion, and competition from multinationals and other monopoly manufacturers. Small companies often cannot afford to have a professional marketing plan.
* ***Quality constraints***: low level technology in manufacturing, including low level of Good Manufacturing Practices (GMP). Untrained production staff and quality monitoring systems are not practiced.
* ***Food regulations***: many anomalies exist and there are practical difficulties in implementation.

FOOD PACKAGING

The prevention of food losses is of vital concern to producers, and there are a number of ways by which waste can be reduced and food security improved. Even though food quality may be debatable, food safety is compulsory.

The use of packaging when properly applied can have a dramatic effect, reducing losses and ensuring that products reach the customer in the best possible condition. At its simplest level, appropriate packaging contains and protects, while at a more sophisticated level it takes on additional roles, such as preserving, selling, informing and enhancing the convenience element of the product.

The type of packaging required depends on the nature of the product or the producer, the length of time and conditions under which it will be transported and stored before use, the final market for which it is intended, and local food laws. So while packing is of vital importance everywhere, solutions to problems will differ according to the region or country.

Principles of Packaging

Selecting the most appropriate packaging means reviewing the type of product, the use for which the packaging is required (bulk, retail, etc.), the duration of storage and distribution (shelf life), the climatic conditions and local availability of materials. Good packaging protection is particularly important in countries with tropical and humid climates like Sri Lanka, where food spoilage can be more rapid.

Packaging has three basic roles:

* to act as a container, enabling the chosen quantity to be handled as a unit without loss during distribution and storage;
* to protect against squashing, breakage and spoilage during distribution, and to maintain the food in good condition through a planned shelf life; and
* to communicate necessary information about the foodstuff such as its origin, method of use, weight, quality or destination.

All these functions are influenced by three basic factors or causes:

* physical damage, including pilferage
* climatic effects
* contamination by microorganisms, insects, or foreign matters.

Physical damage and breakage can occur in a number of ways, including vibration, dropping, crushing, squashing, or pilfering. Retail packs may need to be packed in outer containers for protection during transport.

The most damaging climatic effect is moisture, as most dry foods will rapdily absorb moisture, the rate depending on local humidity. High temperatures also cause rapid spoilage, even to sealed containers such as tins or bottles. Air, especially oxygen, will cause oily foods to become rancid, so they must be sealed after all air is excluded. Light can fade colors and encourage rancidity and so many products are packed in light-proof containers.

Packaging can minimize re-contamination and prevent the growth of microorganisms by protecting the food and providing an environment inside the package where microorganisms have difficulty in growing.

Packaging also plays a role in marketing. Local legislation should require the declaration of details such as net weight, producer, type of food and date of expiry. Attractive packaging can also create a brand image, allow flexibility in the size and design of containers, and make handling and distribution more convenient for customers.

Producers can maximize their cost-efficiency by:

* standardizing their packaging;
* selecting inexpensive local materials, including traditional ones; and
* using reusable packaging.

Packaging Applications

Bulk packaging contains and protects products during distribution, the most common examples being fiberboard cases, crates, barrels, drums, baskets and sacks.

Retail containers protect and advertise the food in convenient quantities for retail sale and home storage, usually in tin cans, glass bottles, rigid or semirigid plastic tubs, collapsible tubes, paperboard cartons, plastic bags, sachets, and over wraps.

The range of packaging that can be used in Sri Lanka is limited by the availability of materials and equipment, much of which have to be imported, are expensive, or too large for small-scale use.

Traditional Packaging Materials

Traditional packaging uses local resources to contain products with short shelf life for local distribution. Fruit, vegetables and fish are usually transported in bulk to a wet market, often in baskets, bales, jute sacks, or wooden boxes, and then sold loose. Clay pots are used for containing fats, oils and dairy products such as milk, yoghurt and curd, either in bulk or for retail sale.

Clean, washed and dried leaves, e.g., banana leaves, are often molded or woven into containers and are commonly used to wrap cooked food, dried food and spices. The fibers of bamboo, jute, rattan, coconut and papyrus are made into bags and baskets.

Modern Packaging

1. ***Paper***

There are two main types of paper used, kraft paper and sulfite paper. Kraft paper is strong and commonly made into multi-wall paper sacks for packaging powdered foods, flours, cereals, legumes, fruits, etc. Sulphite paper is lighter and weaker, and is treated to make greaseproof paper, which is resistant to oils and fats unless it becomes wet.

All papers have negligible moisture or gas barrier properties, and are not heat-sealable unless coated or laminated with wax or plastic film. These types of coated and laminated papers are used extensively for bakery products in Sri Lanka.

2. ***Metal***

The tin cans used for meats, fruit juices, etc., are the most widely used metal containers. Larger, up to 25 liters, tinplate containers are used to pack oils and dry products.

Coated steel drums of up to 225 liters are commonly used for vegetable oils. Aluminum is being used widely both as a foil and as a formed dish to wrap "fast food", cheese, meat, vegetables, confectionery, bakery products, breakfast cereals, milk powder, etc.

3. ***Glass***

Glass bottles and jars are widely used and available in a large range of shapes, sizes and colors. Glass is a recyclable material and represents an 'energy bank'. It has good barrier properties to oxygen and moisture.

4. ***Plastics***

Plastics of many different types are now being used for containing and wrapping. Plastics have many advantages over other materials as the wide range includes plastics with different qualities regarding resistance to physical shock, light, heat, moisture and air, and these different plastics can be combined to increase the options. They are also being produced in fiber form for weaving into bags and sacks, which are more durable than vegetable materials. The disadvantage of plastics is that most are not biodegradable. The following are the most common types of plastic packaging used in Sri Lanka.

Polythene film is probably the most widely used packaging film because of its low cost. Polythene bags are used extensively and polythene film is used to line "traditional" packaging. Polypropylene is used for woven sacking. Films of cellophane, polypropylene, polyester, combinations and laminations of these are also widely used. More commonly, films of this type are being used in sheet rather than made-up bag form. Such sheets are used in form, fill and seal machines.

