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& DEVELOPMENT CORPORATION

Pickled and Dried Asian Vegetables

A report for the Rural Industries Research and Development Corporation

by Dr Q.V. Nguyen,
The Horticultural Research and Advisory Station, NSW Agriculture

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Foreword

Processed Asian vegetables are some of the most important foods in Asia. Among 1.5 million tonnes of processed vegetables valued at A$3.1 billion, that were imported into the Japanese market in 1997, processed Asian vegetables occupied 36% of the market share, valued at A$1.1 billion. Main suppliers of processed Asian vegetables for Japanese import market are China, Thailand and Vietnam.

In 1997/98 Australia exported A$40.5 million of processed vegetables but imported about $131.8 million of these products, some of which were processed Asian vegetables.

The researchers emphasise that Australia can produce high quality processed Asian vegetables including pickles and dehydrated Asian vegetables for domestic and Asian markets, particularly Japan.

This report provides a range of information to help growers, producers and exporters to take advantage of these new crops. There is technical advice on materials and methods, results of trials, demonstration and marketing requirements, particularly for the Japanese market.

The report covers financial considerations and commercial benefits, as well as point to future directions and advice on extension and industry adoption.

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Most of our publications are available for viewing, downloading or purchasing online through our website:

- downloads at www.rirdc.gov.au/reports/Index.htm
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Executive Summary

Preface

A remarkable increase in demand for vegetables and products is underway in Asia.

Japan, Hong Kong, Singapore, South Korea and countries in North East and South East Asia annually import approximately US$9 billion (A$12 billion) of fresh and processed vegetables and fruits to feed a combined population of almost two billion and millions of visitors. Of the several countries in the above regions, Japan is the largest market. Japan imported more than two million tonnes of vegetables and products valued at ¥348 billion (A$4.4 billion)in 1997. In the same year, Japan imported almost 1.5 million tonnes of processed vegetables valued at ¥242 billion (A$3.1 billion). Processed Asian vegetables such as frozen edamame (green soybean) and taro, salted scallion, ginger, eggplant and lotus rhizomes and dried bamboo shoot and daikon (white radish) occupied almost 0.5 million tonnes worth ¥88 billion (A$1.1 billion). Processed Asian vegetables have played a very important role in the Japanese import market, occupying 36% of market share. Main suppliers of processed Asian vegetables to Japanese markets are China, Thailand and Vietnam. The USA has supplied the Japanese market only with western vegetablessuch as frozen potatoes, dried onion, processing tomatoes and canned sweetcorn. Australia exported 7,201 tonnes of processed vegetables to Japan in 1997 and this was valued at ¥1.8 billion (A$22.7 million). However, there were no Asian vegetables among these exports.

The gross value of Australian horticulture was A$4.7 billion in 1996/97. Horticulture industry exports earned A$1.6 billion in 1997/98, only 25% of production. Australia exported only A$40.5 million worth of processed vegetables, while importing A$131.8 million worth of these products , some of which were pickled Asian vegetables.

Australian horticulture, particularly the processed vegetables industry, has potential to grow further its export market share in Asia and, in particular, Japan. To do this, the Australian horticultural industry needs to accept change to be more competitive on a global scale. Some of the approaches that need to be taken include the focus on “low prices” to attract the markets and “sunrise” products which are emphasised in value-added products. Pickled and dried Asian vegetables, which are “sunrise” products of Australia, may penetrate Japan’s A$8.8 billion wholesale pickle market if the Australian horticultural industry supports such enterprise.

Summary

1. World production of processing vegetables is estimated at approximately 42-45 million tonnes. However, in Asia, processing vegetables are mainly used for pickles - the vegetables mostly consumed.

2. Of the several countries in North-East and South-East Asia where A$12 billion of vegetables and products are imported annually, the Japanese market offers the best opportunities for Australian horticulture. Because of the large wholesale market of Japanese pickles, Tsukemono, securing a small part of that market would be a commendable feat for Australian exporters.

3. Japanese tsukemono market:

   3.1 There are many types of tsukemono in Japan with shoyuzuke and asazuke occupying more than 50% of market share.

   3.2 Small and medium-sized manufacturers produce the majority of tsukemono for the Japanese market.

3.3 In 1997, Japan's consumption of tsukemono was 1,254,000 t which was valued at approximately ¥423 billion (A$5.4 billion) at the wholesale market. A study of Shokuhin Ryutsu Kenkyu Kai, the Society for the Research of Food Distribution, has shown that the wholesale market for tsukemono in 1993 was ¥692 billion (A$8.8 billion).

It is predicted that Japanese consumption of tsukemono will soon be around 1.28 million tonnes a year. If this proves to be the case, Japan will need to import materials and/or semi-processed vegetables to make up 180-250,000 t of tsukemono.

3.4 In 1997, Japan imported 227,992 t of salted vegetables, 24,627 t of vegetables in vinegar and 49,801 t of dried vegetables valued at approximately ¥63,650 million (A$810 million). Semi-processed cucumber and gherkins, ginger, Japanese apricot (ume; *Prunus mume*), scallion and eggplant are the most important commodities in Japanese import markets.

Kimchi has recently become a major imported commodity in terms of bulk product. The CIF prices remained unchanged in the 10 years from 1988 with the exception of brackens (*Pteridium aquilinum* KUHN) and baby corn.

3.5 Developing Japanese tsukemono sales relies on freshness, lower salt and its reputation of being a healthy food.

4. South Korean kimchi market:

4.1 There are at least 187 types of kimchi in Korea. However, *Baechu* (cut Chinese cabbage kimchi), *Kakdugi* (Diced white radish) and *Dongchimi* (whole white radish in water) are the most popular.

4.2 In 1996, South Korea's consumption of kimchi was estimated at 1,500,000 t of which only 290,000 t (19.4%) was produced by commercial manufacturers. The portion of commercial kimchi production has been increasing by 15-20% per annum. South Korea exported 5% of its kimchi products in 1996.

4.3 Although self-sufficiency production of vegetables is high, South Korea still imported US$140 million worth of vegetables in 1995. Of these, materials for kimchi such as hot chilli, garlic and onion were the main imports.

5. China - the major supplier of processed Asian vegetables:

5.1 Chinese pickle, *Zha Cai*, and *Sauerkraut* from Europe, are believed to be the world's two oldest types of pickles.

The Chinese pickled their vegetables thousands of years ago. Today pickles are becoming an increasingly important part of their diet. With the improvement of trade relations with Japan, China has recently increased its vegetable product exports from ¥47 billion (A$600 million) in 1988 to ¥146 (A$1,857 million) in 1997. This is an increase of 210% in a period of 10 years. Nowadays, China occupies more than 39% of the Japanese vegetable import market which is valued at approximately ¥349 billion (A$4.4 billion) and ranked No. 1 - outyielding the USA with 31%.

5.2 The Japanese import market for salted vegetables in vinegar and dried vegetables was valued at approximately ¥63,650 million (A$810 million) in 1997. China supplied 84% of the market for salted vegetables, 41.5% for vegetables in vinegar and 79% for dried vegetables. China was the dominant supplier for the Japanese market, particularly Asian vegetables such as lotus, scallion and eggplant.

5.3 China enjoys many advantages over other countries in the Japanese processing vegetables import market, because China's pickles are similar to those of Japan. Japanese manufacturers need only to ensure final products suit Japanese taste and flavour. Also, CIF prices for export of China's pickles to Japan are lower due to China's cheap labour market.

6. Vietnam - A rising exporter of processed vegetables for Japanese markets:

6.1 In 1988, Vietnam exported to Japan 828 t of processed vegetables valued at approximately ¥46 million (A$0.6 million). By 1996, Vietnam had increased exports of processed vegetables to Japan to 11,341 t valued at approximately ¥757 million (A$9.6 million). This was an incredible increase in terms of volumes and values respectively.

6.2 Like China, Vietnam with knowledge of products and low prices has similar advantages in penetrating Japanese import markets..

6.3 However, processed vegetables exports from Vietnam are based on spot markets, not on long-term commitment as the Vietnamese authorities have not yet recognised that pickles are a potential export industry.

6.4 But Vietnam's good processed vegetables export results have resulted mainly from the hard work of Japanese trade houses rather than Vietnam promoting itself.

7. Australian Processed Asian Vegetable Industry - A Big Challenge Ahead!

7.1 In 1998, the Australian Asian vegetable industry was estimated at A$60 million. This represented 1.3% of the gross value of Australian horticulture, valued at A$4.7 billion. While the total export of horticulture products was A$1.6 billion in 1997/98, Australia exported only A$40.5 million worth of vegetables for processing. Importation of these products was around A$131.8 million. But no Asian vegetables were exported. Australia, however, imported some pickled and dried asian processed vegetables.

7.2 In recent years, the Australian processing industry has rapidly and significantly changed in an attempt to fit into the competitive "global market". This has been helped by the wide range of climatic conditions enabling production of many types of "clean" and "green" crops, and by advances in processing technology, ready availability of transport between Australia and Asia. Most importantly, with almost 70% of the industry owned and managed by foreign companies, the Australian processing vegetable industry has further export market potential in Asia, particularly Japan.

