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Food research and product development and packaging practices, issues and strategies in Thailand

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FOOD RESEARCH AND PRODUCT DEVELOPMENT AND PACKAGING PRACTICES, ISSUES AND STRATEGIES IN THAILAND

By

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ABSTRACT

This thesis examines some of the institutions and organizations that play an important role in food research and product development. Packaging practices, issues and strategies in both the public and private sectors in evidence throughout Thailand are also explored. To gain a better perspective of packaging strategies in Thailand, political and economic considerations in the Asia Pacific region are taken into account.

Since packaging and packaging materials are vital to growing and newly emerging economies, just as they are to mature economies, issues pertaining to seafoods, pineapples and other fruits, packaged drinks, beer, the packaging of processed chicken and duck meat products are also discussed.

It is to be noted that in 1960, agriculture was the leading sector in Thailand's economy contributing 40 percent of Gross Domestic Product (GDP) while manufacturing made up only 12.5 percent. By 1981, manufacturing had replaced agriculture as the largest sector. In 1989, the share of manufacturing output in the GDP had risen to 26 percent while that of agriculture had declined to 15 percent. By 1995 agriculture had fallen as low as 13

percent of GDP, while manufacturing had increased to 30 percent and had become more diversified in terms of both products and market outreach.

Major findings on general trends in packaging and trends for the use of particular packaging materials or methods lead to significant restructuring of many companies in Thailand.

In conclusion, although packaging in Thailand is in the primary stage of development, it is an area of real growth opportunity, especially in relation to import replacements for items such as Kraft and for packaging which is more consumer-oriented than technology-oriented. Packaging in relation to the environment and the energy component of packaging will continue to be important political issues. Also, many new packaging developments in recent years can be related to the impact of changing energy costs and of plastic resins.

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Certificate of Approval

M.S. DEGREE THESIS

The M.S. Degree thesis of Grit Thangsupanich
has been examined and approved
by the thesis committee as satisfactory
for the thesis requirements for the
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Title of Thesis: Food Research and Product Development and Packaging Practices, Issues and Strategies in Thailand.

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Table of Contents

Food Research and Product Development and Packaging Practices,

Issues and Strategies in Thailand

LIST OF TABLES

page

INTRODUCTION

Thailand - Its Land and People

Thailand, known to earlier generations as "Siam", is situated in the center of the Southeast Asian Mainland, lying between Myanmar to the west and northwest, Laos and Cambodia to the northeast and east, and Malaysia to the south. Geographically, Thailand is open to the seas having 2,614 kilometers of coastline running through 23 of her 73 provinces. See Figure.1 (Source: Warren, W. and Tettoni, L.I., Arts and Crafts, page 159).

About the same size of France, Thailand covers a land area of 513,115 square kilometers and it stretches from 5 to 25 degrees north of the equator. Approximately 45% of the land mass is under cultivation, with the rest remaining in forests and savanna. Traditionally, the country's shape is said to resemble an ax with the handle pointing downwards towards Malaysia.

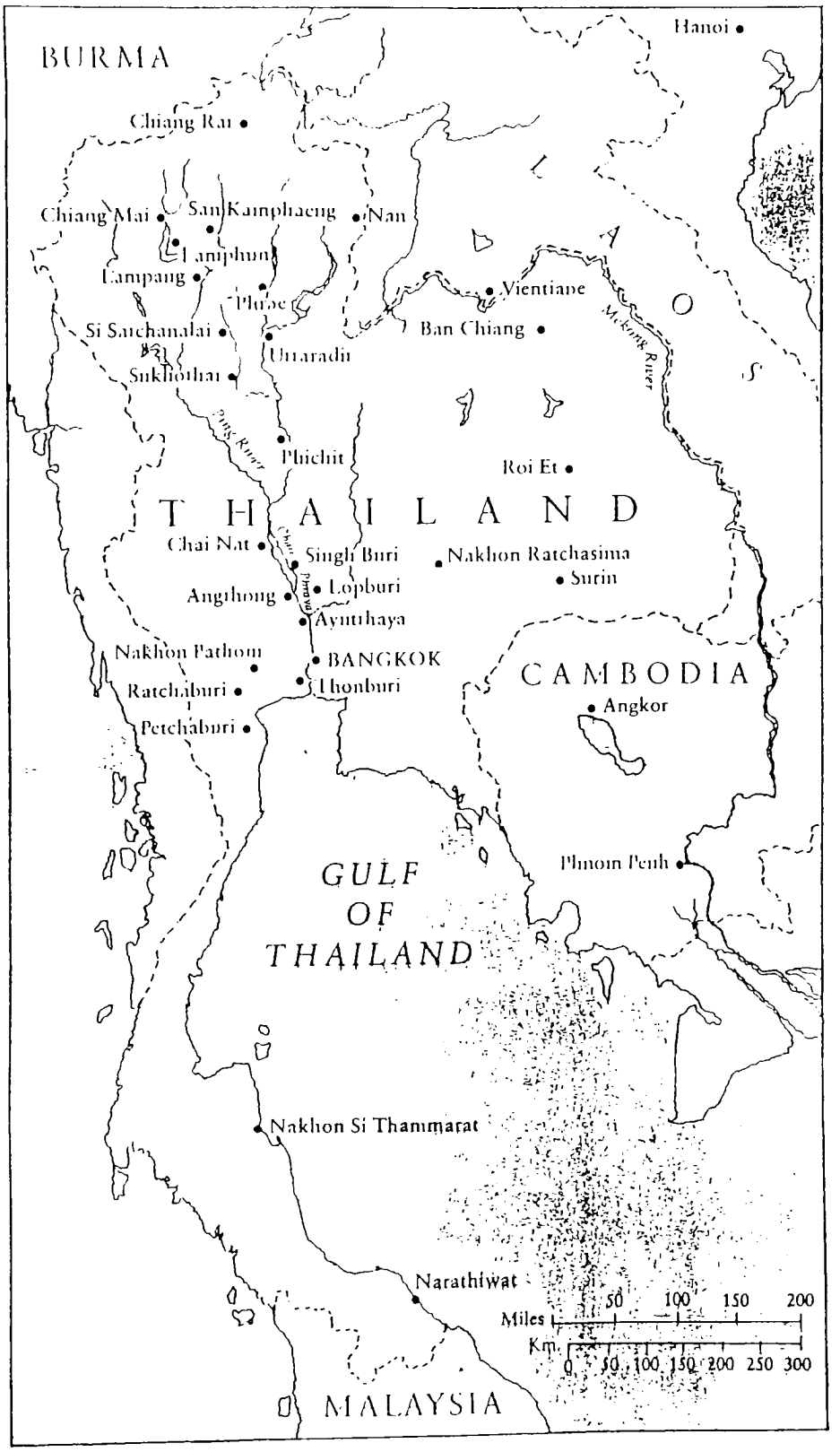
The People

Many theories exist regarding the origin of the Thai people but there is no consensus. Recent archaeological discoveries at Ban Chieng, in Thailand's northeast, point to the existence of a people with a well-developed agrarian economy, herding cattle and using bronze utensils and artifacts dating back to 3,600 B.C. This has led to speculation that Thailand may be the site of the world's oldest civilization.

LIST OF FIGURES

page

Figure. 1 Map of Thailand



(Source: Warren, W. and Tettoni, L.I., Arts and Crafts, page 159)

Again, a very popular theory contends that the Thai people originally inhabited southern China and were slowly pushed out by the Chinese and Tartars over a thousand years ago. The Thai people fled in tribes, working their way southwards over the mountains, until they settled in the fertile Chao Phaya basin and established a Thai kingdom in the 13th century.

Another theory contends that Thais have existed on this land all along and the newcomers from southern China were absorbed into the community living in the Chao Phaya basin.

While Thai boundaries have stretched at various times in the past to various points inside Laos, Cambodia, Myanmar and Malaysia, the heart of the Thai nation has always been the Chao Phaya basin. Covering most of northern and central Thailand, this immensely fertile land has been the home of the Thai people and the seat of administration for over 700 years.

The nation's first recorded history dates from 1238 A.D. when King Intradit established Sukhothai as the first Thai capital. Sukhothai's power soon expanded westwards reaching the Bay of Bengal, southwards towards the Malay Peninsula, and northeastwards to reach Vientiane. Sukhothai reached its zenith in the reign of King Ramkamhaeng the Great, who is acknowledged as the father of the Thai nation. Buddhism became the state religion and numerous temples and stupas were built many of which exist today. "Phra Buddha Sihing", one of Thailand's most revered images, was brought over from Sri Lanka in this period. The image is now kept in the National Museum except on special occasions when it is brought out for worship. Many of Thailand's colorful festivals like Songkran and Loy

Krathong also originated in the Sukhothai days. The Thai alphabet was created by King Ramkamhaeng from existing Khmer and Pali scripts; it is still in use today with some modifications.

The next period, with Ayutthaya as the second capital, lasted from the fourteenth to the eighteenth century. In this period, the Thai nation achieved a level of grandeur and prosperity unequalled in Southeast Asia. Trade flourished with Asian and Western nations and Ayutthaya became a cosmopolitan city.

Ayutthaya was completely destroyed by invading Burmese in 1767, and in December 1768 King Taksin the Great rallied the Thai people in the third capital Thonburi, near the mouth of the Chao Phaya river. Thonburi proved to be a temporary capital as his successor, King Rama the Great (Rama I) moved the capital again across the river to the east bank. Thus on 6th April 1782, Bangkok became the fourth capital of the Thai kingdom, heralding the Rattanakosin period when Thailand opened up to Western influences while at the same time evading direct domination by countries of the West. King Rama I was the first monarch of the Chakri Dynasty, of which the present monarch King Bhumibol is the ninth king. Thailand completed a grand celebration of two centuries of the Rattanakosin period in 1982.

Government

Since 1932, Thailand has been a constitutional monarchy with the King as Head of State and Protector of all religions. In a succession of administrations, the country had moved steadily towards democracy. A permanent constitution was adopted in 1978 which

provided Thailand with its present bicameral governmental system. The Parliament is composed of 270 appointed senators and 391 elected representatives. The Prime Minister is elected from among the members of the House of Representatives.

Monarchy

His Majesty King Bhumibol Adulyadej and Her Majesty Queen Sirikit are both highly respected and revered by the people. Their Majesties, accompanied by the Royal Children, frequently visit their rural subjects in the most remote areas of their Kingdom. His Majesty has personally initiated numerous rural projects such as the building of reservoirs, irrigation canals and agricultural projects replacing opium-growing with cash-crops, brackish water fish farming, development of rice strains and the production of pasteurized milk. All are of great value in raising the living standards of the Thai people. The Thai Royal Family, through their exemplary conduct, have contributed much to strengthen national unity.

Capital

The capital city of Bangkok (officially known as Krung Thep Phra Maha Nakhon Amorn Rattanakosin) with a population of 5.9 million, is the seat of government and the business and industrial center of the country.

Climate

The climate is tropical with much sunshine and high humidity. There are three seasons: Hot from March to June, Rainy from July to October and Cool from November to February. The temperature ranges from about 20 degrees Celsius to 37 degrees Celsius.

Population

The population, predominantly Thai, is approximately 59 million.

Language

The national language, both written and spoken, is Thai, and is used by the majority of the population. English is part of the curriculum in high schools and universities.

Religion

Buddhism is the national religion practiced by 95% of the population. Its emphasis on tolerance has meant an absence of religious friction within the country. There are about 1.8 million Muslims living chiefly in the southern provinces. The rest of the population are Christians, Hindus, Sikhs and others.

CHAPTER I

General Background :

Political and Economic Perspectives in Asia Pacific

Throughout the next quarter century, the western edge of the Pacific Rim is set to be the region of greatest economic activity and economic growth. While the two economies to the north and south of the region, Japan and Australia, are stalled in their growth, or predicted to grow only at the lowest rate (2.0~3.5 percent and 2.5~3.0 percent respectively), the nations in between are in an economic boom. Thailand experienced double digit growth up to 1989/90, but inflation pulled it back to about 4.5 percent after it emerged from its bout of political troubles. The Thai economy is set to grow [1]

Political reform and democracy are also growing apace, with the growth of these regional economies. Reforms in the Indonesian political system opening up the traditional one-party approach; in Malaysia and Singapore, continual free elections; in the Philippines, the return of investor confidence after the Ramos election; in Taiwan, the first free and open elections; in South Korea, the free election of the first civilian president; and in Thailand, the return of democratic government and a respected political leadership all add elements of political stability to those of economic growth.

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[1] Review of growth statistics: Asian Wall Street Journal: Asian Economic Survey - The 1993 Outlook (Hong Kong 1992)

Even the lagging economies of Japan and Australia are marked by significant aspects of reform, for example, the assault on institutionalized political corruption in Japan and the major efforts at micro-economic, structural and labor market reforms under way in Australia.

"Thailand is one of the regional powerhouses in the economic sense, with strong growth based on several sectors including manufacturing and tourism. Bangkok, Thailand's capital city, is almost becoming the regional capital, being a favored location for foreign company headquarters in the region, relocating pre-1997 from Hong Kong and housing several UN and international agency offices." [2]

[2] Lauhawatran, S.: Reaping Thailand's Field of Opportunity

CHAPTER II

Key Packaging Technology in Food Packaging

The Role of the Asian-Pacific Can Co. Ltd. in Packaging Technology

Through the establishment of Asian-Pacific Can Co. Ltd. (APC), the first joint Thai-American can-making venture in Thailand, in June 1988, there has been the transfer of much-needed modern packaging technology and expertise in Thailand. The Van Dorn Company, a leader in packaging innovation in the United States, brings many of the innovative packages to Thailand through APC. Using the latest high technology equipment, APC's ultra-modern plant in Thailand features a high-speed can output of 600 cans per minute. APC's draw/redraw process forms the entire can body from a single sheet of pre-lacquered tin-free steel, creating a two-piece can with only one seam, between the single unit body and the lid, which eliminates the risk of lead contamination from the lead-prone seams common to conventional three-piece cans.

The result is a quality container with easier stackability, futuristic appeal and longer shelf-life. At first, APC supplied cans to three seafood processors: SCT, Unicord Co. Ltd., and Thai Union Manufacturing Co. Ltd., whose products were mainly such prestigious brands of canned tuna as Starkist, Bumble Bee and Ralston Turina, among others, aimed basically at the U.S. market.

APC's final production line uses a hi-tech tester which can detect even the slightest opening in a can. If defective, cans are automatically discarded through a disposal channel.