Thermo-formed and vacuum-formed rigid containers such as jars, bottles, boxes, tubs, large drums, and trays are increasingly replacing glass and metal containers. They do not corrode, are light, tough, easy to mold and seal and are relatively cheap. They are rarely reused for their original application, and this may make them expensive for the small-scale producer. Polyvinyl chloride (PVC) bottles are used only for oil, fruit juices, squashes and concentrates. Polyethylene terephthalate (PET) bottles of varying sizes are also being used extensively in the processed food industry, especially for beverages.

FUTURE PACKAGING DEVELOPMENTS

Retortable pouches are being used in developed countries for packing of fish, meat and vegetable products. Retortable pouches offer advantages over metal cans because of their flat shape, which will reduce the time for heat penetration and reduce heat damage to the product. Heat-resistant pouches are cheaper than cans.

High cost of packaging materials is a problem faced by the food industries in the country, especially because this is an industry where proper packaging is an essential requirement. Low-cost packaging materials and equipment need to be introduced into the industry to improve quality and shelf life of processed foods.

National or regional environmental protection regulations affecting packaging brought in by importing countries may give rise to international trade restrictions. Prohibition of particular packaging materials or

types of packaging may create new hidden barriers for their exports to developing countries such as Sri Lanka. It is important to be aware of the modern trends in the industrialized world which encourage environmentally friendly forms of packaging. Factors such as source reduction (minimizing the quantity of packaging material used consistent with the performance of its packaging role), reduced energy requirements, reduced pollution caused by packaging manufacture, use or disposal, potential for reuse, recycling and ease of disposability, have to be considered when choosing packaging materials and methods.

The development of the processed food industry requires modern technology and investment capital to support expected growth. Foreign investment promotion policy becomes an important issue for the government to emphasize in order to bring in advanced know-how for production and packaging technologies and to develop both domestic and export-oriented production of well-packaged foodstuffs.

12. THAILAND

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Thailand for many years has been known as an agrarian nation where the majority of the population is engaged in agriculture. Today Thailand boasts a complex, multifaceted economy embracing industries, especially agro-industry. Processed food industries represents in one of the most important agro-industrial sectors and play a vital role in the country's economic and social development. Thailand is one of the world's few net food exporters. The *pièce de résistance* of the food industry is processed foods, and Thailand is now the world's largest supplier of canned tuna, frozen shrimps, frozen chickens and canned pineapple. It is also developing a sound reputation for its processed spices and herbs, wheat products and rice.

Most processed food industries are small- and medium-sized enterprises, while large-sized enterprises account for only 4 percent of the total number of food manufacturers. Thai processed food industries are mostly export-oriented industries. Over the past few years, Thai food industries have experienced many barriers and constraints such as: White Paper on Food Safety, Good Manufacturing Practices (GMP), Hazard Analysis of Critical Control Points (HACCP), Sanitary and Phytosanitary Measures, and Genetically Modified Organisms (GMOs). These barriers have impelled Thai food manufacturers to improve their processes, product quality and packaging as well to comply with regulations and to maintain their markets.

Manufacturers of Processed Foods in Thailand

Processed foods in Thailand are made up of four major food categories: fruit and vegetables, meat and poultry, seafoods, and cereals. The manufacturers comprise registered factories, non-registered family producers and agricultural household group producers. Table 1 shows the numbers of manufacturers recorded by the Department of Industrial Works and the number of agricultural household groups recorded by the Department of Agricultural Promotion.

Table 1. Number of Processed Food Manufacturers in Thailand in 1996-98

Year	Large[a]	Medium[b]	Small[c]	Household Group	Total
1996	90	413	1,593	1,357	3,453
1997	94	452	1,664	1,357	3,567
1998	98	481	1,757	1,357	3,693

Source: Department of Industrial Works, 2000; and Department of Agricultural Promotion, 2000.
Notes: [a] Capital over ฿100 million; [b] capital from ฿10 to less than ฿100 million; and [c] capital less than ฿10 million.

The agricultural household groups are normally non-registered factories, so the number shown is based on surveys and interviews. Thai processed food industries are located all over the country, depending on raw materials and markets. Tables 2 and 3 show the distribution of the manufacturers by commodity and location.

Table 2. Types of Registered Food Manufacturers and Their Locations, 1998

Commodity	Number of Manufacturers						Total
	Bangkok/ Vicinity	Central	East	North	West	South	
Fruit and vegetable	164	184	26	163	50	15	602
Meat and poultry	128	39	7	135	146	19	474
Seafood	187	49	46	19	31	192	524
Cereal	202	123	49	219	111	32	736
Total	681	395	128	536	338	258	2,336

Source: Department of Industrial Works, 2000.

Table 3. Types of Non-registered Family Producers and Agricultural Household Groups and Their Locations, 1998

Commodity	Number of Manufacturers						Total
	North-East	Central	East	North	West	South	
Fruit and vegetable	198	28	97	186	88	72	669
Meat and poultry	19	20	4	28	3	4	78
Seafood	38	20	43	30	26	38	195
Cereal	100	36	62	101	42	74	415
Total	355	104	206	345	159	188	1,357

Source: Department of Industrial Works, 2000.

Current Status of Thailand's Processed Food Industry and Trends

The overview of the market in 2000 showed inherent problems with an up-board trend of global agricultural produce volume, coupled with a downtrend of food imports. Thai processed food industries have inevitably faced strong competition in the world market. Moreover, the weakening of the baht, high oil prices, high energy costs, non-tariff trade barriers, reduced Generalized System of Preferences (GSP) privileges, and economic contraction in many exporting countries have contributed significantly to the slowdown in the growth of Thai processed food industries. Many of these industries are actually on the decline or stagnating. Most food products and processing technology remain unchanged, except some new products for niche markets such as health foods, ready-to-eat or ready-to-cook foods, and fruit wines, which have enjoyed significant growth in the local market.