7.3 To do this, the Australian processing vegetable industry needs to accept changes to become more competitive on a global scale. An emphasis should be on new products especially those involving by value-adding.

7.4 Australia needs to focus on higher product technology and lower costs policies. Asian-born Australian manufacturers are also an advantage to Australia in the development of a processing Asian vegetables industry.

1. Asian Pickle Industries and Markets

1.1 Pickles - History

World production of processing vegetables has been estimated at approximately 42-45 million tonnes, representing 10-15% of total vegetable production (Portos, 1997). The USA is the leading country and processing tomatoes were the main crop in both volume and value. Green peas were the second most popular processing crop which is dominant in cool, summer areas. Sweetcorn for processing is also important in North America and production of processing mushrooms has increased rapidly.

Per capita production of processing vegetables such as canned and frozen vegetables, is high in industrialised countries. For instance, consumption of frozen foods in the USA in 1995 was 57.5 kg/person/annum while in Japan. This was only 15.2 kg/person/annum. On the other hand, the Japanese consumed a large amount of Tsukemono, ie. 14.2 kg/person/annum. In Asia or other developing countries, processing vegetables and pickles are the type of vegetables most consumed.

Pickles were, perhaps, originally designed to preserve food and especially as a means to preserve surplus agricultural products for winter when supplies were scarce. Each household prepared pickles as a matter of course and each village or district created different methods of preserving their food and vegetables, resulting in pickled products unique to each family, locality and country. This phenomenon still exists where there are very distinguishable pickled produce in China, Japan, Korea, Vietnam and many other countries.

The origin of pickles is unclear but it is believed that the world's two oldest types of pickles are *Sauerkraut* from Europe and *Zha Cai* from China (Shimizu, 1993). Although China produces and exports a large number of pickles to Japan and other countries, there is no doubt that Japan and Korea have developed pickles to the stage of being a "Food of Art" becoming a "must" for everyday meals in these two countries.

Japanese pickles, *Tsukemono*, were introduced from China and Korea a long time ago. The history of *tsukemono* goes back to probably around 4,500 years ago. During archaeological excavation in Japan, many pots that are believed to have been used to store wild, edible plants pickled in seawater have been recovered (Inden *et al.*, 1997). According to Shimizu (1993) in Japan, vegetables and salt became an integral part of the Shinto religion. It was believed vegetables and salt were the Gods' precious gifts to the people and necessary for good general health.

One theory about the origins of *tsukemono* is that shrine offerings included vegetables and salt. Quantities were heaped on the altar and, as days passed, fermentation occurred. The fragrant taste and aroma that resulted were found to be pleasurable. *Tsukemono* in ancient Japan was called *shiozuke* (salted pickles) first and then *konomono* or *ko-ko*, which translates as "fragrant things".

Korean pickles, known as Kimchi, were also introduced from China and soon after became a traditional fermented vegetable food of Korea. "A man can live without a wife, but not without Kimchi". For centuries, this ancient Korean saying about the country's fiery national food was not far from the truth. A meal to Koreans meant a bowl of rice and a dish of kimchi.Even today, when the diet in the prosperous south is richer and more varied, few Koreans feel satisfied unless their meal includes at least one pungent, fermented and usually highly-spiced pickled vegetable (Park).

Indeed, Korea's most popular myth gives a special place to garlic, one of the vital ingredients of kimchi. According to the story, a tiger and a bear approached the son of the King of Heaven and asked if they could become human. The sun of the King of Heaven gave each a large bunch of mugwort and 20 cloves of garlic. "Eat this holy food and stay away from sunlight for 100 days," he said, "and you will become human."

Together the two entered a dark cave. But the tiger could not endure the diet or the darkness. He became restless and fled. The bear, however, waited patiently, eating all the garlic and mugwort. When 100 days had passed, she emerged from the cave as a beautiful woman and married the son of the King of Heaven. Their son, Tangun, believed to have founded Korea more than 4,000 years ago, is still revered today.

Throughout East Asia, people have accepted the Chinese belief that the universe is composed of two opposing cosmic forces. The Yang or male force is embodied by the sun, light, progress and growth. The Yin or female force includes the moon, darkness, receding and decay. Like all good things in life, kimchi is said to manifest a harmony between the Yin and Yang. Cabbages and radishes are Yin, while red pepper and garlic are Yang. A balance between the two makes kimchi a healthy dish (Park, 1989).

The first historical reference to kimchi preparation is contained in a Chinese text recorded 1,800 years ago. It says that Koreans were adept at preserving vegetables by fermentation. Beginning in the twelfth century, Korean scholars wrote about sophisticated kimchi preparations.

Of the several countries in North East and South East Asia where A$12 billion of vegetables and products are imported annually, Japan offers the best opportunities for Australian exporters. Because of its large wholesale market of tsukemono, ie. A$8.8 billion in 1993, securing even a small part of that market would be a coup for Australian exporters (Table 1).

This report will therefore focus on Japanese markets to create a first step for development of an Asian vegetable pickling industry for Australia.

World production of processing vegetables is estimated at approximately 42-45 million tonnes. However, in Asia processing vegetables are mainly used for pickles such as Zhacai, Tsukemono and/or Kimchi. They are also the type of vegetables which are most consumed.

Table 1. Wholesale market of tsukemono in Japan in 1993.

Product	Production (t)	Import (t)	Wholesale price (¥/kg.)	Value	
				(¥ million)	(A$ million)
Shinzuke	278,000	N/K	855	237,690	3,024
Shoyuzuke	270,000	N/K	600	162,000	2,061
Nukazuke	158,000	N/K	381	60,198	766
Shiozuke	224,000	N/K	421	94,304	1,200
Suzuke	80,000	N/K	446	35,680	454
Kasuzuke	42,000	N/K	779	32,718	416
Misozuke	12,000	N/K	498	5,976	76
Umeboshi	36,000	417	1,305	46,524	605
Scallion	6,309	22,651	100[1)]	2,896	37
Ginger	2,693	48,186	127[1)]	6,462	82
Eggplant/Scallion	N/K	22,651	100[1)]	2,265	29
Cucumber/Gherkin	N/K	60,840	53[1)]	3,224	41
Warabi[2)]	N/K	13,169	114[1)]	1,501	19
TOTAL:				692,438	8,810

Notes:1) Based on import CIF Price = ¥/kg;

2) Warabi = Bracken; *Pteridium aquilinum* KUHN;

3) Currency exchange in 1999 - A$ = ¥78.6

Source: 1994 Shokuhin Seisan Yunyu Shohi. Shokunin Ryutsu Kenkyu Kai, Tokyo, 1994.

尾 張 名 所 図 会

Painting of Takuan manufacturer in Owari (now Nagoya) Japan probably in Edo Period (1615-1868)

1.2 Japanese Pickle Industry

1.2.1 History

The earliest evidence of *tsukemono* in Japan was found in a document called "Zomotsu Osamecho", discovered at Nara's Todaiji Temple. This document was written more than 1,800 years ago during the reign of Emperor Keiko (71-130 AD) in the Yayoi Period where "Shiozuke" was used as a gift offering to the God (Anonymous, 1983).

Tsukemono that existed during the Edo Period (1615-1868) are well documented. From writings of the time, we know that such pickles as *bettara-zuke, fukujin-zuke, omi-zuke* and *takuan* were used at that time.

Festivals celebrating *tsukemono* are held throughout Japan, illustrating the respect and appreciation that traditional Japanese have for pickled vegetables. Each locality has developed its own style of *tsukemono* and these are sold in specially-designed packaging to be purchased as gifts. They are a favourite souvenir for travellers.

Nowadays, the Japanese have chosen the twenty-first day of each month as Pickle Day to promote pickles in Japanese society. However Japanese use pickles on a daily basis.

As a result of Westernisation of food in Japan, which began in 1950 after the Second World War, consumption of *tsukemono* tended to decrease. Therefore, to promote this industry, many studies were undertaken to re-evaluate the healthy aspects of pickles. These studies confirmed that pickles contain many vitamins and fibre.

A packaging revolution occurred in the 1960s, brought on by the development of petro-chemical industries and technological innovations. It was the time that new *tsukemono* products such as Kizami shoyuzuke (cut vegetables pickled in soy sauce) made its debut.

At the same time, a distribution revolution was initiated by mass marketing food through supermarkets. In response to new demands, some small businesses in the *tsukemono* industry began to introduce modern production, packaging and marketing methods.

The Japanese *tsukemono* industry then began to seek inexpensive produce from overseas and established a raw and semi-processed produce import industry. That has developed into almost a half billion dollar import market today.

The 1960s were also a "boom" period for leisure and sightseeing domestically. This promoted sales of famous local *tsukemono* varieties as a souvenir. Consequently, manufacturers of these products quickly moved into urban districts as tenants of department stores, shopping malls and shopping centres.