APC also works closely with clients in various areas: marketing objectives analysis, evaluation of packers' needs before designing and fabricating food-compatible and cost-effective containers. The company stresses after-sales service and closely monitors feedback from food processors and customers.

With constant access to research and technical support from Central States Can in the U.S., APC can also diversify its product line to manufacture lightweight aluminum containers, composite packages and plastic packages.

APC believes that good packaging benefits Thailand's processed food exports which, in turn, stimulate demands for agricultural products. The company's continued development in this field will undoubtedly benefit the Thai economy and support the government's long-term plan to make Thailand an agro-industrialized country.

The Establishment of a Thai Packaging Center Under the Thai Institute of Scientific and Technological Research (TISTR)

Under the National Economic and Social Development Plan, a Thai Packaging Center was established under the Thai Institute of Scientific and Technological Research which has as its goals the improvement of packaging, the reduction of losses in areas such as food and the increase in export and upgrading of packaging standards in the country. The growth of preference for one-way packaging is also leading to an increased emphasis on recycling programmes and technologies (especially in Bangkok) with all recyclable glass being collected and PET bottles kept for use as multi-purpose containers.

TISTR performs many functions such as:

a) initiating and conducting research and providing scientific and technological services to state agencies and private enterprises for the country's economic and social development;

b) conducting scientific and technological research in order to promote the utilization of natural resources appropriate to the economic conditions, environment, health and welfare of the people;

c) improving productivity in accordance with government policies by propagating the result of scientific and technological research to benefit the country in agriculture, industry and commerce;

d) training scientific and technological researchers;

e) providing for testing and measuring services and other scientific and technological services.

TISTR obtains its funding largely from the government budget and government grants, with minor income being earned from contract and service fees. Most of TISTR's research projects tend to be oriented towards the agro-industry. In 1988 TISTR had 24 in-house projects and 26 other research projects for outside institutes for both the public and private sectors. Analysis and testing services form a major part of TISTR's activities and in 1988, it performed 33,126 service jobs. It also operates the Thai National Documentation Center, providing a great deal of reference publication services.

Technology in the Packaging of Seafoods and Pineapples and Other Fruits

Thailand is the second largest exporter of seafood and the world's largest producer of canned pineapple and exporter of pineapple juice. The export of pineapple juice escalated from a mere US$17 million in 1987 to US$108.3 million in 1992.

The basis of the seafood industry is shrimp. Thailand produced 32.5 percent of the world's shrimp production in 1993, and is expected to improve production in the future. The country doubled its 1992 production in 1993 to 155,000 tonnes, and is expected to raise it to above 160,000 tonnes. It has now twice the capacity for farm-raised shrimps than any other country in the world.

Thailand may have come out on top of the shrimp industry, but the National Institute of Coastal Aquaculture in Thailand reports that there is residue in the shrimps from the excessive use of antibiotics. In the seafood export industry, quality control is a potential obstacle.

The USA is not only the largest market for Thai tiger shrimps, but together with the EC, it is one of the two largest markets for canned tuna, importing 32,318 tonnes of canned tuna between January and October 1993. At the end of 1993, the USAFDA set a limit on histamine levels in canned tuna, and concern over quality standards was matched by a dramatic fall in the total Thai export of canned tuna from 243,590 tonnes in 1992 to 200,000 tonnes in 1993. The cost of testing for histamine levels is US$3,400~3,600 per container and up to two weeks delay, a high price to pay for some shipments.

The total export of canned pineapple has remained much the same at about 79,277 tonnes in 1992 and 80,600 tonnes in 1993. Other canned fruits for export have also remained

unchanged for the period, while the total exports of other canned fruit juices were marked by a remarkable increase of more than 100 percent from 21,626 tonnes in 1992 to 48,000 tonnes in 1993.

Due to the advanced canning technology in Thailand, the above products packaged in cans, and of good quality, are able to compete in the world market.

Packaged Drinks in Thailand and Restructuring by Investing in New Plants and Machinery

Thailand , like other countries in Southeast Asia, has caught the popular culture of European and American society typified by an obsession with health on the one hand and fast food on the other. In Thailand, these consumer tastes translate into restructuring and new investment in the food processing industry. In particular, it is the beverage industry that is affected by this trend.

The entire packaged drink market in Thailand worth US$1 billion is expected to grow. The packaged drink market is traditionally dominated by the soft drink sector which reaches a US$480 million mark. In comparison, the juice market is worth US$39~47 million, while mineral water is only US$3.1~3.9 million, 80 percent of which is imported [3]

During examination of the growth rate of the industry, trends strongly indicate a movement away from carbonated soft drinks to health-oriented packaged drinks like juice and mineral water. The strength of the growth in the juice and mineral market has meant that a lot of companies are now restructuring either by changing to the production of these items or by investing in new plants and machinery.

[3] Competing in the Fast Lane: Asia Pacific Food Industry, March 1994.

Northeast Agriculture Industry Company, a company that produces tomato paste, will be going into the ready-to-drink juice industry expecting to capture 10 percent of the market. It has invested US$1.2~1.6 million to expand its plant and produce 50 million units, an investment figure that is expected to rise to US$7.8 million by 1995. Another company that is shifting into ready-to-drink juice production is the beverage company, North Star. It has launched a new juice product called Orangina that is retailed through 5,000 grocery outlets and is targeted at health-conscious 15~20 years olds.

The attractiveness of the juice industry has also lured companies outside the soft drinks industry like Boon Rawd Breweries. The producer of Singha beer has planned to introduce canned fruit juices and canned vegetables, home grown on its own farms to ensure freshness.

The Packaging of Beer in Thailand

The Thai beer industry is thriving. Beer, like health-oriented drinks is now a product of prestige and the beer industry has attracted many investors. Danish Carlsberg went into a venture through the producer of Mekong beer in May 1993, investing in an $80 million plant that is now producing over 1 million hl a year. Heineken is also in a joint venture with Asia Pacific Brewery of Singapore to build a new plant that will produce 500,000 hl a year, to increase to 1 million hl later.

Then there are, of course, established breweries like Thai Amarit, producer of Amarit NB, Kloster and Guiness Foreign Export Stout, that has invested US$59 million in a new plant to be ready in 1995.

The packaging of beer in Thailand uses graphics, materials, and technology that are modern in keeping with consumers' tastes, and joint ventures with foreign companies are conducive to applications of new packaging technology.

High-Technology Chicken Processing Facilities in Thailand and Packaging of Chicken

B Food Products International has just unveiled a new US$15 million factory in Lopburi, Thailand, the latest addition to the Betagro Group of Companies, which has another chicken processing factory in Samutsakhorn under Better Foods Co. Ltd., processing 11,000 tonnes of chicken per year.

Despite being one of the most modern and high-technology chicken-processing facilities in Thailand, a large workforce is still needed to man the cutting and deboning stations as well as the yakitori (grilled chicken meat on skewers) production lines. According to Suthep Tirapipattanakul, the company's senior general manager, such markets can gain a competitive edge in the export business. "Customization is the key to success. We have the human resources and expertise to achieve that," said Mr. Tirapipattanakul. With this strategy, the company has managed to fulfill the specific demands of the Japanese, its principal customers. In yakitori production for example, instead of taking the easier means of grilling in an oven, Better Foods insists on employing a team of 70 workers to grill its yakitoris using charcoal. According to Mr. Tirapipattanakul, this caters better to the Japanese preference for a superior taste profile and minimum use of additives. Better Food's commitment to the market even extends to collaboration with companies like Ajinomoto to develop new products exclusively for the Japanese market.

In the last two years, Better Foods has started widening its export base. It recently diversified into other markets such as Europe, Hong Kong, and Singapore. From a share of 90 percent, Japan now takes up only 70 percent of the company's exports. Twenty percent goes to Europe where breast meat is popular, and the remaining 10 percent to Singapore and Hong Kong.

Better Foods offers special cuts and value-added products. A chicken ball and sausage line is already operational in its older factory in Samutsakhon. Grilled yakitori was the first step towards value-added processing and the company will be using its special cuts like skinless, boneless parts as well as mid-wing half cuts as selling points.

Roast yakitori is removed manually from the sticks and packed into 500g bags by a team of 10 workers. These bags are then vacuum sealed by an Olivetti vacuum packer and pasteurized in four Genesis International steam boxes at 90 degrees Celsius. A maximum of 90 bags can be pasteurized at one time. After 15 minutes, the yakitori pieces are unloaded into chilled water at 2 degrees Celsius to lower the temperature of the meat from 80 degrees to 10 degrees Celsius. This process issues a thermal shock to kill any microbacteria present in the cooked products before these are manually transferred to the individually quick frozen (IQF) APV spiral freezer. At the freezer, products are frozen at -40 degrees Celsius for 1 hour.

The Role of Bangkok Ranch Ltd. in the Packaging of Duck Meat Products and the Use of Technology in Packaging

In 1984, a joint venture was established between KCT International Development Co. and a group of German businessmen; Bangkok Ranch Ltd. was born. The company has since grown into the country's first fully-integrated producer and exporter of frozen and value-added whole duck and duck meat products, commanding an impressive 50 percent of the Thai duck market. According to Joseph Hsu, the company's managing director, the current change in retail trends such as the increasing popularity of supermarkets over wet markets, has propelled the demand for frozen products, thus explaining the domestic interest. Bangkok Ranch's frozen ducks and in particular, its boneless breast meat, has won favor among Thai consumers. The company has already mapped out its two-pronged approach for the domestic market: to strengthen its distribution channels, both in the retail sector as well as in the institutional sectors. Through its appointed agent, Bangkok Ranch will be introducing more value-added items such as duck dim sum (dumplings), duck meat roll and other new products to supermarkets to further boost its profit margin. Also in the plan is a product development facility to develop new and innovative products for both the local and export markets. Bangkok Ranch's ultimate aim is to narrow the consumption gap between chicken and duck. To overcome this problem, a series of plans had been drawn up in 1994. The company entered a joint venture agreement with the Coca Group of restaurants to open 30 restaurants with a floor area of 500 square meters each in the next three years. The purpose is to introduce more duck meat to the local market and in particular to demonstrate to the people, the variety of ways that duck can be prepared and consumed. The first of the

five restaurants under the name "Coca-Dalee" opened in mid-1994. Bangkok Ranch is also making attempts to improve the price competitiveness of duck by 2 to 3 percent from its current retail price of US$1.80, which is considered high for the general population.

Domestically, it has created some unique recipes to cater for the local taste palate. Glutinous rice-coated duck meat balls and duck meat rolled with cabbage, corn and long beans are just some of the products which have been launched.

Although Bangkok Ranch's focus has turned inwards to its domestic market, its strength still lives in exports, which represents some 60 percent of its business. In fact, this strength is the primary factor that has kept the company in business for 10 years. Its sound performance is evident in the significant 65 percent market share in the export sector. To date, the company exports 35 percent of its production to Japan and Germany respectively, with Singapore, Hong Kong and Korea taking up the remaining 30 percent.

Today, 10 years since the company's founding, Bangkok Ranch exports to Europe are currently enjoying a growth of at least 20 percent - a more promising rate than the 10 percent in Japan. Germany, in particular, has the greatest potential at present, due to the presence of more than 1,000 Chinese restaurants, where breast meat and grilled parts are in great demand.

Duck processing, unlike that of chicken, is a much more labor-intensive enterprise. This is especially so considering the extent of customization that goes into each batch of products for the different markets. A possible solution to lowering costs of production lies in the maximization of yield from the raw materials. Efforts to improve the genetic breed of the parent stocks towards faster growing birds with the same quality of meat are currently

underway. At the end-product level, the company's research and development team is utilizing other raw materials to complement the duck meat for its dim sum products.

For a long term solution to lower costs, the company is exploring the possibility of setting up a production plant in China in provinces like Jiangshu and Nanjing. The company is investing an initial capital of US$6 million for a factory with a higher capacity than its present one in Thailand. Apart from the range of frozen whole ducks, parts and dim sum, the company will start a ham and sausage line in China.

Meanwhile, Bangkok Ranch in Thailand has two primary stock farms producing eggs in its hatchery and at the same time, selling day-old ducklings to the contract farmers. During its fledgling stage, the company has to purchase live ducks from independent farmers and produce 800 processed ducks per week - a rather ineffective means of procuring whole ducks. The introduction of contract farming to its new breeding farm in Bothong, Chonburi province, ended the struggle for a constant supply of quality controlled live ducks. It also meant greater control over the breeding environment and the feeds which are prepared according to the company's special formulae. For its processing purposes, Bangkok Ranch uses the "Batbalie" and "Peking" breed of ducks weighing 3 kg. These breeds of ducks, renowned for their tasty red meat and pure soft fluffy white feathers, are ideal for processing into either frozen or fresh products. From the farm, a team of 18 workers manually unload the live ducks and hang them upside down onto shackles attached to a running overhead chain conveyor. This leads to the enclosed slaughter by rotating knives lining the slaughterhouse tunnel. Slaughtered ducks move down the line to the scalder for a hot water dip.

Cleaned ducks ready for processing are first graded according to their sizes. The ducks of medium and good texture are selected for processing into whole ducks while the larger ones are retained for cut-ups.

The ducks are conveyed to the packing station. The duck packing process is accelerated by a device which consists of a series of metal plates forming a conical shape. This serves to insert the duck smoothly into the poly bag in one motion. At the cutting station, a total of 80 workers are assigned to the leg, breast meat and by-product cutting and de-boning lines, running parallel to one another. Each line is manned by a team of 25 workers, which is further divided into the cutting and the de-boning operations.

Crates of de-boned meat are then transported manually to the packing station. Wings and feet are manually slotted into 2 kg bags by a team of 20 workers and then sealed in 2 Old Rivers vacuum packing machines and the various parts are sent to the 10 ton chill room for storage at 0 to -5 degrees C to further reduce the meat temperature to -18 degrees C. This process normally takes 8 to 10 hours and the products remain there until delivery.

CHAPTER III

The Role of Packaging In Thailand

Packaging plays an important role in supporting the food processing industries in Thailand and helps to expand Thailand's export more effectively. It is obvious that the future of Thailand's export depends extensively on product packaging. High quality packaging stimulates export and boosts demand among overseas consumers. Thailand, though surging ahead towards industrialization and greater international trade, still lags behind in this very field.