The domestic market for processed foods has shown a slight increase. Canned tuna has gained more popularity. The export market has enjoyed a fair rate of expansion, where frozen poultry and poultry products contributed the highest rate. As a result of the outbreak of 'mad cow' and foot-and-mouth diseases in England and some European countries, the consumption of red meat has drastically decreased, subsequently poultry products have been increasingly in demand. The production of fruit and vegetables in 2000 was essentially the same as of 1999, due to the strong competition in the world market. A minor production decline in canned pineapple production was experienced due to the shrinkage of the overseas market and antidumping actions from U.S.A., Australia, and Mexico. Frozen seafood and prepared products slightly declined due to the economic contraction in major markets, especially U.S.A. and Japan, and also the shortage of raw materials caused by disease in shrimp farms. The Siam Commercial Bank (SCB) Research Institute reported the current status and the trends of the major processed food industry in Thailand as shown in Table 4.

Current Packaging Status for Processed Foods

The Department of Industry Promotion of the Ministry of Industry conducted a study on packaging trends for processed food industry in Thailand, from September 1999 to December 2000. This study was aimed at determining the status of packaging practices by processed food manufacturers, especially SMEs, cottage industries, and family producers, their problems and needs for government aids. A survey and interviews of 200 manufacturers throughout the country essentially provided the information and data for this study.

Table 4. Status and Trends of the Processed Food Industry in Thailand from 2000 to 2005

Processed Food	2000	2001	2002	2003-05
Frozen seafood	C^+	C	C	Sunshine
– Shrimp	B	C	C^+	Sunshine
– Fish	D	D	D	Sunshine
– Squid	F	D	D	Sunset
Canned seafood	C	C	C	Sunshine
– Tuna	D	B	C^+	Sunshine
– Shrimp	C	D	D	Sunshine
– Crab meat	C	D	C	Sunshine
– Baby clam	D	D^-	D^-	Sunshine
– Squid	D	D	D	Sunset
Fresh fruit	C	C	C	Sunshine
Frozen fruit and vegetable	C^+	C^+	C^+	Sunshine
Canned pineapple	C^-	C^+	B^-	Sunshine
Canned fruits (not including pineapple)	B	C^+	C^+	Sunshine
Canned vegetables	B^+	B	B	Sunshine
Rice products	B	B	B	Sunshine
Wheat products	C^+	C^+	C^+	Sunshine
Cassava starch	B^+	B^+	B^+	Sunshine
Sugar	B	B	B	Sunshine

Source: SCB Research Institute, 2000.

Packaging in Practice for Processed Fruit and Vegetables

Most of the manufacturers are agricultural household producers and small-sized industries who employ mainly basic processing methods, such as sun drying, conventional hot air drying, fermentation, frying and confectionery, while canning, refrigeration or freezing are established in medium- and large-sized industries.

Table 5 shows the type of packaging used for processed fruit and vegetables. Plastics are the most widely used, except canned products. Plastic accounts for 89.5 percent of packaging material used for dried products, of which 56.6 percent is in the form of flexible packages, bag, pouch and film. Household producers and small-sized industries mainly purchase their packaging from wholesalers or family plastic industries. Major materials used are:

* LDPE = Low density polyethylene
* LLDPE = Linear low density polyethylene
* PP = Polypropylene
* OPP = Oriented polypropylene

and laminated multi-layer films for high value goods, designated from outside to inside:

* OPET/LLDPE = Oriented polyethylene terephthalate laminated with Linear low density polyethylene
* OPP/CPP = Oriented polypropylene/cast polypropylene

Due to small quantities ordered, these manufacturers have normally very low bargaining power, and have to pay higher prices. Moreover, the quality of the packages is not well controlled. Most of the manufacturers lack knowledge on packaging technology, especially in the selection of the right packaging for their products. These are the major problems for the packaging of processed fruit and vegetables.

Medium- and large-sized industries generally use more complex packaging materials for longer shelf-life and better appearance. Aluminum foil-laminated films and metabolized films are widely used and supplied, either in roll stock or preformed bags, such as:

* OPP/Al/LLDPE = Oriented polypropylene/aluminium foil/linear low density polyethylene
* OPP/met.CPP = Oriented polypropylene/metallized cast polypropylene

Table 5. Packages and Packaging Materials Used in the Processed Fruit and Vegetable Industry

(Unit: Percent)

Packaging Material and Package Form		Drying	Fermentation	Freezing	Canning
Plastics	Bag/pouch/film	56.6	60.9	60.0	-
	Box	17.1	4.3	20.0	-
	Al-laminated bag	7.9	-	-	-
	Tray/cup	6.6	4.3	20.0	4.2
	Jar	1.3	13.0	-	-
	Sub-total	89.5	82.5	100.0	4.2
Paper	Bag	2.6	-	-	-
	Carton/box	4.0	-	-	-
	Sub-total	6.6	-	-	-
Metal	Can	2.6	-	-	91.6
Glass	Jar/bottle	1.3	17.5	-	4.2

Source: CA International Information Co.,Ltd, 2000.

Some barrier clear films are also employed, for example:

* OPET/LDPE = Oriented polyethylene terephthalate/low density polyethylene
* KOPP/LLDPE = PVDC-coated oriented polypropylene/linear low density polyethylene
* KON/LDPE = PVDC-coated oriented nylon/low density polyethylene

The manufacturers are sometimes obligated to use specific materials required by the customer, which have to be imported and are costly.

Fermented fruit and vegetables are packaged almost the same way as for dried products, except that semirigid plastic jars and rigid glass containers are used at a higher ratio for products containing some liquid. Most of the packaging problems are related to low quality material properties such as strength, product compatibility and cost.

Frozen and refrigerated fruit and vegetables operations are actually done only by the industry, not by agricultural household groups. This is due to the high investment required and need for skilled manpower. Plastics are mainly the materials used; some may find very small quantity of paperboard carton, employed for high-priced products. Polyethylene (PE) and nylon lamination are most widely used and Expanded Polystyrene or Polystyrene Foam (EPS) box and tray are also used, but these are in the downtrend because of environmental concerns in many countries. The problems lie mainly on high-cost and low-quality materials.