During 1970's, health hazards such as high blood pressure etc. caused *tsukemono* manufacturers to decrease the amount of salt and substitute acids and alcohol. Manufacturers were also busily expanding the scale of their business, modernising facilities and building more distribution centres. The consumption market make a shift from producer-orientation to consumer-orientation and mass marketing shops, including supermarkets, began to control prices.

In the 1980s, the growth of low-salt products forced manufacturers to alter their storage equipment. The number of freezer vans and the total area of cold warehouse floors both grew and consumers

began to seek top quality products. Increasingly they emphasised their quality requirements. As consumer taste diversified, food containers and packages grew smaller.

By the 1990s, more attention was being paid to the health aspects of pickles which are now considered not as preserved foods any more, but as new seasoned foods. The increase in consumption of Shinzuke or Asazuke or Ichiyazuke (lightly pickled vegetables) has been remarkable. Consumption of Kimchi and Umeboshi (Japanese apricot pickles) also increased during this period and recognition of the medical properties of Umeboshi, together with the establishment of Rice-ball takeaway in convenience stores, has been responsible for this phenomenon.

1.2.2 Classification of Japanese *Tsukemono*

Tsukemono is a traditional food of Japan and its varieties and tastes are all classified depending on type, origin, method of preservation etc. of raw vegetables. The product classification of *tsukemono*, commonly used by the trade, is as follows:

i) Nukazuke (pickling in rice-bran paste):

Nakazuke is produced by pickling in rice-bran paste and the most popular nukazuke pickle is *Takuan-zuke* (radish pickle). To prepare this type of pickle, dried or fresh daikon radish is preserved in brine for some time, then the radish is placed in a "bed" consisting of rice bran or wheat bran together with seasonings, spices and a colorant. This mixture is called *nuka*, thus the name of the pickle. Besides daikon radish, other vegetables often used include eggplants, cucumbers and carrots.

Rice-bran pickles are rich in thiamin and ascorbic acid.

* *Nuka-miso-zuke (rice-bran pickles):*

Fermented rice-bran paste is called Nuka-miso and is used for pickling various vegetables with the addition of some salt. It has a very strong, distinctive smell, but the pickles have a delicate flavour. Cucumber and eggplant are most commonly pickled in this paste and they are ready to be eaten in one or two days.

ii) Shoyuzuke (pickling in soy sauce):

Shoyuzuke is produced by pickling processed vegetables in Shoyu soy sauce. Brined or dried vegetables are preserved in a seasoning liquid consisting of soy sauce or an amino acid solution. The most popular *shoyuzuke* is called *"Fukujinzuke"*, in which sliced daikon radishes, eggplants, ginger, lotus rhizome, perilla (shiso) leaves, bamboo shoots, *shiitake* mushrooms etc. are used. At present, *"kizami shoyuzuke"* (chopped vegetables preserved in soy sauce) is prepared by using the same technique as *Fukujinzuke*. This has become the most popular variety of *shoyuzuke*. It also uses daikon radishes, eggplants, cucumbers and perilla seeds. Other typical pickles of this group are as follows:

* *Wariboshi-zuke:*

Sliced daikon dried in the sun then preserved.

* *Shiba-zuke:*

A traditional salted and fermented pickle produced with vegetables (cucumber, eggplant etc.) and leaves of perilla. This has a sour taste, is magenta in colour and provides the typical flavour characterises of the quality of Shiba-zuke.

* ***Kimchi:***
  Korean Kimchi has a nice, but very strong garlic taste not popular in Japan. Different from Korean Kimchi, the Japanese version is made from desalted vegetables preserved in salt and then seasoned by a solution containing amino acid and artificial seasonings.

* ***Takana-zuke, Hiroshimana-zuke, Nozawana-zuke:***
  These types are pickled in soy sauce using Takana, Hiroshimana and Nozawana.

iii) Shiozuke (pickling in salt):

Shiozuke is pickled in salt and is prepared by preserving leaf vegetables such as *Hakusai, Nozawana* and *Takana*. Scallions and Japanese apricots in brine also are used. Of the *shiozuke* varieties, that type called "*Ichiya-zuke*" or "*Asazuke*" (meaning "overnight" or "short period" in brine) is the most widely accepted. Materials used in the preparation of "*Asazuke*" are predominantly *hakusai*, but cucumbers, eggplants, turnips etc. are also used. *Umezuke* is prepared by preserving fresh Japanese apricots in brine. *Umeboshi* is a generic term for Japanese apricots first brined and then dried by the sun. *Umezuke* or *umeboshi* preserved in a seasoning solution with Japanese apricot vinegar or citric acid are called seasoned *umezuke* or seasoned *umeboshi* respectively. At present, most of these pickles are prepared by preserving raw materials in a seasoning liquid.

The major *Shiozuke* pickles include:

* ***Umeboshi:***
  A typical Japanese food with a characteristically sour flavour.It is eaten with rice, or by placing into a rice ball, or even placing some pieces into a salad or other food for seasoning. In making *Umeboshi,* Japanese apricots (*Prunus mume* Sieb. et Zucc.) are dried, then preserved in salt, sometimes with perilla (*Pellila ocymoides* L.) leaves which give the pickles their distinctive flavour and reddish colour.

* ***Hakusai-zuke:***
  One of the most popular pickles made with Chinese cabbage (*Brassica campestris* var. pekinensis L.).

* ***Rakkyo-zuke:***
  Rakkyo scallion (*Allium chinense* G. Don).

* ***Tsubo-zuke:***
  Daikon (*Raphanus sativus* L.)

* ***Takana-zuke:***
  Takana (*Brassica juncea* Czern. et Coss.)

* ***Hiroshimana-zuke:***
  Hiroshimana (*Brassica rapa* var. amplexicaulis Tanaka et Ono).

* ***Nozawana-zuke:***
  Nozawana (*Brassica rapa* var. rapa).

iv) Suzuke (pickling in vinegar):

Suzuke is prepared by preserving salted vegetables in a seasoning solution containing vinegar, plum vinegar or an organic acid plus seasonings. Ginger is the most commonly used ingredient, followed in popularity by scallions, turnips and cucumbers.

In addition, there are Kouji-zuke (malted rice pickles), Karashi-zuke (mustard pickles), Moromi-zuke (vegetables pickled in refined sake or soy sauce), Wasabi-zuke (vegetables pickled in wasabi Japanese horse radish, *Eutrema wasabi* Maxim.) and so on. The semi-permeable membrane of plant cells is destroyed by osmotic pressure of the solution of salt or sugar and becomes permeable. In salt pickles, salt permeates into the cell and mixes the internal sugar, acid, free amino acid and AMP to create a nice brewed flavour and taste. The pickles, whose cell membrane is broken to less than 40%, are called Shin-zuke and Asa-zuke. The meaning of Shin and Asa is lightly or for a short while.

Younger people are fond of extra light type pickles. These include lactic fermentation pickles such as Suzuke and Shiba-zuke, and alcoholic fermentation pickles like Takuan-zuke (rice-bran paste type). In the latter lactic acid or alcohol is formed from internal sugar by lactic acid bacteria or yeast and brings out a delicate taste and flavour. In seasoned pickles such as Fukujin-zuke and Rakkyo-su-zuke, cell sap elutes out and is substituted by seasoning solution.

v) Kasuzuke (pickling in sake-lees):

Kasuzuke is pickled in sake-lees by preserving salted or dried vegetables, wild plant shoots etc. in a "bed' of sake-lees containing seasonings. Of all the *tsukemono* varieties, this has been regarded as the best of pickles. Introduction of vacuum packing and portion packages has increased its popularity. The typical product is called *narazuke* and *uri*-cucumbers are commonly used. In addition, daikon radishes, cucumbers, watermelons, eggplants, bamboo shoots, wild plant shoots etc. are used.

vi) Misozuke (pickling in soybean paste):

Misozuke is pickled in soybean paste called "Miso" by preserving brined vegetables, wild plant shoots etc. in a "bed" of miso paste containing seasonings. Materials used include daikon radishes, eggplants, cucumbers, turnip, ginger, *uri*-cucumbers etc.

Wild, edible plants from mountainous regions are also used for misozuke. This is called *Sansai* misozuke. Miso is a typical Japanese seasoning and is made from soybeans mixed with special yeast and some salt, and then fermented. It is mainly used for Miso soup, but vegetables, meat and fish can also be preserved with it. It lasts for several years without deteriorating or decomposing.

vii) Others:

Miscellaneous *tsukemono* varieties include *"kome kojizuke"* which uses a "bed" of rice malt containing seasonings to preserve daikon radishes and *"karashizuke"*. *Karashizuke* is made from small and medium sized eggplants placed in a seasoning liquid containing Japanese or western mustard powder, rice malt, extract of fermented rice and sweetened sake etc.

There are many types of Tsukemono in Japan. Shoyuzuke and Asazuke have more than 50% of the market share. Takuanzuke, which was once the most popular tsukemono, now commands only 10% market share.