During the past years, Thailand has seen a substantial growth in the export of canned processed marine products in addition to canned fruits and vegetables. And recently, canned tuna and pineapple have topped the overall export volume in the seafood and the fruit categories. At present, the United States is a major purchaser of Thai canned tuna, although a bright future lies ahead for the export of other canned products to the Canadian and European markets. To gain global acceptance, it is important that the Thai packaging industry be improved to meet world standards; this can be fulfilled through close cooperation among Thai can-making and food processing companies.

When Apollo XI landed on the moon in 1965, not only did it fulfill man's ancient dream of setting foot on our closest neighbor in space, but it also marked the overwhelming success of one American company - Central States Can Co. - selected by NASA to produce

special high quality cans to contain processed food served to the astronauts on that historic American space flight.

This amazing invention, the Super-Safe can, certified the advanced technology of Central States Can Co. and enabled the company to take the lead in the American packaging industry a leadership it still enjoys today.

APC's ultra-modern plant is situated at 38/70 Sethakit Road, Moo 8, Tambon Thasai, Samut Sakhon, the province selected, because of its large potential market for the establishment of Thailand's giant marine products industry processing plants.

Production Commitments

Emphasizing product quality first and foremost, APC stresses machine precision, inspection of in-coming material, rigorous between-the-process tests and inspections closely supervised by its professional and experienced technicians.

APC is also able to introduce special containers with no sharp edges, so food processors can easily produce instant and snack foods, taking advantage of its safe, well-engineered containers. APC has also considered making cans for processed fruits and vegetables for export.

CHAPTER IV

Packaging As A Science: Innovations And Material Development

The International Trade Center in Geneva, a part of the United Nations UNCTAD/GATT organization, has issued three more in its series of Export Packaging Notes which are intended to help developing countries export their products.

No.36 covers environmental considerations influencing the selection of export packaging; No.37, the international trade implications of eco-packaging initiatives; and No. 38, reduced oxygen packaging technology.

One of ITC's specific publications, a new manual on the packaging of cut flowers and plants, contains useful information on technical, transport and legislative requirements.

Also from ITC is Note II,18, a calendar of selected exhibitions; and L-4, a complete list of its export packaging publications.

Another publication about packaging, is the EC Packaging Report, a newsletter produced 10 times a year by Agra Europe (London).

In 20-24 pages it provides up-to-date legislation, industry responses, and conference material relating to packaging.

The most recent British Standards pertinent to packaging are: BS 5350 Part B4: Adhesives determination of pot life; BS EN 29I42: Adhesives guide to selection of standard laboratory aging conditions for tests; BS EN 646: Paper and Board intended to come into contact with foodstuffs. Determination of color fastness of dyed paper and board;

BS EN 648: Paper and Board intended to come into contact with foodstuffs. Determination of the fastness of fluorescent whitened paper and board.

In May 1994, the Fourth International Food Processing and Packaging Technology Exhibition ProPak Thailand 1994 was held in Bangkok. C. Melchers and Co. Thailand Ltd., traditionally involved in the import and export of technical equipment worldwide had a stand at ProPak Thailand 1994. It has built a name for itself in the global engineering and technical arena as the source of top performance machinery and systems for high-performance manufacturing. The Company gained this reputation through years of specialization and experience in the marketing, installation, commissioning and servicing of industrial machinery, equipment and integrated manufacturing systems for different industries.

C. Melchers and Co. maintains its tradition of keeping up with the advances of science and technology and continually transfers new technologies to its clients.

Another great success at ProPak Thailand '94 was Newlong Thailand Ltd., which has a proven track record in packaging throughout Southeast Asia. The BD+2 automatic sealer, shown at the exhibition, attracted a lot of attention just as their other display items did. The BD+2 produces consistently strong and attractive seals and is capable of handling most modern packaging materials.

With this unit, the user controls the temperature and not the voltage which is a more accurate and reliable way of getting a good seal at all times. Various optional devices are available such as a safety type, sucker type, double heater type and conveyors with wider

belts. It is very mobile, being mounted on casters; it is also height adjustable and can be tilted up to an angle of 45 degrees in order to adapt to the user's particular needs.

Kirby's Converting Machinery Ltd., UK, showing in Asia for the first time, came to ProPak Thailand '94 and exhibited the latest in Sheet Plant Technology the Flexo Printer Slotter.

Also at ProPak Thailand '94, was Vora Cork Industries Pvt. Ltd., the largest manufacturer/exporter of co-extruded polyethylene foam liners in India. These liners find application as seals for bottle caps and closures. They are made of polyethylene foam core sandwiched between a top and a bottom polyethylene skin layer of minimum 40 micron thickness. This configuration has many advantages such as: smooth surface preventing product penetration; superior barrier properties and lower water-vapor transmission rates result in low permeability of oxygen and moisture thereby preventing product deterioration; no additives in the foam core come in contact with the package contents.

Other leading companies that exhibited at ProPak Thailand '94 were General Machine Impianti of Italy, Germann + Frei AG, and Yih Hwa Enterprise of Singapore.

Since 1956, General Machine Impianti has led the world in the fields of drum production plants, drum reconditioning plants, and leak detection. It gave a demonstration in Bangkok to show that it is really possible to reach a very high production capacity and quality as requested by the market at low costs. With regard to this, the company drew the visitors' attention to the introduction of the triple seaming: a high precision helium tester able to detect a leakage through a 0.02mm diameter hole and a new corrugating machine for the production of a new drum.

To spare transportation costs, General Machine Impianti introduced the new corrugation shape Iso-Container Drum, allowing the transportation of 80 drums instead of 68 standard drums in the space container.

Ever since Germann + Frei AG was founded in 1958, it has been dedicated to the production of machines for canmaking. In earlier years machines for the lower speed range were built, but as the welding machines became faster and faster and the tinplate used thinner and thinner, the company since 1984 has very successfully developed a new line of high speed equipment for operations such as spin flanging, beading and die necking. All these machines are compact in design and very flexible offering short change-over times for diameter and height. Equipped with central lubrication, these proved to be very reliable in heavy three-shift operation and achieved a very good reputation among Germann + Frei's customers. The machines are available as single or combined machines and due to their great precision, these can also easily handle very thin and hard DR-tinplate at production speeds up to 750 cans per minute.

Yih Hwa Enterprise of Singapore exhibited a cutting machine. It also has a wide collection of machines for the packing industry, particularly rewinding machines, slitting machines and cutting machines.

Winners from all over the globe were at ProPak Thailand '94 to attend the Worldstar Packaging Awards Ceremony sponsored by the organizers of the exhibition. A Worldstar Award identifies a fully integrated pack which has already received national or international recognition and which scores highly across a wide range of criteria.

An exhibition such as ProPak Thailand 95 gives Thailand some exposure to scientific and technological developments in packaging on a global scale.

Creative Design Based on Materials and Applications

"In packaging, the creative design process can be approached in many different ways. For some, it starts with a few doodled shapes on a sheet of paper. Others seek inspiration from the marketplace - studying competitive products in their own, or far distant locations." [4]

The creative designer may choose from a variety of materials in the packaging industry. One of these is paper or board. From a structural design point of view, paper's most outstanding property is its stiffness and the ability to form both rigid corners and gentle curves. Novel designs may be obtained from flat material by the use of cutting and creasing techniques. Cartonboard also opens up many possibilities and lends itself to an origami approach. One such example is a two-piece egg pack; a single piece carton with integral divisions; and a self-supporting bake-in cake pack made from a flat round blank.

In Thailand, Tetra Pak (established in Sweden 43 years ago) is one of the leaders in packaging. The company, now 20 years in Thailand, packages mostly milk products. In vogue now is the square-shaped carton for milk products, where the container can hold an ample amount of the products while at the same time making handling and transporting easier as the cartons can be piled up and the shape is space-saving. Tetra Pak does the packaging for Foremost Milk products and the packaging design, done in attractive colors

[4] Packaging Week, Volume 9, Issue 36, March 17, 1994.

with the Foremost logo, gives the consumers an idea of what the package contains and they are assured of a quality product.

Packaging As An Art and Marketing Techniques Continually Developed

A leading organization in Thailand, Continental Packaging Company Limited, comprised of a group of companies with expertise in all aspects of packaging printing, is a good example of effective utilization of the advances of science and technology in packaging globally. With forty years of experience, the Branches produce all forms of packaging and structural designs, creative graphic designs and the final finished package or wrapper. Continental Packaging uses the most advanced printing processes and are the distributors for many of the advanced packaging machines in the world market. As a packaging consultant, it successfully renders services that meet customer expectations. In 1988 it received the Ministry of Industry's Packaging Supplier Award.

It is also known that the Thai Packaging Center, a part of the Thailand Institute of Scientific and Technological Research (TISTR), has developed and supervised standard packaging for fresh fruits grown in Thailand, which is acceptable in many countries abroad.

The goals of the Center are to improve packaging, decrease losses, increase export efficiency and upgrade the packaging standards of the country. The Center offers a complete packaging cycle of services such as:

- contracting research and development services
- testing of packaging materials and containers
- providing technical consultations and advice

- collaborating between users and manufacturers
- conducting seminars, workshops and training programs for individual's need

  publishing technological packaging information
- exhibiting packaging samples
- providing special offers to all members.

An example of Thailand Packaging Center's successful packaging is exotic fruits in standard packaging. Thai fruits are in demand on account of their rich varieties, their beautiful color and their good taste. The standardization of packaging here means that the containers, with properly selected dimensions, are suitable for stacking, displaying, palletizing and conducive to increased transportation efficiency which reduces the investment cost. The selection of materials and structural designs result in the protection of fresh fruits from distribution hazards while at the same time achieving good stacking strength. Providing ventilation proper for the product's physiology assists in the post-harvest treatment and gives the produce optimum protection. On the next page is a Table of Thai Fruits that are packaged for export to many countries abroad, with the corresponding dimensions in mm. and net weight in kilograms.

TABLE 1

Fruit	Dimensions (mm.)	Net Weight (kg.)
Pineapple	400 x 300 x 350	8~10
Pomelo	450 x 350 x 200	6
	500 x 400 x 250	18
Rambutan	400 x 300 x 100	4~5
Sapodilla	400 x 300 x 120	4~5
Sugar Apple	400 x 300 x 120	5
Sweet Orange	400 x 300 x 120	6
Tangerine	400 x 300 x 120	6
Watermelon	480 x 450 x 250	25
Young Coconut	450 x 350 x 200	8~9
	400 x 300 x 120	5~6
Banana	500 x 400 x 230	12
Durian	480 x 450 x 230	12
Grape	400 x 300 x 100	5
Guava	400 x 300 x 100	5
Lynchee	400 x 300 x 120	4~5
Longan	400 x 300 x 100	5
Longkong	400 x 300 x 120	5
Mango	500 x 300 x 100	5
Mangosteen	400 x 300 x 100	4~5
Papaya	450 x 350 x 100	5
	400 x 350 x 350	12

The Thai Packaging Center has developed packaging for mangoes for export to London by airfreight from Chiangmai, a northern city in Thailand. In 1984-1985, the Center, after successfully exporting the mangoes in packaging developed by the Center, published information regarding the packaging procedures used. The features and details of the packaging are as follows:

Material: corrugated fiberboard

Type of box: box cover - FEFCO style 0422, box itself - FEFCO style 0423

Type of corrugated fiberboard: single wall

Type of corrugation: B, example is the box cover - KS185/CA125/KA230,
box itself - KS230/CA125/KA230

Dimensions, the outer sides of the package: 500 x 300 x 100 mm

Dimensions, the inner sides of the package: 480 x 280 x 95 mm

Volume: 12.8 liters

Weight: 500 kilograms

Ventilation spaces: 1.65%

Resistance to impact: box cover - 11.3 kilograms per square cm., minimum
box itself - 16.1 kilograms per square cm., minimum

Water absorption of the corrugated fiberboard: 100 grams per square cm, maximum of the fiberboard for the duration of 30 minutes

Resistance to pressure: 700 kilograms, minimum force

Stacking of boxes: not exceeding 16 stacks

Printed information on box label: printed on the outer side of the package:

- name and address of the sender or the logo of the business organization
- type of product
- origin of the product
- information regarding the product such as quality, variety ,class and quantity
- other information according to specifications of the country of origin

Description of packaging of mangoes: mangoes of the "nam dokmai" variety or "nang klangwan" variety of the size of 240-270 grams (16 pieces of fruit per box) or the size of 271-310 grams (14 pieces of fruit per box), and with mangoes not fully ripe (about70~80% mature), clean and dry, devoid of any disease, and mangoes that have gone through post-harvest treatment before packaging thus ensuring the quality and integrity of the product.

Method of packaging of mangoes: place the mangoes on very thin strips of clean paper to protect them from being damaged; the materials and containers used for packaging must be new and not hazardous to health; the ink printing must not be in contact with the mangoes; each box contains 14~16 pieces of fruit and the weight of each box should not exceed 5 kilograms; the duration of time between harvesting and the time of delivery at its final destination, England, is 48 hours.

Precautions in transportation and handling:

- the empty boxes used for packaging mangoes should not be stored in extremely hot or extremely cold temperatures; also, these should not be subjected to heavy weights placed on top of the boxes
- the correct method of assembling the box for packaging should be strictly followed.

- transporting and handling of boxes containing the produce, mangoes, must be done carefully; the boxes must be put upright; the labeling of produce and other important information regarding the contents of the box should be completed
- the boxes must not be allowed to get wet.

Price of the box: approximately 15 Baht per box, with 2-color printing

Standard tests applied to packaging:

- resistance to impact	ISO 2759
absorption of the fiberboard box	ISO 535
- resistance to pressure	ASTM D 642
- temperature conditions	27 $\pm$ 2 degrees Celsius
humidity	65 $\pm$ 2 %

See Figures. 2 ~9 , pages 35~42.

Thai Packaging Center has also developed standard packaging for fresh flowers acceptable in many countries.

Exotic flowers especially Thai orchids, earn a large amount of foreign currency for Thailand's economy. Proper packaging is important for the Thai flowers and orchids to reach the final export destination in good condition.

The Primary Package has two sizes:

large box with outside dimension of 580 x 380 x 74 mm is used for packaging flowers with less than 550mm in length. This box may contain 80 bunches of hybrid dendrobium with a net weight of 1.2 kg.

- small box with outside dimension of 580 x 190 x 74 mm contains 40 bunches of hybrid dendrobium with à net weight of 720 g.