Canning technology is no longer confined to metal cans or glass container. Many forms of semirigid and flexible retortable packages, made of multilayer plastics have been used in the canning industry, especially canned fruit and vegetable. However, lacquered tinplate cans represent the most important containers. Some developments have been noted in canned foods, for example, the growth rate of tin-free steel (TFS) cans, welded cans, two-piece cans and easy-open (EZO) end cans. The major packaging problems for the manufacturer are mainly the tax for imported metal sheet and lacquer. Old machines are only slowly being replaced due to high cost. Consequently can making technology is not well advanced. In addition, the packaging cost of canned fruits and vegetables accounts for 10 percent to more than 30 percent of the production cost, which is much higher than for other packaging.

Packaging in Practice for Processed Meat and Poultry

Dried meat and poultry products are normally packaged in plastic containers, as are dried fruit and vegetables, except the packaging materials used are more complex to give longer shelf life and for better appearance. However, the materials available are quite limited to, e.g., nylon lamination, OPP/met.CPP and

polyvinyl chloride (PVC) boxes. The problems of low material quality and lack of knowledge of the producer can lead to unsatisfactory product quality and short shelf life.

Fermented meat products are very popular in the local market and are produced normally by household groups and small-sized industry. Plastics take the largest place, due to good barrier properties for gas, odor and moisture. The use of traditional material, banana leaf, is at a relative high percentage due to both its appropriate property and the product identity represented by the leaf. Plastic jars are generally used for prepared products which contain some liquid. The major packaging problems are seal integrity and cost. Fermented products normally have a strong odor; the container leakage may cause many adverse affects and affect product acceptability.

Frozen meat products are gaining more popularity in many big towns and franchised markets. Vacuum bags of nylon-laminated films are the most employed material. Few single layer materials of PP and PE are still used by family producers. The problems of material strength, leakage and high cost are also essential to be solved.

Canned meat products are of relatively less importance to the processed food industry. Consequently, these were not covered in this study.

Table 6. Packages and Packaging Materials Used in the Processed Meat and Poultry Industry

(Unit: Percent)

Packaging Material and Package Form		Drying	Fermentation	Freezing	Canning
Plastics	Bag/pouch/film	74.6	84.2	95.0	n.d.*
	Box	9.0	-	-	-
	Al-laminated bag	1.5	-	-	-
	Tray/cup	6.0	-	5.0	-
	Jar	-	5.3	-	-
	Sub-total	91.1	89.5	100.0	n.d.
Paper	Bag	1.5	-	-	n.d.
	Carton/box	4.5	-	-	-
	Can	1.5	-	-	-
	Sub-total	7.5	-	-	-
Metal	Can	1.5	-	-	n.d.
Other	Banana leaf	-	10.5	-	n.d.

Source: CA International Information Co.,Ltd, 2000.
Note: * n.d. = no data.

Packaging in Practice for Processed Seafood

Due to high raw material cost and high working capital required, the size of the seafood industry is automatically determined by the processing methods employed. Household groups, family and small-sized producers are engaged mostly in traditional drying and fermenting processes. Freezing and canning are operated by medium- and large-sized industries. Dried seafood products are totally packaged in plastics, 94.3 percent of which is flexible packaging. Single layer films of PP represents the highest ratio among plastic film. Multilayer films, such as OPP/CPP, OPET/LDPE, KON/LDPE, Al-laminated film and metabolized film, is used for dried shrimps and other high-priced products. In general, dried seafood products are under-packaged, due to lack of knowledge of the producer. Normally, plain film is used with a paper label, while printed film is rarely found except for the export market. The unsatisfactory quality of packaging materials and shorter shelf life than expected are common problems experienced.

Fermented seafood contains liquid in different quantities, so wide-mouth jars of both plastic and glass are mostly employed. Closure leakage and lack of plastic compatibility to specific products are often observed.

Frozen seafood, especially frozen shrimp, represents the most important of the processed food products, in terms of export value. Being an export-oriented industry, the packaging employed is generally adequate. Vacuum packaging in high barrier material, such as nylon-laminated film, is commonly practiced. A High Impact Polystyrene (HIPS) or High Density Polyethylene (HDPE) tray in a laminated bag is an

alternative form normally used for prepared products. In this case, a waterproof paper carton is also added, to promote appearance and protection. Quality of plastic material, seal strength and integrity, and high material costs are the main drawbacks in this industry.

Canned seafood products play a very significant role in Thailand's economy and rely mostly on the export market. Lacquered tinplate cans are widely used and are being gradually replaced by TFS cans, which possess many advantages over the former, such as better corrosion-resistance and better hermetic seal. However, TFS cans are more expensive, consequently their use is restricted to medium- and large-sized industries. Raw materials for can making are imported, so the cost is high and depends on the exchange rate. Some industries have introduced retort pouches to serve some export markets. This requires a significant investment in machinery and the pouch itself is totally imported, which is a big obstacle to the manufacturer.

Table 7. Packages and Packaging Materials Used in the Seafood Industry

(Unit: Percent)

Packaging Material and Package Form		Drying	Fermentation	Freezing	Canning
Plastics	Bag/pouch/film	84.6	-	70.2	-
	Box	-	16.7	2.2	-
	Al-laminated bag	7.7	-	-	-
	Tray/cup	7.7	-	17.0	-
	Jar	-	50.0	-	-
	Sub-total	100.0	66.7	89.4	-
Paper	Bag	-	-	-	-
	Carton/box	-	-	10.6	-
	Can	-	-	-	-
	Sub-total	-	-	10.6	-
Metal	Can	-	-	-	100.0
Other	Jar	-	33.3	-	-

Source: CA International Information Co.,Ltd, 2000.

Packaging in Practice for Cereal Products

Dried cereal products are generally produced by household groups and family producers. Snack foods represent most of the dried cereal products, e.g., rice noodles and vermicelli are among other products widely consumed locally. Instant noodles and extruded snack foods are manufactured by medium- and large-sized industries. The instant noodle industry has enjoyed a continuous expansion rate and achieved a value of about ฿6,000 million in 2000.