1.2.3 Characteristics of the Japanese Tsukemono Industry

A 1996 survey found the number of businesses employing more than four workers in the production of Tsukemono was 2,123. Not much has changed in comparison. Figures in 1985 showed it was 2,229. Each year another 30 to 70 new manufacturers emerge (not included in the survey undertaken), taking the total number of Tsukemono manufacturers in Japan to approximately 3,000.

Based on employee numbers (MITI, 1985), 66.1% of production of Tsukemono is made by the manufacturers who employ four to 49 workers.Those who employ 50 to 99 workers total 21.4% and 12.5% for employers with more than 100 workers. This shows that the Japanese Tsukemono industry is made up of small and medium sized companies which produce 87.5% of Tsukemono products (Fig. 1).

According to Zen-Nippon Tsukemono Kyokai (All Japan Tsukemono Federation) in 1985, more than half of all manufacturers in Japan were involved soley in production of Tsukemono. About 42% acted both as manufacturers and traders (Table 2).

- **Smalls and medium sized manufacturers produce the majority of Tsukemono products;**
- **Companies that exclusively manufacture Tsukemono make up the majority of the industry. However, companies who manufacture as well as wholesale the product are on the increase.**

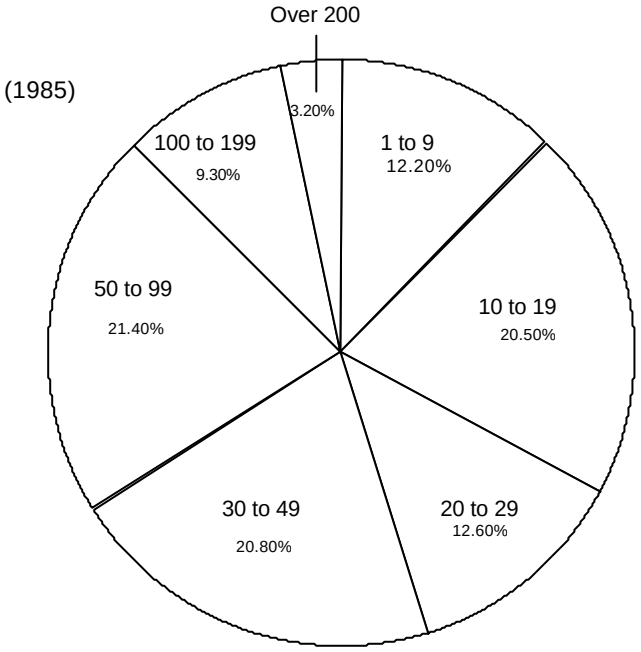


Fig. 1: Production shares of Tsukemono by employee scales (Source: Access to Japan's import market, Tsukemno, JETRO, 1988)

Table 2: Number of Tsukemono manufacturers by business structure.
(Source : Access to Japan's import market, Tsukemno, JETRO, 1988)

Business structure	**No. Firms**	**Share**
Manufacturing alone	895	58.0%
Manufacturing and wholesaling	487	31.6%
Manufacturing and retailing	95	6.2%
Manufacturing and some other business	65	4.2%
TOTAL:	1,542	100.0%

1.2.4 Domestic Production

The production of Tsukemono in 1997 was 1,087,534 t. This was the 15th successive year that Japan produced more than one million tonnes, stabilising its position at 1-1.1 m tonnes per annum. (Table 3). However, it falls short as consumption of Tsukemono is higher, at around 1.2 million tonnes per annum. According to *Fujikeizui* (1998), consumption of Tsukemono during the 21st century will be about 1.28 million tonnes per annum (Table 4). Volumes will need to be imported, with around 180-250,000 tonnes per annum needed.

Shiozuke production totalled 187,966 t representing 17% of the total market. There has been a steady increase to 103% over the 22 years from 1975. Umeboshi and Umezuke production grew to 43,538 t, an increase of 197% since 1975.

Suzuke production reached 82,354 t, representing 7.6% of the total market. During the 22 years since 1975, Suzuke consumption increased only by 11.9%. While output of pickled scallions and ginger has fluctuated over the years, current growth is flat.

Asazuke was previously grouped with Shiozuke (pickling in salt). But the fast growth of this type of Tsukemono has made it one of the most important and popular variety of Tsukemono in Japan today. Asazuke ranks second in popularity, accounting for 27.2% of the total market - an increase of 78% in the 22 years from 1975. Asazuke peaked in 1990 with 320,476 t produced. As it is relatively easy to prepare and, more importantly has many health benefits, it was made in almost every household to outstrip the stagnating Takuanzuke, previously the leading pickle in Japan.

Nukazuke (Takuanzuke) production totalled 113,448 t or 10.4% of the market. Takuanzuke, previously the top ranking pickle, has fallen to fourth position among Japanese Tsukemono pickles. Despite this decrease, Takuanzuke is still considered a typical type of Japanese Tsukemono.

Shoyuzuke production totalled 328,869 t, representing 30.2% of the total market and marked an increase of 49% over 22 years from 1975, making it one of the top ranking pickles. But Kimchi has increased to 355% of the total market during the last 22 years, the highest increase in Japanese Tsukemono history. This increase indicates Japan is experiencing a boom in hot and spicy pickles.

The production of other Tsukemono pickles such as Kasuzuke with 45,890 t, Misozuke with 11,719 t and all others with 21,059 t have decreased during the 22 years from 1975.

Table 3: Tsukemono production in Japan during a period of 22 years (unit = ton)

Item	1975	1980	1985	1990	1995	1996	1997	Percent
Shiozuke total	92,784	122,411	129,625	179,355	193,348	209,767	187,966	17.3
Umeboshi, Umezuke	14,645	22,095	22,281	40,817	37,113	41,053	43,538	
Others	78,139	100,376	107,344	138,538	156,235	168,714	144,428	
Suzuke total	73,565	90,338	85,921	79,123	84,339	83,188	82,354	7.6
Pickled scallions	17,772	19,337	16,693	19,058	27,051	27,016	23,706	
Pickled ginger	45,229	53,156	41,576	48,739	47,160	46,144	47,592	
Others	10,564	17,845	17,652	11,326	10,128	10,028	10,056	
Asazuke	166,138	158,170	194,711	320,476	306,189	308,251	296,229	27.2
Nukazuke (Takuanzuke)	200,468	239,711	254,404	213,371	131,679	123,969	113,448	10.4
Shoyuzuke total	220,067	256,372	278,394	290,546	295,632	309,840	328,869	30.2
Fukujinzuke	57,020	55,053	68,386	55,932	56,281	59,317	58,194	
Chopped vegetables	96,485	112,766	110,105	108,614	110,236	116,576	119,947	
Kimchi	26,487	34,059	46,636	83,474	93,305	100,154	120,560	
Others	40,075	54,494	53,267	42,526	35,810	33,793	30,168	
Kasuzuke total	56,211	46,244	51,829	46,446	44,941	46,252	45,890	4.2
Narazuke	38,723	24,619	31,496	28,903	30,415	31,327	31,852	
Wasabizuke	9,955	10,543	10,810	11,310	8,703	8,702	8,831	
Others	7,533	11,082	9,523	6,233	5,823	6,223	5,207	
Misozuke	13,902	11,632	12,575	14,314	12,128	12,517	11,719	
All others	32,883	37,240	36,246	36,535	28,583	25,102	21,059	1.9
Grand Total:	856,018	952,178	1,043,705	1,180,166	1,096,838	1,118,884	1,087,534	

Note: "All others" include Karashizuke (tiny eggplants etc. preserved in a mustard "bed"), Kojizuke (daikon radish preserved in a rice male "bed") and

Sansaizuke (wild plant shoots preserved in brine).

Source: Food Supply Demand Research Centre

Table 4. Consumption trend of Tsukemono in Japan.

Year	Consumption (t)	Value (¥ million)[1)]
1989	1,151,000	407,000
1990	1,197,000	423,000
1991	1,246,000	440,000
1992	1,220,000	436,000
1993	1,228,000	427,000
1994	1,240,000	423,000
1995	1,260,000	425,000
1996	1,260,000	425,000
1997	1,254,000	423,000
1998	1,254,000	423,000
2002	1,279,000	430,000

Source: Fujikeizai, 1998: 1998"s Shokuhin Marketing Report No. 1, Tokyo, Japan.
Note: 1) Currency exchange in 1999 - A$ = ¥78.6. These values are approximate only. Figures in Table 1 have shown the data of 1993 in which wholesale markets for tsukemono in 1993 were ¥692,438 million (A$8.8 million).

Consumption of Tsukemono in Japan in the early part of the 21st century is expected to be approximately 1.28 million tonnes per annum. Therefore, Japan needs to import more semi-processed vegetables to make 180-250,000 t of Tsukemono.

1.2.5 Importation

During the 1960s, Japanese manufacturers began sourcing ingredients for Tsukemono from overseas, the requirements then being:

i) produce that was unavailable in Japan;

ii) produce available all year-round;

iii) low prices;

iv) high quality.