The Transport package for air freight is described below:

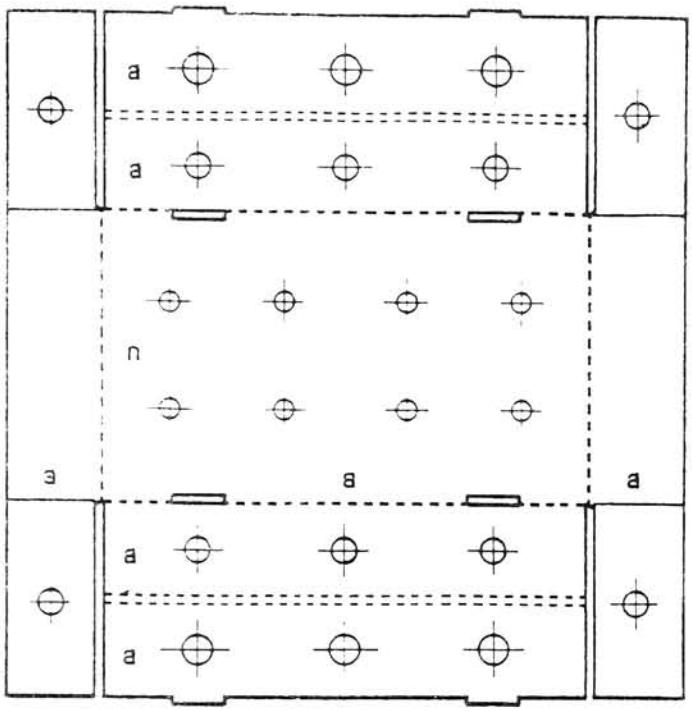
The standard box has an outside dimension of 600 x 400 x 390 mm and fully utilizes the pallet space of 1,200 x 1,000 mm. Such transport packaging can contain 5 large and 10 small primary packages. The compression strength of the box is 370 kgf which is suitable for air freight.

The standardization of packaging has its advantages:

The containers with properly selected dimensions are suitable for stacking, displaying, palletizing and have increased transportation efficiency which reduces the investment cost.

- Good stacking strength: the selection of material and structural design results in good stacking strength for both normal handling and cooling systems.
- Optimum produce protection: efficient ventilation is proper for forced-air cooling systems and keeps flowers in perfect condition.

Figure. 2 Design of box for packaging of mangoes



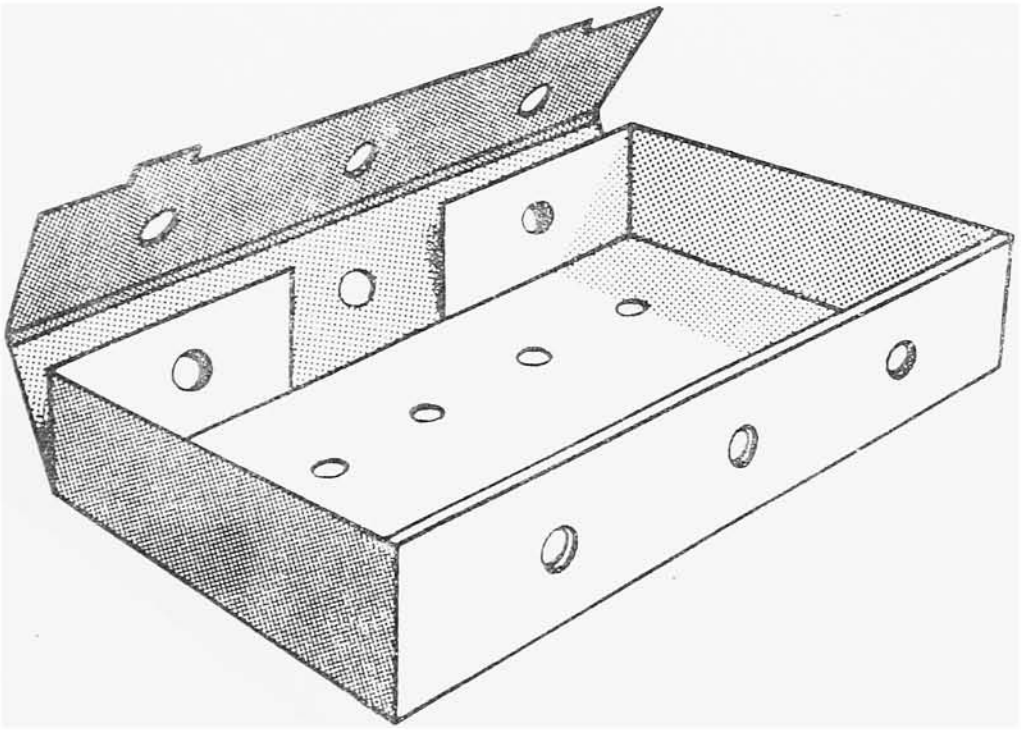
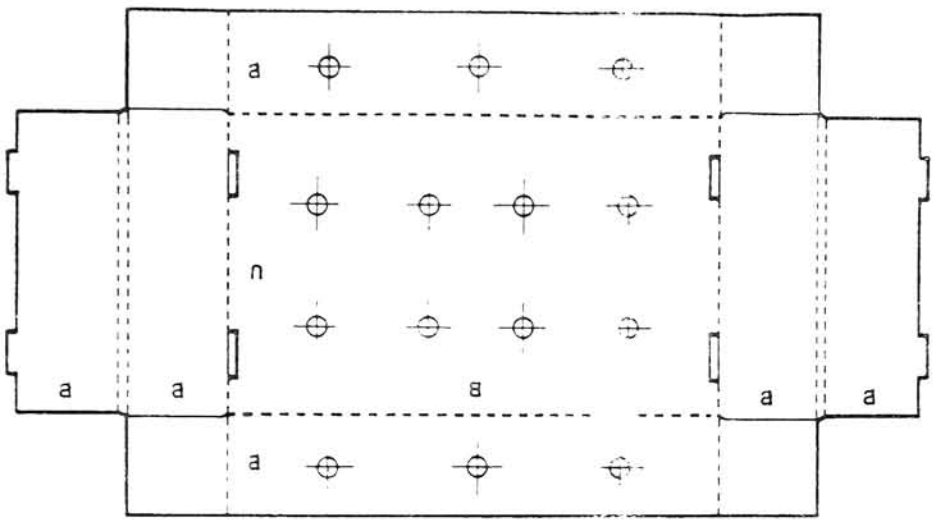


Figure. 3 Design of the box cover



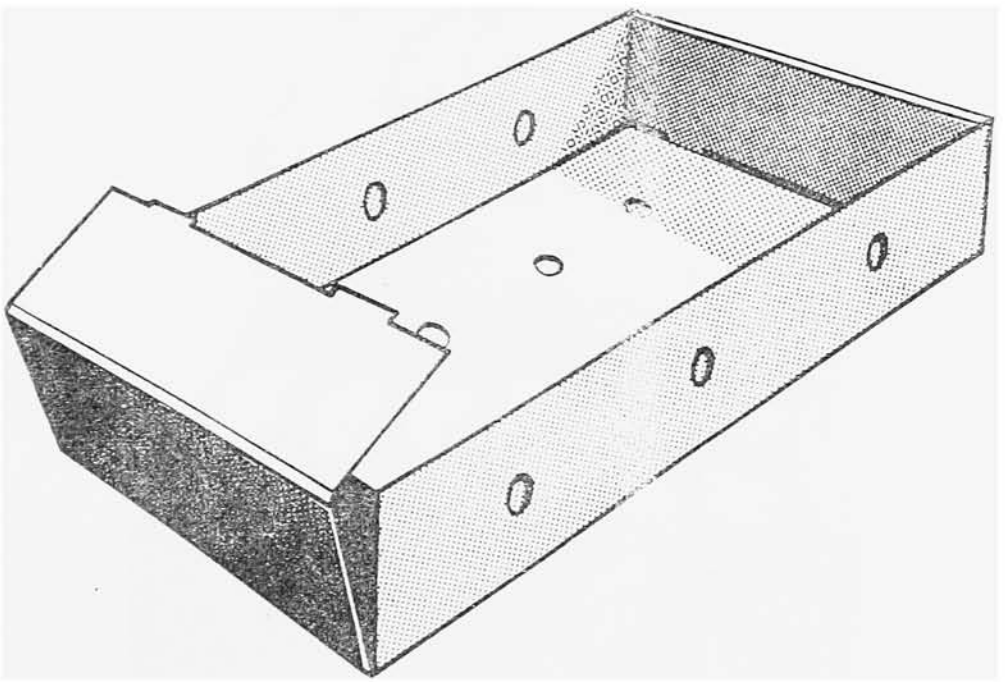
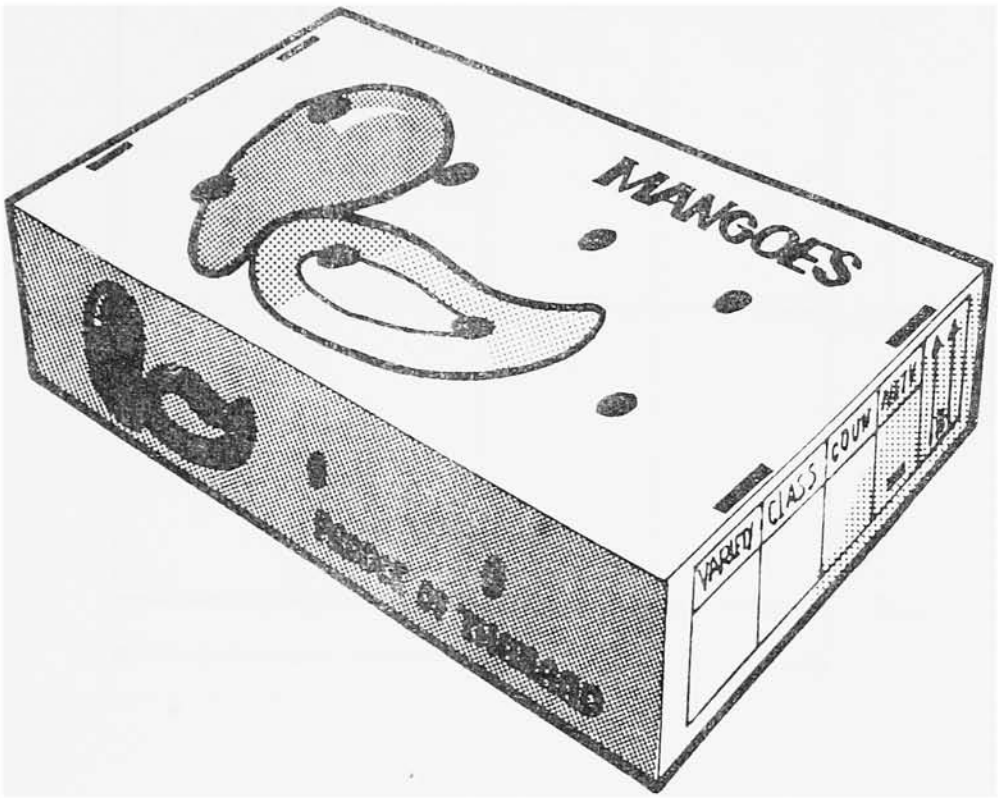


Figure. 4 Graphic design of box and the arrangement of the fruits in the box



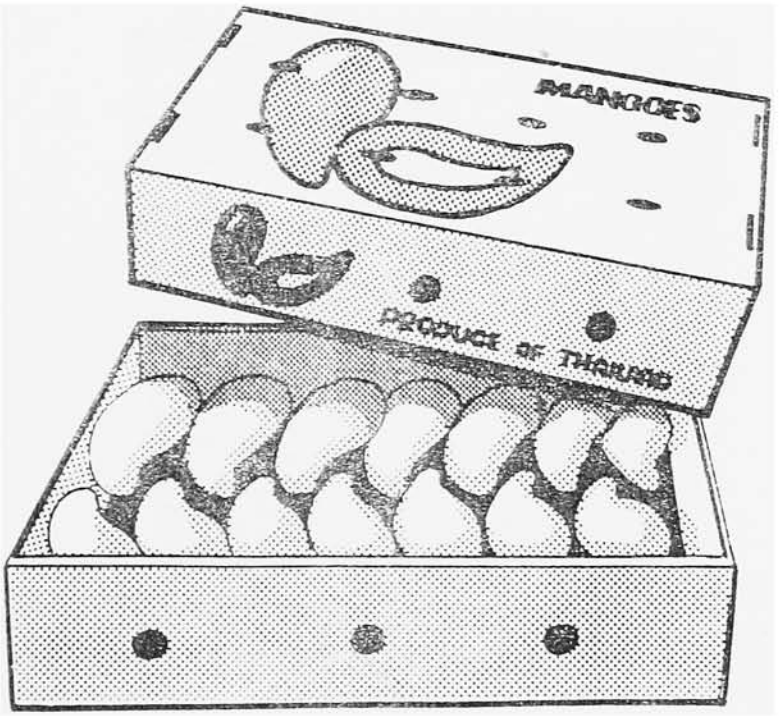
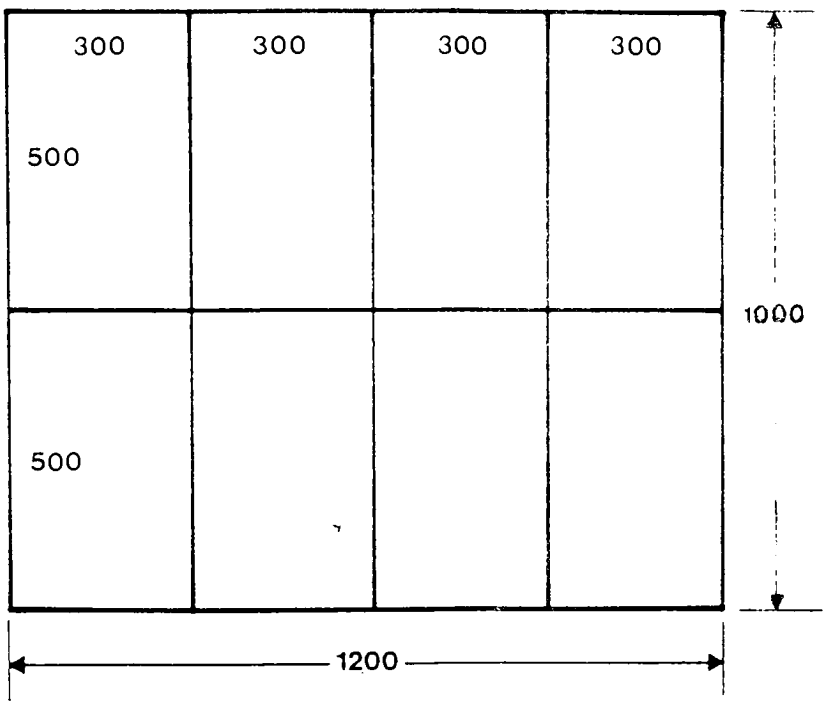


Figure. 5 Stacking of boxes on a pallet, size 1,000 x 1,200 mm.