Table 8. Packages and Packaging Materials Used in the Cereal Product Industry

(Unit: Percent)

Packaging Material and Package Form		Drying	Fermentation	Freezing	Canning
Plastics	Bag/pouch/film	61.9	-	-	-
	Box	-	-	-	-
	Al-laminated bag	17.5	-	-	-
	Tray/cup	-	-	-	-
	Jar	1.6	-	-	-
	Sub-total	81.0	-	n.d.	-
Paper	Bag	1.5	-	-	-
	Carton/box	7.9	-	-	-
	Can	3.2	-	-	-
	Sub-total	12.6	-	n.d.	-
Metal	Can	3.2	-	n.d.	60.0
Other	Jar	3.2	100.0	n.d.	40.0

Source: CA International Information Co.,Ltd, 2000.
Note: * n.d. = no data.

Plastic films, both single layer and multilayer are mostly used. Short shelf life products are normally packaged in PP or PE bags. Long shelf life ones manufactured by medium- and large-sized industries are packaged by using a Form-Fill-Seal (FFS) machine or a semiautomatic one with multilayer film. The films available and widely used are, for example, OPP/PE, OPP/CPP, OPP/met.CPP, KOPP/PE, OPET/PE, and OPP/PE/Al/PE. Some metal cans and paperboard-laminated cans are also employed for very long shelf life products or high end-products. The instant noodles, accompanied by cooked meat, then packaged in retort pouches, have achieved increasing popularity among working people and students. They are presented in PP cup with a peelable lid, to provide convenience for consumers and to promote sales volume.

Measures for Packaging Improvement

Based on the problems of packaging in the processed food industry, the following needs for governmental support are raised by the industry:

* Training courses on food packaging technology
* One-stop service packaging center and packaging information center
* Research and development center in collaboration with the industry
* Reduced import tariff for packaging machinery and materials
* Promotion of local manufacturers of packaging materials
* Low interest loans for the export-oriented industry.

Some measures have been carried out by many governmental bodies, for example, by organizing training courses and seminars nationwide, through 11 regional agricultural extension offices; carrying out packaging development on demand through universities, Thai Packaging Center, the Department of Agribusiness Promotion and the Department of Agricultural Promotion; and tax privileges for imported packaging machinery and materials.

Future Prospect of Packaging for Processed Foods in Thailand

The packaging of processed foods has been oriented towards minimum materials usage, shelf life extension of packaged goods, safety aspects of packaging materials, and environmental concerns. The retort pouch has increasingly replaced metal cans and glass jars for prepared foods. The manufacturers of packaging materials have been encouraged by the government, through tax privileges, to invest in new technology and to produce appropriate quality materials. Minimally processed foods and ready-to-eat products have achieved success in larger communities. Therefore, many packaging development activities have been conducted as a result of demands by the food producers. According to the national agenda concerning the project "One Product One Village", a number of packaging development projects have been initiated to serve the needs of family producers and agricultural household groups. Most of the projects are aimed at developing better packaging designs, both in terms of technical aspect and appearance.

Environmental awareness and non-tariff barrier measures regarding packaging waste management in the overseas market have encouraged the Royal Thai Government to issue acts for packaging waste management in the near future. The Department of Pollution Control, responsible for drafting the acts, has recently proposed a packaging waste disposal tariff as a function of the materials, as shown in Table 9.

Table 9. Packaging Waste Disposal Tariff Proposed by the Department of Pollution Control to be in effect in 2002

Packaging Materials	Tax Rate (฿/mt)	Packaging Forms	Tax Rate (฿/piece)
Paper	800	Plastic foam package	5.00
Glass	500	Single use glass bottle	1.00
Plastic	4,100	T-shirt plastic bag	0.08
Metal can	1,700	Detergent bottle	1.50
Aluminum	2,100	Drinking water plastic bottle	4.10-5.00
Rubber	300	Beer/wine glass bottle	1.00
Others	500	Plastic-coated paper carton	4.10

Source: Prachachart Business, 2001.

Due to the packaging waste management regulations issued by many industrialized countries and the environmental awareness of the people, many attempts have put emphasis on the search for substitute materials that can properly serve the country's needs and do not harm its environment. A Thai research group at Kasetsart University has achieved success in developing biodegradable starch-based packages, and the technology has actually been developed to the industrial scale. The packages, called KU-GREEN, are principally made from cassava starch and are for food use. They are processed into various shapes and sizes, for example soup bowls, round plates, lunch boxes, trays and coffee cups. KU-GREEN products can be used for a wide range of products such as dried food, liquid food, hot or frozen food. Moreover, KU-GREEN can be used for warming food in a microwave oven, thus providing convenience to consumers. After usage, KU-GREEN products are biodegradable without polluting the environment. They may be used in animal feed mixtures or as plant fertilizers. The benefits of this research are not only to alleviate the pollution relating the packaging waste disposal, but also to solve the problems of overproduction and low price of cassava in the nation.

13. VIETNAM (1)

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In the mid-1980s, Vietnam was one of the poorest countries in the world. At that time, economic growth was stagnant, the rate of inflation was very high, and hunger was widespread. The introduction of the "renovation" policies in the late 1980s has led to a dramatic improvement in the incomes and the standard of living of the Vietnamese people. By the late 1990s, real incomes per capita had doubled, inflation had dropped to very low levels, Vietnam became the world's second largest exporter of rice, and the living standards of the Vietnamese people had increased dramatically.

"Renovation" had a strong effect on socioeconomic areas, such as the consumer products markets, with high quality goods. In the past, processed foods had not usually been packaged. Nowadays, research into packaging of food and advertising of goods has begun. There are packaged rice, rice paper, instant rice noodles, instant rice soups appearing in the market. Instant noodles sell well both in domestic markets and overseas.

Minimum-packaging technology for processed foods has not yet been introduced in the farm household. Only private and public companies produce this kind of product. In minimum-packaging technology through process research and development in Viet Nam shows there are:

1. ***Strong Points***
* Ensures a standard for sanitary-secure food which is very important for consumers
* Reduces food losses by processing after harvest
* Quality packaged food products have a longer shelf life than non-packaged foods
* Value-addition to food products, occurs with sound packaging
* Improved perception of packaged labeled foods through advertisement.

2. ***Weak Points***
* High price for printed packaging
* High cost for packaging technology lines
* Only consumers with high income and the export market can afford minimum packaged foods from Vietnam because food prices increase after packaging
* Need high quality seeds, e.g., special rice, to justify packaging.