Tsukemono is mainly imported in semi-processed forms and most of these products are re-packed in Japan. Imports to Japan began from Taiwan in the 1960s, but later shifted to Chinaand Thailand and then to Vietnam during the 1990s. Trading companies such as Marubeni, Mitsubishi and Mitsubutsan have controlled the importation of semi-processed products for Tsukemono in Japan, with 43.8% of total imports. Tsukemono manufacturers imported 24.6% from raw materials suppliers.

Recent imports position:

Tsukemono is imported into Japan in two forms - semi-processed and in packaged products in bulk, bottles, bags and/or cans. According to statistics, imported Tsukemono is divided into two types of items - salted vegetables and vegetables in vinegar. In 1997, Japan imported 227,992t of salted vegetables valued at approximately ¥24,399 billion (A$310 million when A$ = ¥78.6 in 1999) and 24,627 t of vegetables in vinegar valued at approximately ¥4,518 million (A$57 million) (Tables 5, 6 and 7).

Table 5: Volume of imported Tsukemono materials into Japan during a period of 10 years from 1988-1997 (unit : ton).

Item	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Salted vegetables:	**206,728**	**227,000**	**197,240**	**216,170**	**223,440**	**210,693**	**220,283**	**254,880**	**263,054**	**227,992**
Cucumbers and Gherkins	54,561	71,251	57,557	60,180	61,718	60,840	64,457	72,227	58,476	60,476
Small eggplant	-	-	-	-	-	-	-	5,982	7.788	6,714
Scallion	-	-	-	-	-	-	-	22,656	25,145	14,380
Eggplant and Scallion	15,115	14,793	14,272	16,642	19,047	22,651	22,614	-	-	-
Eggplant	-	-	-	-	-	-	-	8,867	9,186	6,677
Lotus	-	-	-	-	-	-	-	14,887	16,484	15,332
Warabi[1)]	15,526	13,264	15,203	10,514	13,096	13,169	10,688	12,876	12,569	6,790
Ginger	50,020	47,875	41,404	47,391	41,974	19,822	24,598	35,396	29,387	30,219
Others	71,505	79,818	68,804	81,442	87,604	94,210	97,925	81,989	104,018	86,404
Vegetables in vinegar:	**6,216**	**6,421**	**5,737**	**8,162**	**19,054**	**38,596**	**34,537**	**26,141**	**26,471**	**24,627**
Cucumber and Gherkins	343	411	766	438	531	949	2,188	3,527	4,051	3,941
Onion	10	13	23	20	31	20	17	17	37	21
Sweetcorn	451	74	73	72	76	-	3	7	386	17
Baby corn	29	36	9	7	3	5	6	22	1	6
Ginger	-	-	-	-	-	-	-	14,288	13,999	11,824
Others	5,383	5,888	4,867	7,625	18,413	37,620	32,323	8,279	7,997	8,820

1) Warabi = Bracken (*Peteridium aquilinum* KUHN.)

Table 6: Values of imported Tsukemono materials into Japan during a period of 10 years from 1988-1997 (unit : ¥ million).

Item	1988 (¥)	1989 (¥)	1990 (¥)	1991 (¥)	1992 (¥)	1993 (¥)	1994 (¥)	1995 (¥)	1996 (¥)	1997 (¥)
Salted vegetables:	**22,675**	**25,220**	**22,083**	**22,325**	**23,176**	**18,987**	**17,550**	**19,978**	**28,587**	**24,399**
Cucumbers and Gherkins	3,002	4,144	3,471	3,504	3,654	3,252	3,064	3,661	3,525	3,338
Small eggplant	-	-	-	-	-	-	-	413	725	611
Scallion	-	-	-	-	-	-	-	1,830	3,650	2,353
Eggplant and Scallion	1,750	1,712	1,601	1,776	2,194	2,261	2,031	-	-	-
Eggplant	-	-	-	-	-	-	-	542	651	565
Lotus	-	-	-	-	-	-	-	878	1,392	1,511
Warabi	1,238	1,427	1,985	1,386	1,613	1,507	1,261	1,466	1,710	1,047
Ginger	4,568	4,990	4,018	4,342	4,420	1,775	1,604	2,739	3,661	3,169
Others	12,117	12,946	11,007	11,316	11,294	10,192	9,590	8,448	13,273	11,805
Vegetables in vinegar:	**868**	**994**	**1,048**	**1,251**	**2,328**	**3,735**	**2,926**	**2,874**	**4,403**	**4,518**
Cucumber and Gherkins	92	114	224	**132**	150	152	266	380	498	561
Onion	4	6	8	**11**	17	7	7	6	13	11
Sweetcorn	51	11	10	**10**	10	-	1	1	36	3
Baby corn	4	5	4	**3**	1	2	2	3	1	2

Ginger	-	-	-	-	-	-	-	1,247	2,298	1,715
Others	718	858	802	**2,150**	2,150	3,574	2,651	1,237	1,557	2,227

Table 7. CIF prices of imported tsukemono materials into Japan during a period of 10 years from 1988-97. (unit = ¥ /kg.)

Product	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Salted vegetables:	**110**	**111**	**112**	**103**	**104**	**90**	**80**	**78**	**109**	**107**
Cucumber/Gherkin	55	58	60	58	59	53	48	51	60	55
Small eggplant	-	-	-	-	-	-	-	69	93	91
Scallion	-	-	-	-	-	-	-	81	145	164
Eggplant/Scallion	116	116	112	107	115	100	90	-	-	-
Eggplant	-	-	-	-	-	-	-	61	71	74
Lotus	-	-	-	-	-	-	-	59	84	99
Warabi	80	108	131	132	123	114	118	114	136	154
Ginger	91	104	97	92	92	90	65	77	125	105
Others	169	162	160	139	139	109	98	103	128	137
Vegetables in vinegar:	**140**	**155**	**183**	**153**	**122**	**97**	**85**	**110**	**166**	**183**
Cucumber/Gherkin	269	276	292	302	282	160	122	108	123	142
Onions	351	436	355	553	546	363	420	382	348	520
Sweetcorn	113	149	132	136	127	-	282	196	94	166
Baby corn	122	143	508	481	467	396	291	141	383	439
Ginger	-	-	-	-	-	-	-	87	164	145
Others	133	146	165	144	117	95	82	149	195	252

Importation by item:

Cucumber and gherkins, ginger, Japanese apricot (Ume: *Prunus mume*), scallion and eggplants are the most important imported commodities for the Japanese Tsukemono industry.

* *Cucumber and gherkins:*

Japan imports an average of 65,000 t per annum of salted cucumber and gherkins in vinegar, valued at approximately A$50 million. China and Vietnam supplied 58,961 t or 97.5% or these vegetables (Table 8).

Table 8. Major items of Tsukemono material imported into Japan in 1997.

Item	Total import (t)	China	Thailand	Taiwan	Vietnam
Cucumber and Gherkins	60,476	53,122 (87.8%)	435 (0.7%)	-	5,839 (9.7%)
Ginger	69,345	18,903 (27.3%)	41,469 (60%)	4,560 (6.6%)	56 (0.2%)
Japanese apricot	29,396	22,015 (74.9%)	-	7,250 (24.7%)	-
Scallion	14,380	14,340 (99.7%)	-	-	28 (0.2%)
Eggplant	7,677	7,228 (94.2%)	167 (2.2%)	-	-
Small eggplant	6,714	5,996 (89.3%)	651 (9.7%)	32 (0.5%)	36 (0.5%)

* *Ginger:*

As far as the import volume of a single item is concerned, ginger imports ranked above all others. As the domestic supply of ginger is scant, Tsukemono manufacturers are almost entirely dependent on imports. In 1997, Japan imported 69,345 t of ginger in salted, slightly pickled and in vinegar forms. Thailand occupied 60% of the market, followed by China with 27.3%. Taiwan, which was the main supplier in 1986 with 14,000 t, is now ranked third, supplying only 4,560 t.

* *Japanese apricot products (Umeboshi, Umezuke):*

In 1997, Japan imported 29,396 t of Japanese apricot products including Umeboshi and Umezuke. Approximately 75% of total imports came from China. The remaining 25% came from Taiwan. It should be noted that in the 1980s, Taiwan ranked as the top supplier of Umeboshi, supplying 99% of

imports. Imported Ume is chiefly used to produce *Katsuo* ume. Domestic Ume, particularly from Wakayama Prefecture is considered the highest quality with thin skin and rich, soft meat andis used for premium markets supplying Umeboshi and Umeshu (Japanese apricot wine).

*** *Scallion (*Allium bakeri *REGEL):***

China dominated the Japanese scallion import market, supplying 99.7% in 1997 with 14,340 t. Scallions are imported in salted or seasoned forms and are used as Tsukemono or as an accompaniment to curried rice.

*** *Eggplants:***

Eggplants are used mainly as materials for *Karashizuke* and/or *Shiozuke* and China is the major supplier of both eggplant and small eggplant items. Thailand and Vietnam contribute approximately 10%.