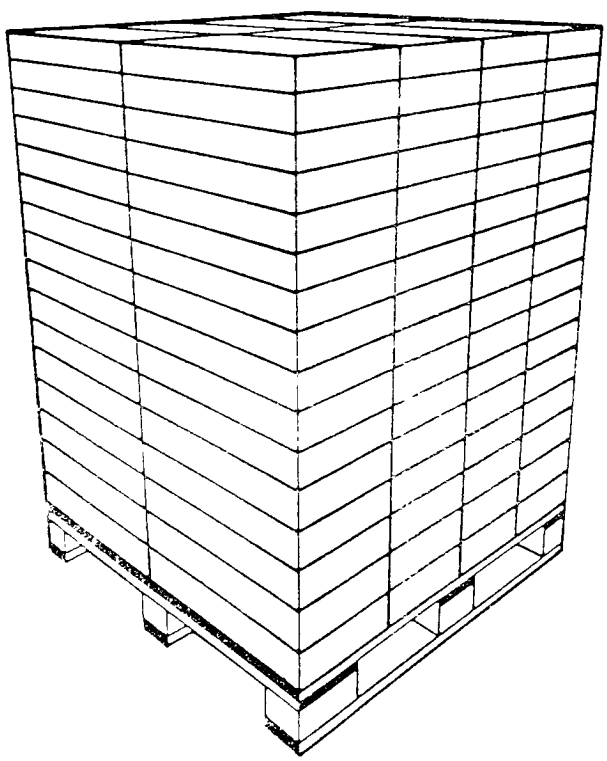


Figure. 6 LD-3 container for air freight

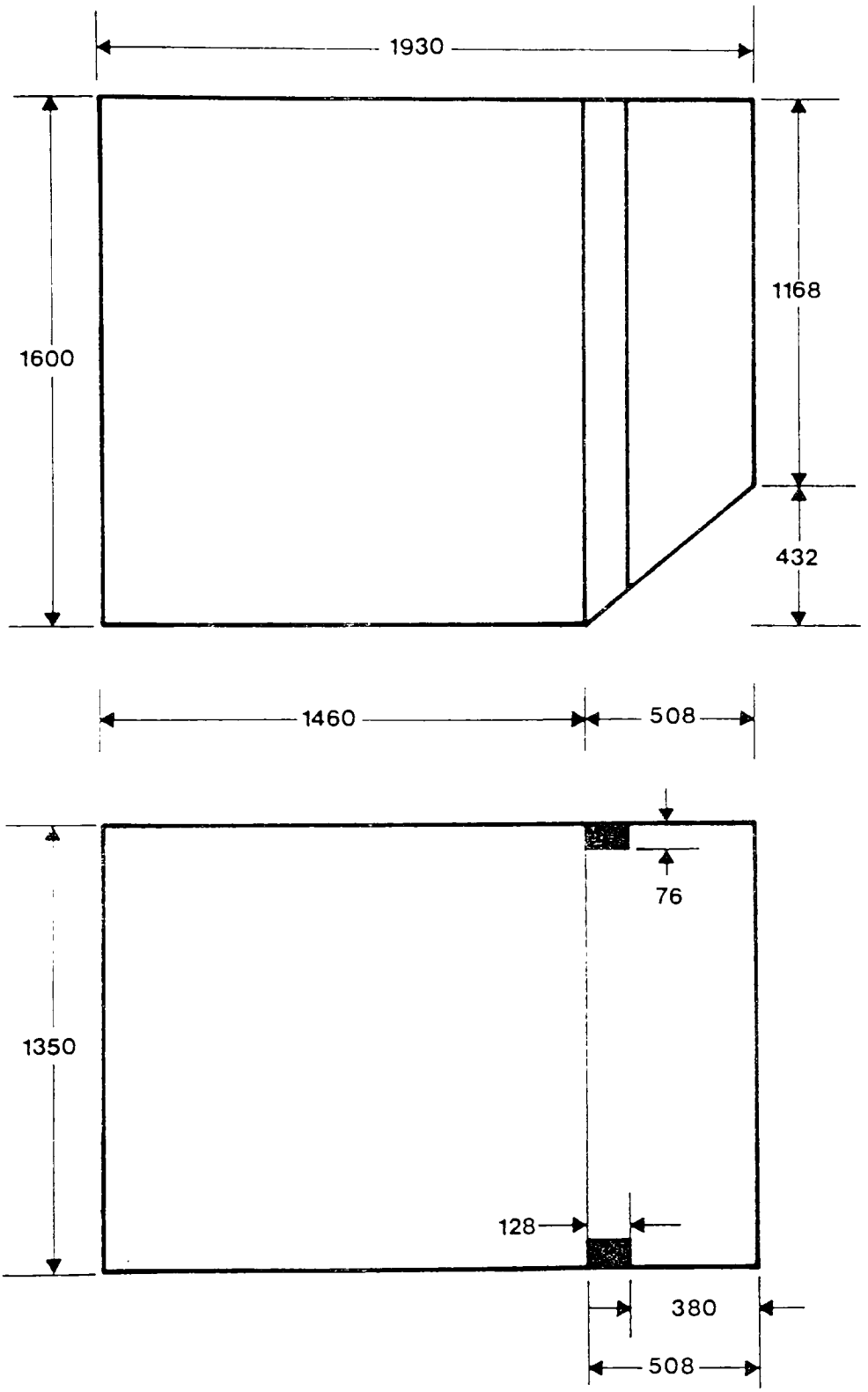
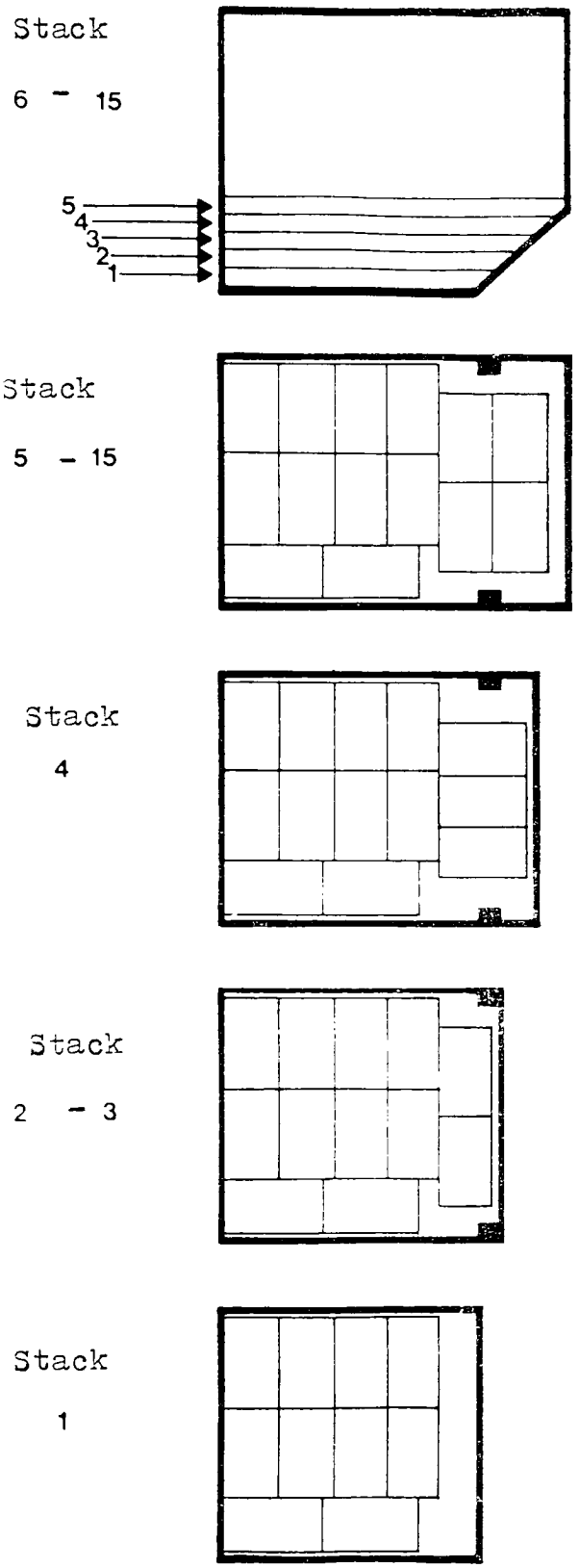


Figure.7 Arrangement of boxes in LD-3 container



No. of boxes /stack		No. of stack
I4	x	II
I3	x	I
I2	x	2
I0	x	I
Total 20I		boxes

Figure. 8 **LD-7 container and arrangement of boxes in container**

Number of stacked boxes per level: 38 boxes
Area used: 92%
Total number of boxes: 552 boxes

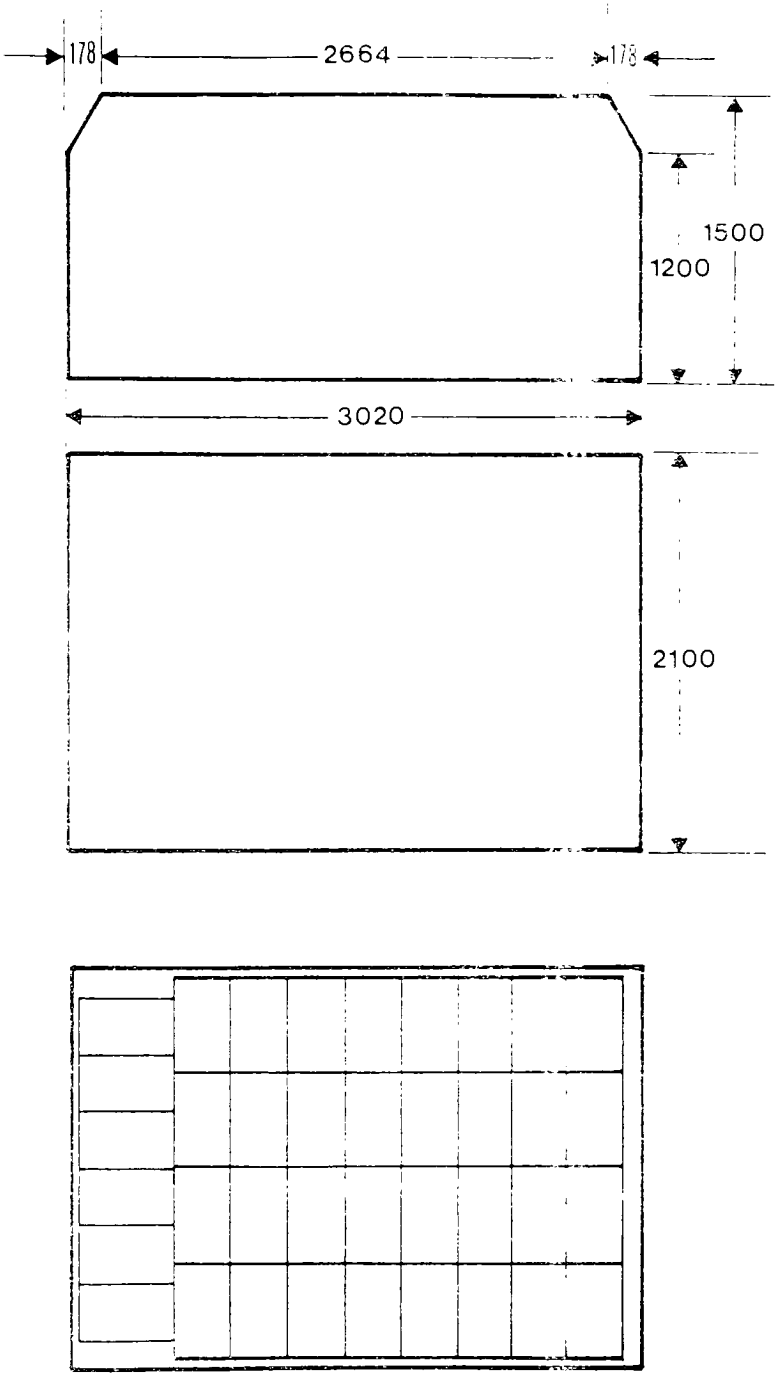
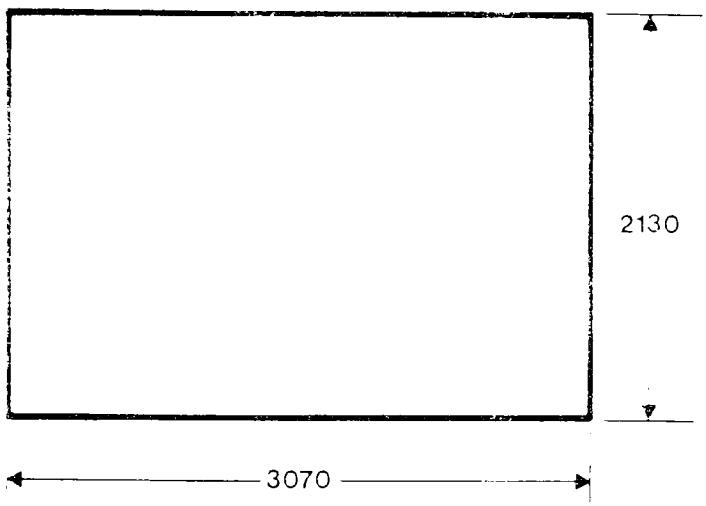
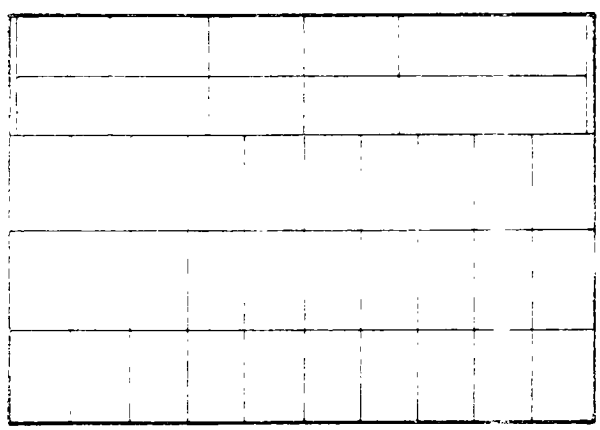


Figure. 9 **Pallet and net container and arrangement of boxes in container**

Number of stacked boxes per level: 42 boxes
Area used: 99%
Total number of boxes: 672 boxes





CHAPTER V

General Trends in Packaging and Trends for Particular Packaging Materials/Methods

"A review of the latest development in the most important aspects of packaging is made mainly to illustrate what is going on in the industrialized target markets for packed products from Asia in order to show what the future competition is likely to be and what packaging requirements face Asian exporters (including Thai exporters) now, and in the future" [5] . The possibilities of complying with these requirements will then depend on the techno-economic feasibility for implementation of the necessary developments in Asia. With the exception of a few of the largest Asian countries, this will pose difficult problems for producers/exporters and will call for unique and innovative action to find feasible solutions for the smaller countries.