AGRO-PRODUCT PACKAGING

Rice Product – Domestic Market

1. ***Workers Market***

Before 1989, the government had implemented a food subsidy policy and had a monopolistic business. Foods were delivered with unchanged prices and exchanged for non-agricultural products. The farmers were practicing subsistence agriculture. Foods exchanged for non-agricultural products were sold in food stores. Rice varieties were packaged into 20-kg and 50-kg jute bags. After the 'renovation' period, when the government removed the subsidy system, retail trading of food appeared in cities and towns, substituting for governmental food stores.

In rural areas, farm households consume their own agro-products or in other words they mostly practiced self-sufficiency. About 85-90 percent of population living in rural areas produced food by

themselves. This reaches approximately 100 percent in the Red River Delta, Mekong River Delta and South Central Coast. For other areas such as North Mountain and Midlands, Central Highlands, North, East and South, farm households cultivate perennial plants such as coffee, rubber, tea, pepper, cashew nut and fruit trees or aquaculture or salt production, which earned money to buy food.

In the rural markets, rice was sold without packaging with people carrying it home in their baskets and putting it into storage bins when they got home.

In contrast to the rural areas, the urban markets which mainly sold commodities for non-farm workers, e.g., government officials, workers, and traders normally go to market after work, so that generally packaged goods would be preferred. Rice here is packed in 50-kg jute bags and then retailed in the markets. The quantity sold depends on the demand of the consumers. Commodities are weighed into plastic bags, not available in retail packaged form. The bags are only simple polyethylene (PE) bags without labeling. These account for 70-80 percent of the population living in urban areas who consume rice. This kind of distribution is not sanitary, and lowers food security. Rice is dusty and is of poor quality. However, the price is cheap and the system seems convenient for both buyer and seller.

2. ***Middle-class Market***

This market was prevalent from 1993 up to the present. There are now two main methods of rice packaging:

- *Packing*: After milling and sieving, rice is packed into retail packs of 2-kg, 5-kg and 10-kg jute bags or nylon bags, with a simple label. Usually, rice with higher quality will be packed in this way, including plain rice and sticky rice. The food trading company of the government as well as private companies use this method. Retail packaged rice is provided mainly for medium income earners.
- *Selection and classification*: Rice is selected and classified into four levels, having 0, 5, 10 and 25 percent broken rice, after milling and sieving. This rice will be packed into 2-kg, 5-kg, 10-kg and even 25-kg, sizes with well-printed labels. This first class rice will be supplied for higher income earners and foreigners working in Vietnam. The importers of this higher quality rice are Hong Kong, Singapore, and Australia.
- *Selling*: Small vehicles deliver the higher quality rice which is sold in supermarkets, restaurants or hotels. Restaurants and hotels with larger consumption buy up to 50-kg bag. However, retail packed products in general or packed rice bags in particular, have a higher price, higher than the normal cost by about 5-10 percent. For example, the retail price of 1-kg '*Haihau*' scented rice is VND (Vietnamese dong) 6,500/kg if packaged into PE bags, and is VND7,000/kg if sold as described above (7.69 percent additional price). The price would be raised to 120 percent or even 140 percent with perfect packaging and printing, but this rarely occurs in the Vietnam market.

Government, non-government and foreign companies take part in this kind of production, which requires medium to high investment.

The process from paddy to market is shown below:

Milling → Sieving → Classification of broken rice → Color grading → Packaging → Market

The process of selection and classification of broken rice is done by machine in large companies (machine price is approximately VND1.6 billion or US$110,000). Because of the high expenditure for this machine, small and medium companies cannot afford it. Hence, this process is traditionally done manually. The process of termite treatment involves using vacuum cleaning method or insect-steaming method before packaging.

In high quality rice processing, careful selection and classification meet the requirements for sanitation and food security.

Rice Market – Export Market

Large amounts of exported rice is packed in 50-kg jute bags or PE bags. Some bags have two layers (the inside is PE). A small amount of quality rice is packed in small packages for export to Hong Kong, Taiwan, Australia and Singapore.

Vietnam at present is exporting instant noodles to the Russian Federation and to Eastern Europe. The Vietnam Industrial Husbandry Products Company expects to invest VND40 billion over three years (from 2001 to 2004) for four instant noodle manufacturing projects, with a capacity of 7,500 mt/year to meet those two buyers' demands.

In general, Vietnam does not have a food export market for retail packages.

Other Agro-products

Agro-products such as instant noodles, rice paper, rice noodle, instant rice noodle, instant rice soup and maize powder have all entered into the market, particularly rice products. Those products are in retail packaging and have a large consumption in urban and rural areas.

Instant noodles are packed into 50-g, 75-g, 80-g, 100-g bag and even 250-g or 1-kg bags of various kinds including PE bag, paper bag or two-layered bags with quality printing. Normally, instant noodles in good packaging are sold at higher prices.

Instant rice noodles and instant rice soup are sold in quality packaging, with similar net weights. Nowadays, the consumption of those products is very small and these products are sold in urban areas generally. In rural areas the consumption is tiny because of conservative customs towards consuming new products.