*** *Kimchi:***

Kimchi, which are traditional fermented pickles from Korea, have become popular in Japan. Kimchi consumption has increased from 35,000 t in the 1980s up to 119,628 t in 1998 (Table 9). Importation of Kimchi is dominated by South Korea, which exported 15,015 t to Japan in 1998, valued at approximately ¥5,576 million (A$71 million). However, CIF prices decreased by 12% to ¥371/kg in comparison with the previous year (Table 9).

Table 9: Total consumption and importation of Kimchi into Japan.

Year	Total consumption (t)	Domestic production (t)	Importation (t)	Importation (¥ million)	CIF price (¥/kg.)
1980	34,059	34,059	NIL	-	-
1990	83,474	83,474	NIL	-	-
1994	101,962	93,229	8,733	3,821	438
1995	102,940	93,305	9,635	3,971	412
1996	110,188	100,154	10,034	4,125	411
1997	131,386	120,560	10,826	4,580	423
1998	134,643	119,628	15,015	5,576	371

Import price trends:

A review of 10-year import price trends of Tsukemono between to 1997 has shown that prices have remained unchanged (Table 7). However, prices of Warabi (Brackens), onion and baby corn are rising.

- **Semi-processed cucumber and gherkins, ginger, Japanese apricot, scallion and eggplant are the most important commodities for Japanese import markets.**
- **Kimchi has recently become a major imported commodity in terms of bulk product.**
- **The CIF prices have remained unchanged in the last 10 years from 1988 with the exception of brackens and baby corn.**

1.2.6 Consumption Trends:

Role of Tsukemono *in the Japanese diet:*

Tsukemono is one of the necessities on the dining table of Japanese families, especially in the case of traditional Japanese cooking. Japanese diets include a mixture of dishes from around the world as well as their own traditional cooking. Chinese or western style foods are very popular. In addition, some food chains serve various fast foods and, with a boom of various ethnic dishes, Japanese food has become very diversified.

Tsukemono is closely tied in with eating rice, and few eat it with bread. The Japanese, who previously subsisted primarily on rice, gradually introduced bread into their diet as a result of Westernisation. Younger generations, in particular, are fond of bread and pastries. Various surveys report that bread is eaten at breakfast due to its convenience. It is also prepared for supper, following cooked rice. In households consisting of three generations, the same dining table might provide cooked rice, vegetables and fish, along with tsukemono and miso soup for the elders and bread, eggs, meat and milk for the children. This mixture of diets in one household is no longer unusual.

Varieties of tsukemono were previously explained and the following indicates the way in which it is eaten:

1. Ingredients of tsukemono commonly consumed in the home, are primarily daikon radish, Chinese cabbage, cucumbers and eggplants. Whether preserved in soy sauce, rice-bran paste or brine, tsukemono is eaten as a side dish. Consumer-packaged products contains minced or chopped materials to save preparation time. There are products however, that preserve these ingredients whole which are later chopped or sliced to serve and these are still very popular as the original taste and flavour does not deteriorate. Also, some seasoned asazuke, which is widely accepted by the young people, may require some soy sauce.

2. Although ginger is used in a variety of tsukemono, when it is, consumption is different from other tsukemono. The largest users of ginger are Sushi restaurants, where the product is called “gari”. As sushi is prepared using cooked rice with vinegar, raw fish and raw shellfish, gari is eaten to remove the aftertaste and freshen the palate. In addition, “shredded ginger” preserved in plum vinegar and red coloured “scarlet ginger” are used as accompaniments to boxed lunches and curried rice. These kinds of tsukemono are also widely used by fast food chains. General household use is limited.

3. Japanese apricots are used to prepare umeboshi, umezuke and katsuo-ume, but, like ginger tsukemono, these products are consumed in a different way from other general tsukemonos. It has long been believed that Umeboshi is good for health and that it prevents food from spoiling. Therefore, it has been used traditionally with cooked rice in the form of “Onigiri” or boxed lunches to be eaten later. As nukazuke often smells bad if warmed, umeboshi and another product, shoga, are used instead in boxed lunches.

   Domestic Japanese apricots from Kishu (Wakayama Prefecture) are larger in diameter and softer than others, being regarded as a luxury item. Imported Japanese apricots from China and Taiwan are used widely in general households in the form of “katsuoume”.

4. Whole scallions are usually preserved in sweetened vinegar or brine and are eaten as is. Scallions come in two varieties: one-year-old with large and medium sized scallions and two

–years old with small scallions - the latter being called “hana-rakkyo”. Scallions are widely used by both households and restaurants, especially as an accompaniment to curried rice. As both ends of scallions have to be removed manually during processing, this labour-intensive work means most are imported to reduce costs.

5. As for other packaged imports, traditional foreign tsukemono varieties are imported mainly in the form of bottled products. They typically include sweet and sour pickles. In particular, Kimchi from Korea is becoming more popular.

B. Consumption patterns - General households:

As tsukemono can be easily prepared from fresh vegetables, many general households make it. However, with growing employment opportunities for women and an increase in the number of double-income families, the trend towards homemade tsukemono has decreased with more tsukemono mass produced (Table 10).

According to the *Annual Report on the Family Income and Expenditures Survey* issued by the Statistical Bureau of Management and Co-ordination Agency (1999), the annual purchase of the three varieties of tsukemono - takuanzuke, umeboshi and hakusaizuke - by volume per household totalled 4.3 kg. This is a decrease in the total of these three varieties (Table 10). However, the scale of the market for tsukemono as a whole, including the asazuke group and other groups, remained unchanged or slightly increased.

Table 10: Annual purchase of tsukemono per household in Japan.

Item		**1973**	**1978**	**1983**	**1988**	**1993**	**1997**	**1998**
Takuan	Volume (g)	3,145	2,889	2,971	2,625	2,061	1,601	1,667
	Value (¥)	808	1,421	1,668	1,542	1,550	1,113	1,164
	Price (¥/kg)	25.69	49.20	56.13	58.77	75.16	69.47	69.82
Umeboshi	Volume (g)	381	501	601	709	658	760	835
	Value (¥)	190	435	802	1,182	1,408	1,685	1,778
	Price (¥/kg)	49.83	86.81	133.48	166.69	213.89	213.89	213.03
Hakusaizuke	Volume (g)	2,363	2,035	1,912	1,910	1,769	1,780	1,744
	Value (¥)	414	615	735	899	1,112	1,087	1,171
	Price (¥/kg)	17.53	30.22	38.41	47.06	62.90	61.06	67.11
Other	Value (¥)	2,986	5,065	6,021	6,983	8,173	8,362	8,778
Total:	Volume (g)	5,889	5,422	5,486	5,242	4,488	4,142	4,246
	Value (¥)	4,308	7,534	9,227	10,601	12,242	12,248	12,891

The general household proportions of tsukemono are as follows:

i) 37.5% purchased from shops;
ii) 14.2% given as gifts or souvenirs;
iii) 48.3% by self preparation (Tsukemono Distribution Structure, ibid.).

Though the proportion of homemade tsukemono is on the decline, considerable numbers in the older age groups still prepare it in the home. The data also indicates that the ratio of tsukemono received as souvenirs and gifts represent a sizeable share.High quality tsukemono items are often used as gifts during the mid-year (Chugen) and the end-year (Seibo). Local tsukemono often is bought by tourists as a souveniror gift.

As for consumption frequency, 56.6% of the survey respondents eat Tsukemono at least once a day, followed by 34.7% at least once a week and 6.7% once a month. Less than 2% seldom eat it. The older women at home are, the more Tsukemono they eat (Table 11).

Table: 11: Homemade Tsukemono by women's age brackets.

Those in their 20s	32.6%
30s	47.2%
40s	52.4%
50s	51.7%

Trends of consumer needs:

Due to health problems, Japanese food with low sugar and low salt is preferred. Tsukemono in particular was previously regarded as a typical salty product. To fulfil low salt product needs, low salt tsukemono varieties were introduced to the market. They achieved some success - a typical example being the success of the asazuke group. As asazuke contains less salt and retains the original taste and flavour of the fresh materials, consumers have accepted it. Leaf vegetables, including daikon radishes and turnips are commonly used as raw ingredients. The seasoning liquid in which the vegetables are preserved contains various seasonings which differentiates brands.

Twenty-eight per cent of Japanese people now consume asazuke, which is remarkably high and exceeds all other individual tsukemono pickles (Table 12). Consumption of umeboshi has also increased although its salinity is among the highest of any tsukemono. Recognition of the medical effects of umeboshi and the increase in sales of Rice-Ball in convenience stores is probably the reason for this phenomenon.

Table 12. The transition of tsukemono intake among Japanese people over a period of 10 years from 1987 to 1997 (Unit = household/year).