The fact that little institutional infrastructure for packaging development and research exists in these countries, Thailand as well, may make it difficult to find such solutions.

1. Worldwide trends in packaging

"In the future, there will generally be more emphasis on compliance with already existing and forthcoming legislation/regulations affecting the packaging and packing

[5] Asian Packaging Directory, published by Asian Packaging Association in collaboration with International Trade Center, 1988

industry. Sudden changes in legislation, as in the past, are likely to continue to take place, making it difficult for the industry to project its investment plans into the future. Ecological considerations will also continue to force industry investment in anti-pollution methods and equipment. Most aspects of packaging will be heavily regulated in the interests of protecting the consumers' health, and of the need for fair trade practices. A case in point is the considerable number of EEC directives related to packaging which have a substantial impact on packaging development in the whole of Europe. Traditionally, regulations have been even more strict in the United States" [6] .

Ever since the start of the energy crisis, with its deep impact on packaging costs, the industry and trade have concentrated their efforts on finding more economical ways of packing their products.

A systematic method to look for alternatives has been carried out with the use of sophisticated research and value analysis procedures. According to Frank Paine, former director of the Packing Division of PIRA in the United Kingdom, these activities have concentrated on finding answers to the following three questions:

How can a package (which does not satisfactorily protect its contents) be improved without a corresponding increase in expenses?

How can a package (which is satisfactory) be reduced in cost without lessening its performance characteristics?

- How can a new product (which has never been packed before for this market) be packaged at an economical cost?

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[6] Ditto.

Under such circumstances, one of the main problems for Asian industry and trade is the lack of technical and commercial information to answer these questions effectively. The development trends in the distribution system in industrialized countries will focus on the increasing labor cost. It is to be noted that the share of the overall distribution costs in Europe corresponds to 60 percent of the retail price of the product, and it is not less than this in the United States. Efforts, therefore must be concentrated on reducing manual handling, speeding up loading and unloading, organizing effective supermarket operations and, from the Asian exporter's point of view, adapting packaging to meet these requirements.

At the present time, about 80 percent of foodstuffs and other household products in industrialized countries are distributed through large self-service, supermarket chains. This package-oriented distribution system is increasing rapidly in less advanced markets and also in other distribution outlets, such as department stores. Self-service is one of ways to reduce labor costs. To fit the distribution systems, products in the future will have to be pre-packed. It is however difficult to foresee how producers and exporters in developing countries will comply with these new requirements.

Against this background, the increase of skills in graphic and structural design of packaging in the Asian region can be considered of great importance.

Consumers are becoming more educated, and aware of protecting their own rights. They are more interested in new products and in information about the composition, origin and quality of these products. The activities of the different members of the family also influence the consumer market, as for example, more working housewives, shorter working hours, or more leisure time leads to more individualism. This, in turn, will promote the use

of convenience foods. Microwave ovens will become increasingly popular. The higher percentage of elderly people in the population and a small average size of the family will promote the use of packaging in smaller unit sizes. However, package sizes will increase as an economy measure. It is difficult to forecast what will happen to promotional/graphic design but the trend to the use of strong brand names seems likely to continue, including own brands used by large supermarket chains. Regulations regarding fair trade practices and required labeling may limit the designer's graphic design presentation. Package design simplification, already seen in European markets, is likely to become popular in North America also. "It will not be easy for producers in developing countries to introduce their own brand names on the world market, and subcontracting under strong umbrella brands in the target markets may be the only solution" [7]

2. Asian packaging trends

In many Asian countries, supermarkets are fast developing and becoming popular. Therefore, demand for packaging will be ever increasing in the years to come in these countries.

As for plastics, these have become cheaper than paper in many ways. There is a trend to move away from paper packaging and as an alternative, to use plastics in packaging instead.

Export products from Asia traditionally sent for export in bulk are sent in retail packs. In effect, this requires rapid development of local packaging technology and skills.

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[7] Adapted, with acknowledgments, from Asian Packaging Directory, 1988, published by Asian Packaging Federation in collaboration with International Trade Center, page 3.

Many of the exporters are small and the machinery and equipment for retail packaging will be more efficient and cost effective if centralized. This would mean contract packing. There is however a cultural block in the region which does not encourage the use of common facilities, but for purely economic reasons, contract packing is the trend.

Because of the shortage of timber, traditional wooden packaging applications may shift towards paper or plastics as alternatives.

3. Trends in particular packaging materials or methods [8]

Wood

Wood is still a popular material, particularly for the packaging of fresh fruits and vegetables. However, future acceptance in target markets is unclear because of the problems regarding disposal of the empty boxes; it is being replaced by die-cut paperboard.

New handling techniques as the use of slip sheets and clamp trucks supplement wooden pallets.

The strength of box constructions is improved by the use of new types of nails.

Many users are moving away from wood in keeping with increased environmental awareness and the concern for forest conservation. However, tea chests still use much plywood.

Paper and paper-based packaging

Even for food packaging, the unbleached or semi-unbleached grades are becoming popular.

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[8] Ditto, pages 3-5.

Plastic films, primarily polypropylene, are replacing regenerated cellulose films (cellophane).

Vacuum metallized papers and paperboards are replacing aluminum foil laminates.

The paper sack industry is looking for new applications for this type of package as, for example, large-sized paper sacks (big bags) have been developed for semi-bulk transports, to replace tea chests.

The pallet bin, made from high-strength corrugated paperboard is another form of semi-bulk package that is becoming more popular.

Corrugated boxes with plastic liners (bag-in-box) are being used for liquids in increasing numbers.

Because of the savings in raw material, wrap-around corrugated box constructions and equipment are gaining popularity for the transport packaging of canned and bottled products.

Corrugated paperboard trays with an overwrap of plastic shrink or stretch film are used for many types of unit package.

Composite paperboard and plastic cans have become acceptable alternatives to metal cans and other types of unit packs. Plastic ends are being used more for paperboard composite cans.

Moulded pulp, made out of recycled waste paper and easily disposable is gaining ground as a packaging material. It is finding new applications in the form of corner protectors and shock absorbing inserts.

Baskets

Baskets are still used for the export of fruits and vegetables. But, since 75 percent of the final cost to the consumer goes towards airfreight, even a saving of 5 percent in damage can pay for a corrugated carton and therefore the trend is away from baskets.

Metal-based packaging

As a raw material for metal cans, the tin free steel plate (TFS) is becoming popular. The side seams are welded or cemented.

Aluminum two-piece cans are giving way to steel, however their position is still retained, for example, for fish canning and for special shapes of shallow cans.

As alternatives to metal cans, flexible, retortable pouches, polypropylene-based plastic cans and composite paperboard cans are being introduced.

The use of beaded metal cans is increasing. They give better strength with less use of material.

Aluminum foils are finding an expanding use as components of flexible packaging materials, but are threatened by the introduction of the vacuum metallizing method.

Manufacturers of aerosols are finding other, safer gases to replace fluorocarbon propellant gases. Mechanical pumps and roll-on dispensing of products have also become popular.

Metal cans are being replaced by plastic cans and composites.

Glass packaging

Glass will continue to be used as a packaging material, contrary to general opinion. The future developments in glass packaging will focus on methods of saving energy in glass

production. In the past, developments in making glass packages lighter and the employment of various surface treatments for additional strength and protection against scratching have been fully utilized. Returnable glass packages are preferred to non-returnable ones.

Plastic packaging

The basic types of plastic materials and their relative popularity are considered here. Polyethylene (PE) will continue to be the main plastic for packaging purposes. The linear low density polyethylene (LLDPE) has been successful;. high-density polyethylene (HDPE) will advance and replace many current applications for paper. Polypropylene (PP), especially oriented polypropylene (OPP), will advance at the fastest rate. OPP will replace regenerated cellulose films (cellophane). Although polyvinyl chloride(PVC) has overcome most of its problems related to toxicity, it remains questionable because of disposal problems. Polystyrene (PS) has difficulties on the basis of price and because of concerns regarding residues of styrene monomer. Expanded polystyrene (EPS) is regarded highly as a shock absorbing material, both in the form of contoured inserts and as a loose-fill material in beads. Vacuum metallized and high barrier plastic films will increasingly replace aluminium foil. Thermoforming will gain popularity, especially using co-extruded materials. The use of multi-layer films will increase, combining high barrier materials such as PVDC and EVOH. Skin and blister packaging will continue in popularity.

In the food and beverage sectors, upright standing pouches of the Doy-pak type will find new applications. Polyester (PET) bottles for carbonated and non-carbonated beverages are used increasingly, in sizes from 3 liters down to 1/2 litre. Products using PET bottles will include syrups, edible oils, salad dressings and liquor. A range of products such as jams,

jellies, ketchups, etc. will increasingly use multi-layer co-extruded squeezable bottles. Food cans are likely to be replaced by retortable pouches and cans made out of combinations of plastics and metal foil regarded as possible alternatives.

Plastic tubes will gain their place in the market from metallic tubes.

Plastic sacks made from woven polypropylene or polyethylene will become a stronger competitor for jute and other textile fiber sacks. The use of large-sized plastic sacks for semi-bulk transport ("big bags") will continue to develop quickly.

Stretch films will be preferred to shrink films, particularly for pallet load overwraps, as they consume less energy.

4. Machinery and methods

Machine users are currently giving priority to reliability, automation, flexibility (that is : providing easier change-overs in size, use of alternative materials, etc.), ease of operation and ease of maintenance. Although development will continue in the construction of machinery for higher speeds, in Asia more attention is paid to slower, more reliable and simple equipment for the small and medium-sized users.

Large-scale equipment will increasingly become multi-functional, that is, the package making and filling/closing will be done on the same machine.

There is a trend towards the use of packaging systems where the user is not obligated by license to buy his packages from one supplier.

New materials for printing plates and the use of infra-red or ultraviolet drying and curing of printing inks are recent developments in the field of printing.

5. Food processing / packaging

Milk, fruit juices and other similar products will increasingly be in aseptic packaging. The use of inert gases (gas packaging) and vacuum packaging will increase also.

If consumers are willing to accept irradiation, it may become an important method to preserve food. Accordingly, the packaging technology will have to make the adjustments to this new processing method. Traditional heat processing has as its alternative, the use of microwave radiation as a method of sterilization and processing.

6. Food and vegetable packaging

Recent findings show clearly the trend towards the use of standard sizes in packaging and quality certification of package materials and construction, especially for export. There is also a trend towards the use of corrugated board thus moving away from wooden packaging. Palletization and other unit load techniques, the use of strong brand names and the use of plastic crates in closed distribution circuits from the field to the packer are other significant trends in fruit and vegetable packaging.

7. Transportation, warehousing and materials handling

To cut down on labor costs, the use of unitized loads will increase and dominate the whole distribution system.

Containerization will increase, especially for intermodel systems. (For example, it is estimated that 80 percent of air cargo costs arise from terminal and ground operations.) Bulk

and semi-bulk handling of products such as cement in bulk, juice and wine in tanks, will increase.

Rack storage in warehouses will be more popular and there will be a need for standard sized pallets and better use of expensive storage space. Also stretch wrapping of pallet loads will be used more than shrink wrapping in order to save energy and materials. To eliminate extra wrapping material, unit load stabilization by the use of palletizing adhesive will be more common.

For packages handled manually, workers in target export markets will insist on complying with the ILO recommendation of 16 kg. maximum weight.

8. Retail distribution in export markets

Standard size retail shelves are used in the retail distribution in Europe, based upon the ISO module 600 x 400 mm. Therefore it is necessary for packages to fit the size of the shelves. Prescribed retail volumes for most products will be introduced and in the EEC countries some are already required. Automatic supermarket check-out systems will increase. In most industrialized countries, it is now mandatory to have all retail products marked with the UPC or EAN bar code symbols.

9. Environment, energy and regulations

Packaging in relation to the environment, and the energy component of packaging will continue to be important political issues. Governments will prefer returnable or reusable packages and more fiscal duties will be introduced to penalize non-returnables. The

recycling of all kinds of packaging materials will increase. Regulatory measures will be diversified covering new areas as nutritional labeling, unit pricing, consumer health protection, fair trade labeling practices, etc.

10. Packaging developments [9]

Many new packaging developments in recent years can be related to the impact of changing energy costs and of plastic resins. Some of the other reasons that have influenced packaging developments include:

a) the lack of re-investment that has been imposed upon many of the aging facilities within the packaging materials industry,

b) the minimal R&D investments for many of the mature products that have served the packaging industry and the constant need of food retailers to develop particular market positions, especially through innovations in packaging design.

As mentioned earlier, the past few years have been marked by many changes with the key raw material industries that supply the packaging industry - paper, glass, metal, aluminium and plastic. Plastics have continued to outgrow competing packaging materials, despite the concerns about oil and gas, as they relate to rising prices resulting from embargoes, scarcity, deregulation, etc.

The yields generated from each packaging material substance is another indicator of actual unit growth. Plastics have led in this area. Improved resin properties have allowed

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[9] Adapted, with acknowledgments, from Business Outlook, published by St. Regis Corporation, Corporate Planning Department.

many products to be packed using lighter film plies or thinner walls for bottles. The numerous advances in plastics and plastic composites have gained more importance in spite of the advances in developing stronger paper grades.