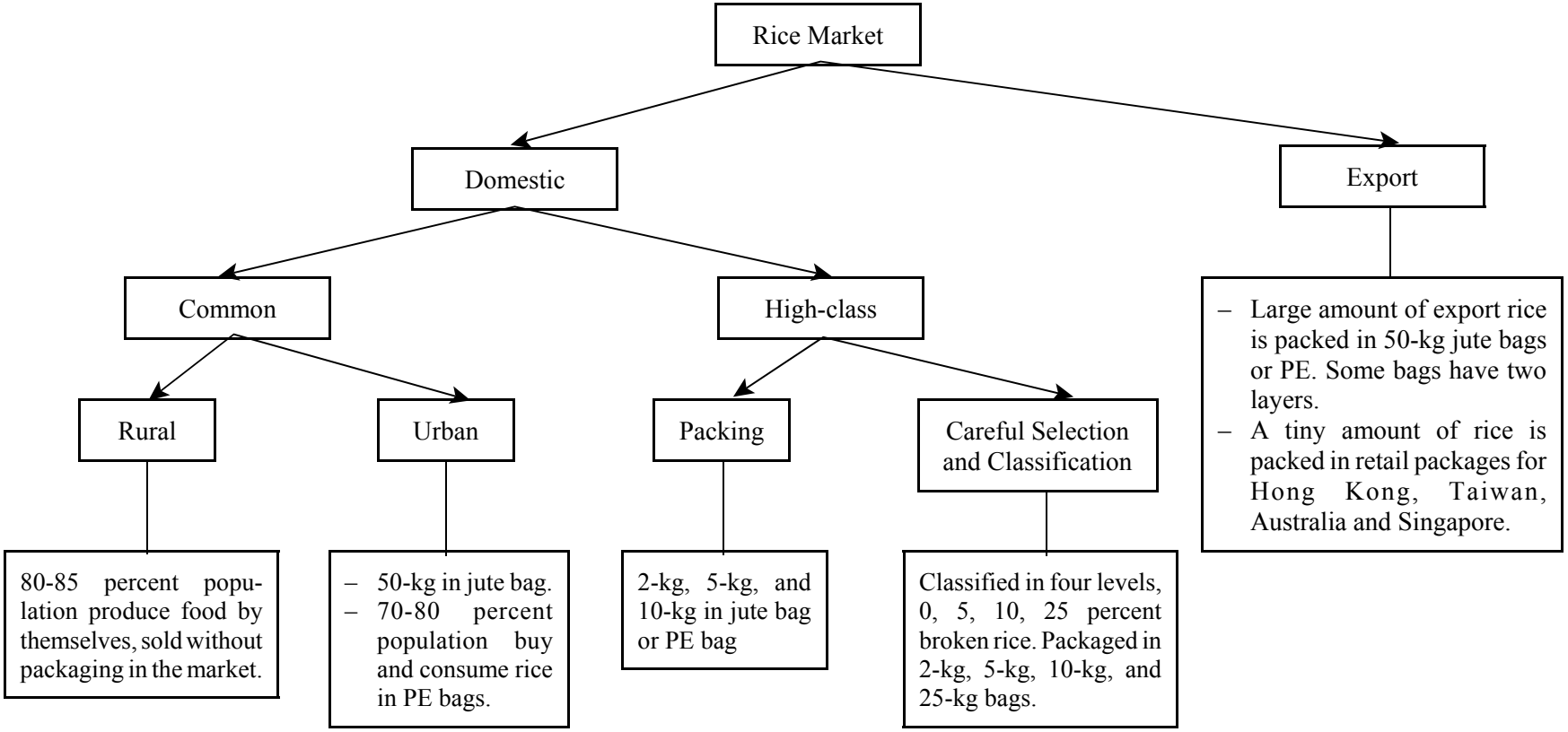
Rice paper is a major ingredient for "*nem*" – a Vietnamese traditional dish. The quantity in a pack is about 25 rice paper pieces with a simple label, even without packaging in the rural areas. The price is no different between packaged and non-packaged.

Instant maize powder has just entered into the Vietnam market from the year 2000, packed into 45-g bags, with good packaging and a rather cheap price. It is mainly sold in urban areas in small amounts because of people's eating habits.

CONCLUSIONS

In order to develop packaging technology in Vietnam in the near future to meet the demand of domestic consumption as well as export, detailed applied research is needed. Several proposals for agro-production and packaging technology under present conditions of Viet Nam are as follows:

- Develop special rice producing and processing zones with large scope, to meet the demand of product packaging technology;
- Invest in technological lines for product packaging in order to raise product quality, especially grading and classifying machines in mini sizes; and
- Allow the present market of packed products to mature and expand this market.



Rice Packaging in Vietnam

Source: NIAPP, 2001.

14. VIETNAM (2)

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INTRODUCTION

Vietnam is a tropical country with climate conditions favorable for agricultural development, where many crops can be grown every year. Vietnam's agriculture plays a very important role in the country's economy: 76.5 percent of the population lives in the rural areas and 76.88 percent of the total labor force (42.6 million people) comprises rural labor. Agricultural land covers 22.2 percent of the total area of the country and the sector provides about 30 percent of the country's national income. As a result of the important position of agriculture, the processed food industry of Vietnam, which uses mostly raw material from agriculture, has large potential for development, now and in the future.

Because of the low development level of the economy, the processed food industry has developed slowly, with old processing technologies and facilities, resulting in bad quality in some products, low competitiveness, unstable market, and an imperfect distribution system. These negative factors have restricted the development of this important industry in particular and of the economy in general.

Thanks to the "*doimoi*" policy, the economy of Vietnam has developed at a good rate. It has largely escaped the economic crisis and has made some achievements by initiating steps towards industrialization and modernization of the country. Along with the improvement of the economic situation, the processed food industry in Vietnam has undergone fresh development in meeting the requirements of domestic and export markets. Large raw material producing regions with significant output have been established in the country and following these, new factories with modern facilities and advanced technology have been built to process tea, coffee, cashew nut, sugar, beer, beverages, biscuit, candies, meat, milk and seafood. The development of the production regions and the processing factories has contributed to the change in economic structure in the rural areas, to improvements in rural life and to the increased income farmers. In recent years, the output and revenue of the national processed food industry, of local industry, of state-owned and of private enterprises has increased, while that of cooperatives and households have decreased.

EFFECT OF PACKAGING IN FOOD PROCESSING

The processed food products sold on the market use up to 50 percent of total packaging in all kinds of application. The changes in packaging technology follow closely the changes in the food products which are contained in them. The food products are processed in a more sophisticated way, ready-to-eat. For these products, the consumer just heats them on a hot plate or in the microwave oven. Nowadays, the preparation time for meals is very limited, while the quality of unprocessed food usually changes quickly. The economic factor is important, therefore, the food products need to be preserved for a longer time without using frozen or cold storage. The preservation time needed is usually from six months to one year, but there is also a kind of food product which just needs to be stable in its quality for 20 days or so (between production and consumption).