Item	1987		1997	
	Intake (¥)	Percentage	Intake (¥)	Percentage
Takuan	1,572	16.1	1,113	9.1
Umeboshi	1,037	10.6	1,686	13.8
Hakusaizuke	737	7.6	1,087	8.9
Asazuke	N/K	N/K	3,429	28.0
Others	6,409	65.7	4,933	40.2
TOTAL	9,755	100%	12,248	100%

Freshness, lower salt content and healthy food are the key points in developing Japanese Tsukemono markets. Increased consumption of

***Asazuke, Kimchi* and *Umeboshi* are results of the above concerns.**

1.2.7 Distribution:

Tsukemono products are distributed to general consumers chiefly by the following channels:

1. ***Manufacturer → Wholesaler → Retailer → Consumer:***
   Wholesaler includes two types - (A) wholesalers specialising in tsukemono and (B) general food distributors (not related to wholesale markets).

2. ***Manufacturer → Wholesaler (Primary) → Wholesaler (Secondary) → Retailer → Consumer:***

3. ***Manufacturer → Retailer → Consumer:***
   Wholesalers specialise in both the production and distribution of Tsukemono. Manufacturers of supermarkets' private labels are also included in this channel.

4. ***Manufacturer → Consumer:***
   Manufacturers are in possession of retail outlets to sell directly to consumers. Manufacturer/wholesalers lease sales floors in department stores for direct marketing. This trend is on the increase.

5. ***Manufacturer → Central Wholesale Market → Retailer → Consumer:***
   Tsukemono also goes through the same Central Wholesale Market as fresh vegetables or fruits and in this market, two types of wholesalers handle tsukemono - (A) wholesaler specialising in tsukemono and (B) wholesaler not specialising in tsukemono. The volume that passes through this channel represents 20-25% of the total tsukemono distribution.

   Transactions are by individual negotiations not auction. Supermarkets dominate sales selling 65% of the total tsukemono. Food shops sell 14%, department stores 9% and green grocers 8% (except where they are sales arms of manufacturers).

   Purchasing prices paid at each stage of distribution depends on each product and its volume during each transaction. Ordinarily, primary wholesalers pay 65% and secondary wholesalers approximately 70% of the retail price. The profit margin of retailers ranges from 25-30% for supermarkets and department stores, and approximately 20% for other retailers.

1.2.8 Business Practices:

Supermarkets order from manufacturers or wholesalers a week in advance and delivery is made daily. This is necessary because the time span from production to consumption of the current tsukemono mainstay, asazuke, has to be shortened to maintain freshness. In addition, manufacturers have to control preparation and production schedules. Deliveries to supermarkets are made daily and tsukemono is included along with other perishables or so-called daily delivery goods. Delivery/service staff are responsible for order taking, product display, price tagging, collection of money and acceptance of returns. They also sell new products and provide sales training for clients' employees. Many manufacturers emphasise this sales promotion and education of clients.

1.2.9 Sales Promotion:

Among their food items, supermarkets place a great deal of emphasis on tsukemono. In particular, in connection with sales promotion, they stress:

1. control of limit dates on products displayed and control of temperature in display cabinets to maintain quality;
2. careful selection of suppliers and that new items are introduced only after strict screening.
3. a product mix inclusive of famous brands and local manufactured products reinforcing that availability of private labels is dependent on consigned production to manufacturers and by in-house production;
4. preference to encourage an assortment of high class products and face-to-face selling of loose products.

Manufacturers highlight to supermarkets the production of more delicious products, more careful control of sanitary conditions, fuller product mixes, manufacturing of non-additive/non-colorant products, and production of low salt tsukemono.

Meanwhile, both manufacturers and retailers are becoming very competitive to fill consumer needs and outsell competitors.

All Japanese Tsukemono Federation of Co-Operatives (Zen Nippon Tsukemono Kyodo Kumiai Rengokai) have promoted the 21st day of each month as a National Pickle Day.

· *List of Related Organisations:*

A. Government offices and associations:

Name	**Address**	**Telephone No.**
Vegetable Production and Marketing Division, Food and Marketing Bureau, Ministry of Agriculture, Forestry & Fisheries	2-1, Kasumigaseki 1-chome, Chiyoda-ku, Tokyo 100, Japan.	03-3502-8111
Processing Industry Division, Food and Marketing Bureau, Ministry of Agriculture, Forestry & Fisheries	2-1, Kasumigaseki 1-chome, Chiyoda-ku, Tokyo 100, Japan.	03-3502-8111
Fruits and Flower Division, Agricultural Production Bureau, Ministry of Agriculture, Forestry & Fisheries	2-1, Kasumigaseki 1-chome, Chiyoda-ku, Tokyo 100, Japan.	03-3502-8111
Food Sanitation Division, Environmental Health Bureau, Ministry of Health and Welfare	2-2, Kusumigaseki 1-chome, Chiyoda-ku, Tokyo 100, Japan.	03-3503-1711
Zen Nippon Tsukemono Kyodo Kumiai Rengokai, All Japan Tsukemono Federation of Co-operatives	Chiyoda Chuo Building, 16-2, Sotokanda 2-chome, Chiyoda-ku, Tokyo, Japan.	03-3253-9798
Nippon Tsukemono Kensa Kyokai (Japan Pickles Inspection Association)	Shyokuryo Building, 8-13, Saga 1-chome, Koto-ku, Tokyo, Japan	03-3643-0461
Japan Co-operative Association, Import-marketing Salted Green	C/- Tokyo Chuo Tsukemono K.K., 2-1, Tsukiji 5-chome, Chuo-ku, Tokyo 104.	03-3542-8341

Nukazuke: Radish pickled in Rice-bran paste (***Takuan-zuke***).
(Source: Shimizu, K. 1993: Tsukemono Japanese pickled vegetables)

1.3. Korean Pickle Industry

1.3.1 History:

According to Park (1997), it is suspected that the origin of kimchi was probably from Chinese pickles. The pickles were brought into Korea and modified to form several types of kimchi with common raw ingredients to suit the taste of Koreans during the Shilla (A.D. 654-935) and Korea (A.D. 918-1392) dynasties (Chang, 1972). Until the Korean dynasty, the main vegetable used in the making of kimchi was radish. Records also showed that, in addition to radish, cucumber, eggplant and bunching onion and/or shallot were used to produce pickled vegetables. Whole Chinese cabbage kimchi and other kimchi prepared with hot chilli became popular after the middle of the Rhee dynasty (A.D. 1392-1910) (Lee, 1986). Hot chilli was imported to Korea in the early part of the 17th century and the first record of it being used as an ingredient of kimchi was in 1766 (Cho, 1988).

1.3.2. Classification of Korean Kimchi:

Many types of kimchi are available depending on availability ofraw ingredients, processing methods (Park *et al.*, 1996), harvest seasons and localities. For example, *Baechu* kimchi is made mainly from Chinese cabbage, *Kakdugi* kimchi is made mainly from radish (long white type), and *Mool* kimchi is noted for the preparation method of adding water (Cheigh and Park, 1994).

There are at least 187 types of kimchi available in Korea (Koo *et al.*, 1991). Chinese cabbage and radish are the most widely used vegetables in the making of kimchi, but many other vegetables are also used depending on availability. Since the northern part of Korea is cold and the southern part is mild in winter, the winter kimchi prepared in the northern part contains less salt, whereas that prepared in the southern part requires more salt for preservation. Also, people living near the sea tend to add seafoods to their kimchi as it is naturally abundant.

There are two main groups of kimchi - ordinary and a *Mool* kimchi, which has added water or brine solution. Each group consists of many different types of kimchi. For ordinary kimchi, there are *Tongbaechu* kimchi (made with whole Chinese cabbage), *Baechu* kimchi (made with cut Chinese cabbage), and *Kakdugi* kimchi (made with diced radish). These are all prepared by mixing the salted major raw material with other ingredients and by fermentation. Common types of kimchi belong to this group. *Mool* kimchi includes *Baik* kimchi (*Baechu* kimchi with added water), *Dongchimi* (whole radish kimchi with added water), *Nabak* kimchi (cut radish and Chinese cabbage kimchi with added water) and others. They are prepared with added water (or with brine solution) and various ingredients through fermentation.

Table 13. Classification, varieties, and major characteristics of kimchi.

Classification	Varieties of kimchi
Ordinary kimchi	1. *Baechu* (cut Chinese cabbage) kimchi; 2. *Tongbaechu* (whole Chinese cabbage) kimchi; 3. *Bossam* (wrapped upo Chinese cabbage) kimchi; 4. *Kaktugi* (diced radish) kimchi; 5. *Yangbaechu* (cabbage) kimchi; 6. *Oisobaegi* (cucumber) kimchi; 7. *Pa* (bunching onion) kimchi; 8. *Yeolmoo* (radish) kimchi.
Mool kimchi (kimchi with added water)	1. *Baik* (*baechu* with water) kimchi; 2. *Dongchimi* (whole radish kimchi with water) kimchi; 3. *Nabak* (cut radish and Chinese cabbage with water) kimchi; 4. *Yeolmoo* (young oriental radish with water) kimchi

Baechu kimchi is the most frequently prepared product followed by *Kakdugi* kimchi and *Dongchimi* kimchi in Korea (Yu and Chang, 1974). Therefore, *Baechu* kimchi is the "typical kimchi" and it is often referred to simply as "kimchi".