11. Evolution of new packaging trends

Most of the developments in packaging have been well documented in the trade publications. It is known that according to studies made, packaging changes tend to be evolutionary, rather than revolutionary. It seems that once the consumer has accepted a package as a standard within the type of products, its continual use may make it quite difficult for new package concepts to gain ground. This effect is shown by private label brands and most new product entries which try to equal or surpass the market leader's packaging style.

Some of the more important considerations which cause packaging changes to be evolutionary are as follows:

a) the current investment in package handling and filling machinery that exists at food and beverage manufacturing facilities
b) governmental standards and regulations
c) the type and availability of merchandising space at food retailers
d) the available space and method of storage required for a product in the consumer's home.

A change in packaging, for the larger food and beverage manufacturers, is a decision that often rests with the marketing function. In these companies, packaging is one of the

most important components of marketing. Even the slightest change in appearance and function has to be justified.

12. The leading packaging trends in industrialized countries [10]

The following points represent the most identifiable trends in the packaging of food and beverage products in the coming years:

a) Petrochemical based raw materials will be the focus of most new packaging developments. Based upon current developments, this will continue into the future. Most package-producing companies have expanded to include plastics.

b) Aseptic packaging represents the most important new trend in packaging. Its future success will be decided by the consumer, who will have to be educated to the new capabilities afforded by this technology. Its future use could reduce the current need for refrigerated packaging and its related merchandising requirements.

c) Glass, and in some cases, metal-based packaging will be displaced by plastic containers and jars as these gain acceptance. Glass, as a packaging material, is vulnerable, and metal cans as well, although not to the extent of glass.

d) Flexible packaging as a packaging material will continue to grow in its sophistication. Whereas before, flexible packaging used simple films, relatively simple closures and provided minimal barrier protection, this has clearly changed and can be exemplified by the above-average growth of both multi-layer laminations and co-extrusions.

[10] Export Packaging Notes issued by the International Trade Center.

e) Improved packaging performance rather than cheaper materials will achieve a reduction in packaging costs. Packaging has a variety of roles -within the packaging and filling line, in storage, in transportation, as a merchandising and marketing tool and as a functional vehicle for the use of the product in the home. When one considers all the roles that the package must perform, it becomes clear that improved packaging outweighs the need for lower costs.

f) Packaging will get lighter continually. In several of the above trends, one notices a general reduction in the weight of the finished packaging. The use of light-weight flexible packaging instead of metal and glass will reduce the cost of transportation for many products. Lighter packaging would also mean easier-to-carry packages for consumers and retail staff, and lighter pallet loads for the same volume, which should lessen demands on trailers and forklift trucks. Lighter packaging has also shown an increased need for stronger corrugated board outer boxes to provide stronger protection in moving these products to the store.

g) Because of the changing lifestyles and the changing composition of the population, single portion packaging will become a more important factor in the packaging concept and its applications.

h) Glassine and cellophane which are traditional fiber-based packaging substrates will continue to be replaced due to the availability of a wide range of new films, particularly those that can impart extra capabilities to the finished package. Oriented polypropylene (OPP) has been the strongest force affecting the demand for cellophane. Improved

performance characteristics, a lower cost, a plentiful supply and an appearance that looks like cellophane, have allowed this transition to take place.

i) The need for tamper-evident packaging will become more important in the food and beverage market. In industrialized countries, it is believed that any major marketer with a sizable and profitable brand has alternative plans in place, should the government decide that a switch is necessary or if the situation calls for it.

j) With the popularity of the microwave oven (over 50 percent of all households in the USA use microwave ovens), a sizable and distinct packaging market has been created. This trend in the way people prepare their meals has provided incentive for food marketers to prepare their products in trays that can be placed directly into the microwave oven. The oven-proof paperboard, which is used for easy construction of trays, serves the double purpose as a cooking or serving container for the consumer.

k) There are other developments in packaging that complement the above findings such as the following : the future of the retort pouch is uncertain; an increased use of shrink and stretch wrap, for unitized bundling and tray wraps of canned goods; bulk aisle distribution and warehouse stores create new packaging demands; new consumer applications for the bag-in-box, aside from the already known applications in wine; a continued use of metallized plastics materials, although slower in pace than expected; new bulk shipping methods that will try to replace corrugated boxes, especially for lightweight products with some strength in structure.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Thailand is adjusting to changing international and domestic circumstances. There is a growing market for dairy products in Thailand. The Thailand milk market is estimated at 20,000 tonnes. For the first six months of 1994, the sales for ready-to-drink milk products were US$121.38 million, powdered milk, US$80.92 million, infant formula, US$76.87 million, sterilized milk, US$40.46 million and pasteurized milk, US$84.96 million. Consumption of ready-to-drink milk is growing at 15~20 percent annually. A budget of US$80.92 million is allocated yearly by the government for ready-to-drink milk for school children. According to S. Bulakul, president of the Chokchai Group, drinking yogurt has become very popular. Consumption is pegged at about US$48.55 million and is still growing strong averaging 20 to 30 percent a year. In Thailand, the growth of drinking yogurt has been 80 percent per annum for the last three years. In sharing these statistics, the international business development manager of National Dairies, Peter McKinnon is sure that there is a great opportunity to expand dairy products into the Asian market. In many cases, he said, the domestic supply cannot cater for the potential demand for fresh dairy products. The company estimates the total demand for dairy-based products can be increased in the areas of fresh and long-life milk, flavored milk, dairy desserts, ice cream and yogurt beverages. The general trend will be towards fresh, natural, nutritional products with fewer calories (sugar) and lower in fat.

The packaged drink market in Thailand is traditionally dominated by the soft drink sector which reaches a US$480 million mark. In comparison, the juice market is worth US$39~47 million, while mineral water is only US$3.1~3.9 million, 80 percent of which is imported.

Regarding chicken processing, the B Food Products International has one of the most modern and high-technology chicken processing facilities in Thailand and customization is the key to the company's success. With this strategy the company has managed to fulfill the specific demands of the Japanese, its principal customers. It has also diversified into other markets such as Europe, Hong Kong, and Singapore.

Another company, Bangkok Ranch Ltd. plays an important role in the packaging of Duck Meat Products and uses technology in packaging.

The current change in retail trends such as the increasing popularity of supermarkets over wet markets, has propelled the demand for frozen products, thus explaining the domestic interest. Bangkok Ranch's frozen ducks and in particular, its boneless breast meat has won favor among Thai consumers. Domestically, Bangkok Ranch has created some unique recipes to cater to the local taste palate. But, although Bangkok Ranch's focus has turned to its domestic market, its stronghold still lies in exports which represents some 60 percent of its business. It exports its products to Japan and Germany.

It is apparent that packaging plays an important role in supporting the food processing industries in Thailand and greatly helps to expand Thailand's export effectively. Thailand, though surging ahead towards industrialization and greater international trade still lags behind in the field of packaging.

To gain global acceptance, it is important that the Thai packaging industry must be improved to meet world standards, which can be fulfilled through close cooperation among Thai can-making and food processing companies.

The establishment in June 1988 of Asian Pacific Can Co. Ltd., the first joint Thai-American can-making venture in Thailand, provided a channel for the transfer of this much-needed modern packaging technology and expertise. APC manufactures cans for the food processing industry on high speed equipment which uses the most modern technology. The company also works closely with clients and monitors feedback from food processors and customers.

With constant access to research and technical support from Central States Can, APC can also diversify its product line to manufacture light-weight aluminium containers, composite packages and plastic packages. APC believes that good packaging benefits Thailand's processed food exports, which in turn stimulate demands for agricultural products. The company's continued development in the field will undoubtedly benefit the Thai company and support the government's long-term plan to make Thailand an agro-industrialized country.

Aside from packaging news and publications, exhibitions play an important role in keeping up with recent developments. At ProPak Thailand '94, winners from all over the globe were at the exhibition to attend the World Star Packaging "Awards Ceremony sponsored by the organizers of ProPak. Among the leading companies that exhibited at ProPak '94 were General Machine Ispianti of Italy, Germann + Frei AG and Yih Hwa Enterprise of Singapore.

An exhibition such as ProPak Thailand '94 gives Thailand some exposure to scientific and technological developments in packaging on a global scale. This year, another exhibition ProPak Thailand '95 was held in Bangkok with the latest in packaging technology. "ProPak Thailand, now in its fifth year, has become one of the most important global exhibitions for the packaging and processing industries. It is where hundreds of suppliers exhibit products , systems and services that are designed to benefit the processing and packaging in the key areas of quality, productivity and efficiency. Not only can industry visitors see a huge variety of technology and equipment, but it is the perfect and regular opportunity for discussing new ideas, production methods and meeting the industry," according to the guest of honor, Mr. Kasem Snidvongs of the Ministry of Science, Technology and Environment. Also present at ProPak Thailand '95 was Dr. Saipin Maneepun, president of the Food Science and Technology Association of Thailand. He welcomed the opportunity to combine the conference with the ProPak Thailand exhibition as it provides the ideal opportunity for Thai and Asian food scientists to see and question the specialists from many companies offering the latest technology and equipment. Then Mr. C.S. Wong, president of the Asian Packaging Federation, gave a view on the importance of Thailand in Asia's food processing and packaging sector, and the central role that ProPak Thailand takes in providing a meeting place in Asia for the processing and packaging industry.

Pertaining to the subject of Packaging as an Art, the creative design is based on materials and applications. Some seek inspiration from the marketplace, studying competitive products in their own, or far distant, locations. Another approach is to look at

totally different product ranges, considering each form of pack in its functional role, to see if the principle can be applied to other products.

In the previous chapter, general trends in packaging and trends for particular packaging materials / methods are discussed at length. Although packaging in Thailand is in the primary stage of development, it is an area of real growth opportunity, especially in relation to import replacement for items such as Kraft and for packaging which is more consumer-oriented than technology-oriented as is the current position. There is evidence of rising consumer preference for one-way packages (especially in larger-than-liter PET bottles) and in cans (despite their cost disadvantage compared with glass). Packaging in relation to the environment and the energy component of packaging will continue to be important political issues. Many new packaging developments in recent years can be related to the impact of changing energy costs and of plastic resins.

The packaging scene will inevitably face many changes and those companies that can identify future directions will be leaders in the packaging industry in the years to come.

APPENDIX

Names of Selected Suppliers in Thailand and a Classified Index of Products and Services

TYPES OF PACKAGES AND MATERIALS AND SERVICES	NAMES OF SUPPLIERS
Adhesives	3M Thailand Ltd. Adhesives (Thailand) Ltd. Dintex Adhesive Dunlop Thailand Ltd. Eternal Co. Ltd. Henkel Thai Ltd. Kosmik K., Co. Ltd. Siam Glue Co. Ltd. Siam Resin and Chemical Co. Ltd. True International Ltd. Union Carbide Thailand Ltd.
Ampoules/Vials, Glass	Alcan (Siam) Co. Ltd. Alcan Thai Co. Ltd. Metropolitan Metal Co. Ltd. Reynolds Aluminum (Thailand) Co. Standard Foil Ltd. Partnership Udom's Property Co. Ltd.
Bags, Cellophane	Samutprakarn Glass Industry Co. Ltd.
Bags, Plastic	Hiang Seng Fiber Containers Co. Ltd. P.K. Converting Co. Ltd. Siam Kraft paper Co. Ltd.
	Asian Plastic Factory Co. Ltd. Bangkok Polysack Co. Ltd. Blowtech (Thailand) Co. Ltd. Chai Pathana Factory Charmy Products Hercules Export-Import (Thailand) Co.

	K.C. Rubber and Plastics Ltd. Naraipak Co. Ltd. Pacific Polysak Industry Co. Ltd. Phra-Arthit Co. Ltd. Thai Bamroong Import Export Co. Ltd. Thai Poly Knitting Co. Ltd. Thai Saeng Charoen Rubbers/Plastics Mfg. Co. Ltd.
Baskets (Bamboo, Wicker, etc.)	Anny Marketing Co. Ltd. Asian Equator Cooperation Co. Ltd. B.P. Brothers Pte. Ltd. Blowtech (Thailand) Co. Ltd.
Bottles, Glass	Bangkok Glass Industry Co. Ltd. Dodwell Thailand Ltd. Kong Thavorn Pte. Ltd. Ocean Glass Co. Ltd. Samutprakarn Glass Industry Co. Ltd. Sanyei Co. (Thailand) Ltd. Siak Kwang Pte. Ltd. T.P. Intertrade Corp. Ltd. Tae Nguan Seng Heng Ltd. Thai Glass Industries Ltd. Union Glass Co. Ltd. Union Victors Co. Ltd. Winston Glass Manufacturing Co. Ltd.
Bottles, Plastic	Anglo-Thai Industries Ltd. Conimex Co. Ltd.
Boxes/Cases, Corrugated	Asa industry Co. Ltd. Bangkok Package Factory Pte. Ltd. Bangkok Visypak Co. Ltd. Hiang Seng Fiber Containers Co. Ltd. Hiwa International Co. Ltd. Kong Sak Wattana Paper Container Co. Kwang Hua Industries Pte. Ltd. Thai Fiber Containers Co. Ltd.
Boxes/Cases, Wooden, Plywood	Kurt Pte. Ltd. Wongchote Co. Ltd.
Cans, Metal, Food	Asia Cans Industrial Co. Ltd.

	Metal Box Thailand Ltd. Poon Sub Steel Work Press Co. Ltd. Premier Specialties (Int'l) Co. Ltd. Royal Can Industries Co. Ltd. Siam Cans (Hua Eng Press) Pte. Ltd. Soon Huat Cheang Co. Ltd. Universal Steel Co. Ltd.
Cans, Metal, Other	Alucon Manufacturing Co. Ltd. Asia Cans Industrial Co. Ltd. Metal Box Thailand Ltd. Poon Sub Steel Work Press Co. Ltd. Satit Metalpack Co. Ltd. Soon Huat Cheang Co. Ltd. Swan Industries Pte. Ltd. Thai Hoover Industry Co. Ltd. Universal Steel Co. Ltd.
Cans, Composite	Thai Fiber Drum Industry Co. Ltd. Thai Udom Pte. Ltd.
Caps, Closures, Crown	Crown Cork and Seal (Thailand) Co. Ltd. Crown Seal Co. Ltd. Thailand Crown Cork and Seal Co. Ltd.
Caps, Closures, Lids, Other Metal	Grace W.R. (Thailand) Ltd. Sermthai Industry Pte. Ltd.
Caps, Closures, Lids, Plastic	Alcap Closure Co. Ltd. Buathong Wattana Industry Ltd.
Cartons, Folding Paperboard	Continental Packaging (Thailand) Co. Hiwa International Co. Ltd. Niyomchang Packaging Co. Ltd. Printex Co. Ltd. Silp Thavee Press Pte. Ltd. Sriboon Printing Industry Ltd.
Cartons, Rigid, Set-up	Continental Packaging (Thailand) Co. Hiwa International Co. Ltd. Niyomchang Packaging Co. Ltd. Printex Co. Ltd. Silp Thavee Press Pte.Ltd. Sriboon Printing Industry Ltd.