The technology combining thermo-stable packaging (high temperature bearing) for sterilizing, combined with vacuum-packaging, is applied to suitable kinds of food products. Formerly, the raw material for food packages was usually aluminum foil, laminated with plastic film for airtight purposes. Recently, complex films are being used as raw material for making soft, airtight bags, or hardened packs made by thermoformage. The popular plastic for making package are: PE (polyethylene), PP (polypropylene), PS

(polystyrene), PVC (polyvinyl chloride), usually laminated with PVDC (polyvinylidene chloride) or EVA (ethylene vinyl acetate).

There is a clear change in packages for liquid foods (juice, soft drink, carbonated drink, beer, pickles, sauces, fruits in syrup) from glass, tin, aluminum to pouch pack (retort pouched) with laminated material (PE + polyester or PE + Al + polyester) at present. Nowadays, juice is packed in tetra-pack (250 ml-2 liter) which comprises paper laminated with aluminum and PE. The weight of the package is usually only 5 percent of the weight of products kept in that package.

At present, in Vietnam, PET (polyethylene terephthalate) is being researched for making bottles for wine, beer and carbonated drinks. PET is a kind of polyester (polyphthalate ethylene glycol) with good points such as fast, forming high melting point and non-toxic. If PET bottle is coated with PVDC film or EVOA, the preservation time of product will be prolonged.

Liquid products such as juice, honey, sauce, or cooking oil, can be contained in clary bag (laminated film, soft bag), packed in 20-50 kg. The clary bags are very convenient because they are reused many times. Empty bags can be folded compactly and they can be returned packed in cartons.

When these improvements in packages and the new packaging technologies are applied, then new products can be introduced into the market, or exported.

USE OF PACKAGING FOR FOOD

Nowadays, Vietnamese food products are exported, so their packages must be designed and invested in appropriately, including the application of industrial fine-arts and design for packages.

Generally, Vietnamese export standard canned vegetables and fruits are appreciated for quality, but some packaged products have failed to impress the buyers. For example, the buyers do not believe the quality of products contained in rusted cans.

At present, when customers go shopping in the supermarkets or self-service shops, they will not be interested in products without decoration or a good looking appearance.

In recent years, Vietnam has tried to improve their food packaging but there are a lot of problems needing to be solved. These include:

* the shortage in quantity of packaging material, such as jute bags for agricultural products, although a lot of local jute weaving factories have been developed. The same situation occurs in the case of containers for drinks. Because of this shortage, some exporters have to use poor quality packages, resulting in the loss of contained products.
* inadequate quality of some kinds of packages, in terms of dimensions, structure and specifications, resulting in an inability to keep the product in good condition over time. There are also difficulties in storage, transportation, loading and safety. As a result of bad quality packages, the quantity of products is diminished. There are complaints from buyers, even the loss of markets.
* the technology is mostly hand-made or small scale, low-yielding and high costing. The domestic raw material has not been utilized effectively for making packaging items.

The development of packaging for food in Vietnam must be synchronized with the development of quantity and quality of exported goods. The packaging for exported goods must be considered at a higher priority over domestic goods. The domestic raw material must be researched and utilized as replacement of imported material for packaging.

Different kinds of packages are suitable for each kind of product. Vietnam is focusing on developing the production of packaging with big demand, using mostly domestic raw materials.

Common Forms of Packaging

* ***Glass Container***: In recent years, the demand for quantities of glass containers for wine, beer, vegetable and fruit products has expanded. Vietnam has favorable conditions to develop this kind of package, with abundant and high quality raw materials.

  In South Vietnam, the output of factories is 45 million glass containers per year. They are also equipped with machines for printing label directly onto the glass container.

* ***Cardboard***: With the developing demand, a lot of factories producing cardboard packaging have been built to provide high quality packages for food manufacturers to limit the quantity of imported cardboard packaging.
* ***PE Film and Other Plastic Package***: In order to save half of the production cost, instead of importing PE package, at present, Vietnam imports PE in primary form and produces the final package. In Ho Chi Minh city, there are well-equipped factories producing plastic packages such as plastic cans, bottles, boxes, PE film, PVC film, laminated film (PVC + paper, PVC + aluminum, PVC + tin).

While producing goods for foreign partners, some enterprises request the latter for investment in packaging technology and machinery.

With the developing and expanding demand, the packaging industry in Vietnam must utilize its potential, enlarge international cooperation and better meet the requirements of the market.

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2. PROGRAM OF ACTIVITIES

(10-15 September 2001)

Date/Time	Activity
Mon., 10 Sept.	
Forenoon	Opening Ceremony Presentation and Discussion on Topic I: *Minimum-Packaging Technology for Processed Foods – Environmental Considerations* by Dr. Alastair Hicks
Afternoon	Presentation and Discussion on Topic II: *Packaging of Fruits and Vegetables: A Project Experience in Chiang Mai* by Dr. Narin Tongsiri Presentation and Discussion on Topic III: *Packaging of Processed Beverages* by Dr. Somjate Sirivatanapa
	Trip to Chiangmai
Tues., 11 Sept.	
Forenoon	Presentation of Country Papers by Participants
Afternoon	Presentation of Country Papers by Participants
Wed., 12 Sept.	
Forenoon	Video Presentation on Royal Project Foundation Visit Royal Project, Packaging Department
Afternoon	Visit Food Processing Factory, Chiangmai University and Activity on Food for Health Project Visit Vanasanan Co., Ltd., Chiangmai
Thurs., 13 Sept.	
Forenoon	Return to Bangkok Visit Thai Packaging Center, Thailand Institute of Scientific and Technology Research
Afternoon	Visit CP Group Co., Ltd. Visit Wet Market near Pathumwan Princess Hotel area
Fri., 14 Sept.	Structured Workshop
Forenoon	Visit and Purchase Samples (Tesco Lotus Supermarket)
Afternoon	Analysis of Packaged Foods Presentation of Group Reports Conclusions and Recommendations
Sat., 15 Sept.	
Forenoon	Evaluation/Final Remarks by Participants Presentation of Draft Study Mission Highlights
Afternoon	Closing Ceremony