Color Separation/Type Setting	Narada International Co. Ltd.
Consultants	Price and Pierce (Far East) Ltd.
Contract Packers	Custom-Pack Co. Ltd. Jawa Manufacturing Co. Ltd.
Crates, Plastic	Srithai Superware Co. Ltd.
Cushioning Materials	Bangkok Foam Co. Ltd. Ferko Industrial Co. Ltd. Thai Foam Co. Ltd.
Drums, Metal	Satit Metalpack Co. Ltd. Thai Metal Drum Mfg. Co. Ltd.
Films/Sheets	A and B Poly Pack Co. Ltd. A.C. Interchemical Pte. Ltd. Asian Trading Pte. Ltd. Bangkok Polysack Co. Ltd. Bhagwant Textiles Pte. Ltd. Chamnan Overseas Trade Co. Ltd. Hercules Export-Import (Thailand) Co. International Plastic Mfg. Pte. Ltd. K.C. Rubber and Plastics Ltd. Kimpai Litho Pte. Ltd. Naraipak Co. Ltd. P.U. Polytex Pte. Ltd. Phra-Arthit Co. Ltd. Prepac Thailand Co. Ltd. Print Master Co. Ltd. SCT Co. Ltd. South East Paper Industry Co. Ltd. Strong Pack Co. Ltd. Thai Modern Plastic Industry Co. Ltd. Thai Nam Plastics Co. Ltd. Thai Polyplastic Industry Co. Ltd. Towa Plastic Industrial Pte. Ltd. Universe Import and Export
Films/Sheets, Polyethylene, LD and MD	A and B Poly Pack Co. Ltd. Asian Trading Pte.Ltd. Bangkok Polysack Co. Ltd. Hercules Export-Import (Thailand) Co. K. C. Rubber and Plastics Ltd.

	Prepac Thailand Co. Ltd. Print Master Co. Ltd. South East Paper Industry Co. Ltd. Strong Pack Co. Ltd.
Films/Sheets, Polyethylene, HD	A and B Poly Pack Co. Ltd. Asian Trading Pte. Ltd. Bangkok Polysack Co. Ltd. Hercules Export-Import (Thailand) Ltd. Naraipak Co. Ltd. Phra-Arthit Co. Ltd. Prepac Thailand Co. Ltd. Print Master Co. Ltd. South East Paper Industry Co. Ltd. Strong Pack Co. Ltd.
Film/Sheets, Other Plastics	A and B Poly Pack Co. Ltd. Asian Trading Pte. Ltd. Bangkok Polysack Co. Ltd. Bhagwant Textiles Pte. Ltd. Chamnan Overseas Trade Co. Ltd. Hercules Export-Import (Thailand) Co. International Plastic Mfg. Pte. Ltd. P.U. Polytex Pte. Ltd. Prepac Thailand Co. Ltd. Print Master Co. Ltd. SCT Co. Ltd. South East Paper Industry Co. Ltd. Strong Pack Co. Ltd. Thai Modern Plastic Industry Co. Ltd. Thai Nam Plastics Co. Ltd. Thai Polyplastic Industry Co. Ltd. Towa Plastic Industrial Pte. Ltd. Universe Import and Export
Films/Sheets, Shrink or Stretch	A.C. International Pte. Ltd. Asian Trading Pte. Ltd.
Films/Sheets, Printed	Kimpai Litho Pte. Ltd. Prepac Thailand Co. Ltd. Print Master Co. Ltd. Strong Pack Co. Ltd. Export Service Center Industrial Service Institute

Jars/Glass	Bangkok Glass Industry Co. Ltd. Dodwell Thailand Ltd. Kong Thavorn Pte. Ltd. Ocean Glass Co. Ltd. Samutprakarn Glass Industry Co. Ltd. Sanyei Co. (Thailand) Ltd. Siak Kwang Pte. Ltd. T.P. Intertrade Corp. Ltd. Tae Nguan Seng Heng Pte. Ltd. Thai Glass Industries Ltd. Union Glass Co. Ltd. Union Victors Co. Ltd. Winston Glass Mfg. Co. Ltd. Alucon Mfg. Co. Ltd. Anglo-Thai Industries Ltd. Custom Pack Co. Ltd.
Jars/Plastic	Srithepthai Investment Co. Ltd.
Labels, Printed, Paper	Niyomchang Packaging Co. Ltd. Silp Thavee Press Pte. Ltd. Sriboon Printing Industry Pte. Ltd.
Lacquers and Coatings	Aik Hong Co. Ltd. Grace W.R. (Thailand) Ltd. R.J. London Chemical Pte. Ltd. Sigma Paints (Thailand) Ltd. Thailand Paints and Chemical Co. Ltd.
Laminates (with Paper, Aluminum or Plastic)	Bangkok Polysack Co. Ltd. Reynolds Aluminum (Thailand) Co. Ltd.
Machines for Packaging	A.C. Interchemical Pte. Ltd. B.M.C. International Co. Ltd. Bosco Karnshang Pte. Ltd. Kwang Long Machinery Co. Ltd. Narai Enterprise Co. Ltd. Price and Pierce (Far East) Ltd. Santi Phanich Pte. Co. Ltd. Sintraco Pte. Ltd. T. Sureeyont Co. Ltd. Technic Karnchang Factory Unipack International Co. Ltd. Watana Bhand Phanich Pte. Ltd.

Machines: Form/Fill/Seal	Bosco Karnshang Pte. Ltd. T. Sureeyont Co. Ltd. Unipack International Co. Ltd.
Machines: Heating Sealing	Bosco Karnshang Pte. Ltd.
Machines: Shrink Wrapping/ Stretch Wrapping	A.C. Interchemical Pte. Ltd.
Machines: Tube Filling/Sealing, Crimping	Watana Bhand Phanich Pte. Ltd.
Machines: Packaging Manufacture	Kwang Long Machinery Co. Ltd. Narai Enterprise Co. Ltd. Price and Pierce (Far East) Ltd. Santi Phanich Pte. Co. Ltd. Sintraco Pte. Ltd. Technic Karnchang Factory
Pallets	Sinsermwat Co. Ltd.
Paper	Bangkok Paper Factory Co. Ltd. BDF Intanin Co. Ltd. Central Paper Industry Co. Ltd. Eastern Industrial Co. Ltd. Hiang Seng Fiber Containers Co. Ltd. Industrial Krungthai Co. Ltd. Inter Paper Industry Co. Ltd. Mae Nam Paper Industry Pte. Ltd. Patoom Dhanee Paper Factory Ltd. Phoenix Pulp and Paper Co. Ltd. Sahapan Paper Co. Ltd. SCT Co. Ltd. Siam Kraft Paper Co. Ltd. Siam Paper Co. Ltd. Thai Card Board Co. Ltd. Thai Paper Co. Ltd. Thai Union Paper Mill Co. Ltd. Theppattana Paper Mill Co. Ltd. V. Sang Thai Paper Co. Ltd.
Paper. Wrapping	Eastern Industrial Co. Ltd. Siam Paper Co Ltd. Thai Union Paper Mill Co. Ltd. Theppattana Paper Mill Co. Ltd.

Paper, Waxed	BDF Intanin Co. Ltd.
Paper, Printing	Central Paper Industry Co. Ltd. Eastern Industrial Co. Ltd. Industrial Krungthai Co. Ltd. Siam Paper Co. Ltd. Thai Paper Co. Ltd. Thai Union Paper Mill Co. Ltd.
Paper, Kraftliner	Eastern Industrial Co. Ltd. Hiang Seng Fiber Containers Co. Ltd. Inter Paper Industry Co. Ltd. Patoom Dhanee Paper Factory Ltd. SCT Co. Ltd. Siam Kraft Paper Co. Ltd. Thai Card Board Co. Ltd. V. Sang Thai Paper Factory Co. Ltd.
Paper, Testliner	Inter Paper Industry Co. Ltd. Siam Kraft Paper Co. Ltd. V. Sang Thai Paper Co. Ltd.
Paper, Fluting	Eastern Industrial Co. Ltd. Hiang Seng Fiber Containers Co. Ltd. Inter Paper Industry Co. Ltd. Patoom Dhanee Paper Factory Ltd. SCT Co. Ltd. Siam Kraft Paper Co. Ltd. V. Sang Thai Paper Factory Co. Ltd.
Paper, Sack	Eastern Industrial Co. Ltd. Hiang Seng Fiber Containers Co. Ltd. Inter Paper Industry Co. Ltd. Patoom Dhanee Paper Factory Ltd. SCT Co. Ltd. Siam Kraft Paper Co. Ltd. V. Sang Thai Paper Co. Ltd.
Paperboard	Arkaney Paper Manufacturer Co. Ltd. Capital Paper Manufacturer Co. Ltd. D. Sri Rung Kij Pte. Ltd. Eastern Industrial Co. Ltd. Industrial Krungthai Co. Ltd. Siam Kraft Paper Co. Ltd. Thai Card Board Co. Ltd.

	Thai Development Paper Co. Ltd. Theppattana Paper Mill Co. Ltd.
Plastic Resins	Diagias Co. Ltd. Eternal Resin Co. Ltd. Five Dragons Rubber Co. Ltd. Pacific Plastics (Thailand) Ltd. Siam Chemical Industry Co. Ltd. Siam Chemicals Co. Ltd. Thai Nam Plastics Co. Ltd. Thai Petrochemical Industry Co. Ltd. Thai Plastic and Chemical Co. Ltd. Union Carbide Thailand Ltd.
Plywood	A.C. Interchemical Pte. Ltd. Metropolitan Plywood Co. Ltd. Promphan Wood Industries Co. Ltd. South East Timber Trading Ltd. Thai Plywood Co. Ltd. Thai South Forestry Co. Ltd. Tien Hong Industrial Co. Ltd. V and K Enterprise Co. Ltd.
Printing Inks	Dainippon Ink and Chemical (Thailand) Co. Ltd. Eason Paint Products Co. Ltd. Nan Kuo Co. Ltd. Santi Phanich Pte. Co. Ltd. Toyo Ink (Thailand) Co. Ltd.
Sacks	Agripac Manufacturing Co. Ltd. Alphatex Industries Co. Ltd. Bangkok Jute Mill Bangkok Package Factory Pte. Ltd. Bangkok Polysack Co. Ltd. C.P. Poly Industry Co. Ltd. Chum Phae Jute Mill Co. Ltd. Eastern Impex Ltd. Ek-Sin Polysack Industry Hiang Seng Fiber Containers Co. Ltd. Jute and Kapok Industry Co. Ltd. Kadard Rung Rong Co. Ltd. Laem Thong Industry Co. Ltd. Laemthong Corp. Industry Co. Ltd. Nathiphan Industrial Supplier Co.

	North East Jute Mill Co. Ltd. Oriental Jute Mills Co. Ltd. Pacific Polysack Industry Co. Ltd. Park Chong Jute Mill Co. Ltd. Roy Chan Trading Pte. Ltd. Sikew Jute Mills Ltd. Simco Plastic Industry Co. Ltd. Tep Phanich Co. Ltd. Thai Coating Industrial Co. Ltd. Thai Nguan Import Export Co. Ltd. Thai Poly Knitting Co. Ltd. Thai Polylon Woven Industry Pte. Ltd. United Grain Jute Mill Co. Ltd. Universe Import and Export Vibul Paisarn Co. Ltd.
Sacks, Jute/Hessian	Alphatex Industries Co. Ltd. Bangkok Jute Mill C.P. Poly Industry Co. Ltd. C.P. Textile Co. Ltd. Chum Phae Jute Mill Co. Ltd. Eastern Impex Ltd. Jute and Kapok Industry Co. Ltd. Kenaf Export Corp. Co. Ltd. Leam Thong Industry Co. Ltd. Leamthong Corp. Industry Co. Ltd. North East Jute Mill Co. Ltd. Oriental Jute Mills Co. Ltd. Park Chong Jute Mill Co. Ltd. Pathum Jute Mills Ltd. Roy Chan Trading Pte. Ltd. Sikew Jute Mills Ltd. Tep Phanich Co. Ltd. United Grain Jute Mill Co. Ltd.
Sacks, Paper, Multi-wall	Bangkok Package Factory Pte. Ltd. Hiang Seng Fiber Containers Co. Ltd. Kadard Rung Rong Co. Ltd. Vibul Paisarn Co. Ltd.
Sacks, Plastic, Plain	Thai Nguan Import Export Co. Ltd.
Sacks, Plastic/Woven/Net	Agripac Manufacturing Co. Ltd. Bangkok Polysack Co. Ltd. Ek-Sin Polysack Industry

	Nathiphan Industrial Supplier Co. Pacific Polysak Industry Co. Ltd. Simco Plastic Industry Co. Ltd. Thai Coating Industrial Co. Ltd. Thai Poly Knitting Co. Ltd. Thai Polylon Woven Industry Pte. Ltd. Universe Import and Export
Sawn Wood	South East Timber Trading Ltd.
Strapping	Soonthorn Metal Industries Co. Ltd.
Tapes, Paper, Gummed	Bangbon Industry Co. Ltd.
Tapes, Plastic, Self-Adhesive	BDF Intanin Co. Ltd. Louis Adhesive Tapes Co. Ltd. Sang Ngam Stationary Industries Ltd. Union Thai-Nichiban Co. Ltd. Vong S. Phaibal Pte. Ltd.
Tinplate	Thai Tinplate Mfg. Co. Ltd.
Trays, Plastic	Srithepthai Investment Co. Ltd.
Tubes, Metal, Collapsible	Alupact Manufacturing Pte. Ltd. APA Industries Co. Ltd. Metal Box Thailand Ltd. Top Pack Co. Ltd.
Tubes, Plastic, Collapsible	Conimex Co. Ltd.
Twine	Chum Phae Jute Mill Co. Ltd. Roy Chan Trading Pte. Ltd. Siam Brothers Industry Ltd.
Testing Equipment	B.B.C. Brown Boveri (Thailand) Ltd.

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