Raw materials used for kimchi preparation:

The ingredients for kimchi preparation include four major groups - the main vegetable, spices, seasonings and additional materials as shown in (Table 15). It is apparent that Chinese cabbage or white radish is selected as the most important ingredient among 30 other types of "main vegetables". The "spices" group includes garlic, hot chilli, bunching onion, ginger, onion and others. "Seasonings" is a group of optional ingredients that include salt (this is used mainly for brine pre-treatment in addition to taste enhancement), salt-pickled seafoods, sesame seed, soy sauce, vinegar and sugar. Lastly, the group of "additional materials" as optional ingredients include small amounts of other vegetables, fruits, cereals, nuts, meats, seafoods and mushroom. The optional ingredients influence the rate of fermentation, and taste and flavour and nutritional value of kimchi, as well as the fermentation process.

Major processes for kimchi-making:

The methods for kimchi preparation differ depending upon the variety of kimchi and ingredients used. Another factor is whether the production is carried out by households or industrial companies. However, the principal process involves selection of ingredients, pretreatments, blending of ingredients, and fermentation. Chinese cabbage and/or radish may be pretreated in several steps such as grading, washing and cutting. Other materials are also graded, washed and cut or chopped. Pretreated Chinese cabbage or radish is brined at various salt concentrations by either dry-salt or brine solution. Brine-treated vegetables are rinsed and then mixed together with other minor ingredients (eg spices, seasonings etc) according to the formulas. The mixed vegetables are packed into the jar container, covered with a lid and then fermented at various temperatures depending upon season and other conditions (Kim, *et al*. 1991; Lee, 1986; Lee, 1991). The following are brief descriptions of the major processes for *Baechu* kimchi.

Table 14. Raw materials used for the preparation of kimchi.

Group	Raw materials
1. Major raw materials	*Baechu* (Chinese cabbage), radish, ponytail radish, young white radish, cucumber, bunching onion, lettuce, cabbage, leek, green chilli etc.
2. Spices	Hot chilli, bunching onion, garlic, ginger, black pepper, onion, cinnamon etc.
3. Seasonings:	Dry salt or brine solution
* Salt	Anchovy, shrimp, clam, hairtail, yellow corvenia etc.
* Salt-pickled seafood	Sesame seed, soybean sauce, monosodium glutamate, corn syrup etc.
* Other seasonings	
4. Other materials:	Water cress, carrot, parsley, mustard, leaves etc.
* Vegetables	Pear, apple, jujube, melon, ginko nut, pine nut etc.
* Fruits and nuts	Rice, barley, wheat flour, starch etc.
* Cereals	Shrimp, Alaska pollock, squid, yellow corvenia, oyster, beef, pork etc.
* Fish and meats	Mushrooms etc.
* Miscellaneous	

a) Ingredient selection and formulation:

The quality and species of the major vegetable may significantly affect the characteristics of kimchi. Selection of an appropriate species of Chinese cabbage, with soft and light-green leaves, oval-shaped head and compact structure, is a prerequisite for good-tasting *Baechu* kimchi. Also, the selection and formulation of other ingredients are important depending on the types and preparation methods used for *Baechu* kimchi. One example of the proportion of ingredients in a formula for *Baechu* kimchi and *Baik* kimchi is shown in Table 16.

Table 15. Ingredients used in typical kimchi (wt%).

Raw materials	*Baechu* kimchi	*Baik* kimchi
Chinese cabbage	80.0	80.0
Radish	12.0	12.0
Hot chilli (powder)	1.0	-
Garlic	0.5	0.5
Ginger	0.4	0.4
Bunching onion	1.0	1.0
Mustard leaves	1.0	1.0
Parsley	1.0	1.0
Pickled shrimp	0.8	0.8
Fermented fish soup	1.1	0.8
Salt	0.5	-
Other ingredients	0.7	2.5

b) Brining treatment and blending:

The trimmed Chinese cabbage is cut 3-5 cm in length, washed, mixed with salt (8-15%) for 2-7 hours, rinsed with fresh water and then drained. Sliced radish, onion and bunching onion, chopped

garlic, ginger, hot chilli and salt-pickled seafood and dry salt are combined together to make a pre-mixture in an appropriate ratio according to the formula. These minor ingredients are mixed well by hand with the treated cabbage.

The amount of salt added for the pretreatment of Chinese cabbage is important for the fermentation, ripening and preservation. Generally, in *Baechu* kimchi, this treatment is carried out over a wide period of time depending on the salt concentration and temperature. A salt-treated cabbage is then rinsed and drained before mixing with other ingredients. The final salt concentration of the mixed vegetable fermentation is usually adjusted to approximately 2-3% (Lee, 1986).

c) Fermentation:

The mixed vegetables described above are placed in a fermentation vessel with a closed lid and left to ferment for 1-3 weeks at a low temperature (2-10°C) or for 2-3 days at room temperature (20-25°C). As stated, among numerous factors, the salt concentrations, temperature and pH greatly influence the rate of lactic acid fermentation. The optimum fermentation periods are used to attain the most acceptable product at different temperatures and salt concentrations (Table 17). More acceptable kimchi is prepared by fermentation with a lower salt concentration and at a lower temperature for a longer period as a typical organoleptic quality, such as odour, taste and texture is formed during the slow fermentation process (Lee, 1986; Lee, 1986; Kim *et al.*, 1991).

Table 16. Optimum fermentation time by salt concentration and temperature and period required to produce the most acceptable kimchi.

Temperature (°C)	Salt concentration (%)			
	2.25	**3.5**	**5.0**	**7.0**
30	1-2[1)]	1-2	2	2
20	2-3	2-3	3-5	10-16
14	5-10	5-12	10-18	13-32
5	35-180	55-180	90-180	Not ripened

1) Time in days

Kimchi preservation and distribution:

The quality of optimally-fermented kimchi can be kept for reasonable periods until consumption. However, improper storage of kimchi can result in acidifying deterioration and softening. This causes serious spoilage problems for most kimchi products. In Korea, traditional kimchi was prepared in early winter and stored at a low temperature during the winter season. Today, kimchi is stored and distributed in refrigerated cold systems regardless of the season.

Fig. 2. Flowchart for production of *Baechu* kimchi

i) Low temperature preservation and/or distribution:

Preservation and/or distribution of kimchi at a low temperature underrefrigeration and/or freezing, is generally accepted to be the best preserving method to maintain the quality of kimchi. Kimchi with 3.5% salt concentration is known to maintain a high quality at 30°C for two days whereas the same kimchi at 14°C keeps a similar quality for up to 12 days (Mheen *et al.*, 1981). It is also known that kimchi stored at 4°C maintains a high quality for 20 days, while kimchi stored between -5°C to 0°C keeps its quality for up to three months. Because of the salt concentration, the liquid in the kimchi freezes at around -5°C . The solid portion begins to freeze at below -5°C. Therefore, it is suggested that kimchi be fermented at a low temperature (approximately 7-15°C) and stored at a lower temperature around -1°C (Lee and Yang, 1970; Choi *et al.*, 1990). To store kimchi for a long period, the combined treatments of pasteurisation and low temperature storage is suggested - done by packing kimchi in polyethylene film bags and heat treating at 65°C for twenty minutes. This kimchi can then be stored at 4°C for up to four months and it will retain its good quality (Lee and Yang, 1970).

The texture of kimchi frozen at -15°C is significantly damaged during the process of freezing and thawing but there is little change in taste and flavour. Therefore, quick freezing is recommended for the prevention of texture degradation. For example, when kimchi products are placed in plastic film bags, frozen quickly in brine at -30°C to -38°C and stored in a frozen state, the texture quality is relatively high after thawing (Shin and Kim, 1975).

ii) Other preservation trials:

There are many other ways to preserve kimchi such as sterilisation with and without preservatives, heat treatment with flexible packaging, canning and bottling, using food additives and irradiation (Lee, 1986; Cheigh and Lee, 1991).

Thermal processing is mainly designed to destroy *Lactobacillus* and other micro-organisms which are responsible for the over-ripening in the later stage of kimchi fermentation. For the purpose of this, D-value and Z-value of related micro-organisms in addition to thermal diffusibility of kimchi in a retort pouch were studied (Pyun *et al.,* 1983). Pasteurisation can increase the shelflife of kimchi. But the combined treatment of pasteurisation and low temperature storage is reported to markedly increase shelflife (Lee and Yang, 1970; Gil *et al.,* 1984). A commercial canning process for kimchi has been developed and there with a few of these products in the market place. However, the freshness of kimchi is not maintained due to the heat treatment (Kim, 1958; C. Lee *et al.,* 1968; Kim, 1967; Lee, Cheigh and Lee, 1991).

Many attempts have been made to preserve high quality kimchi by using certain preservatives or pH buffering agents which may alter the fermentation process and extend the shelflife of the product. Some success in retarding the over-production of acids was accomplished, but they are associated with reduced flavour in many cases (Kim, 1967; Lee and Yang, 1970; Kim, 1985). Pre-heating and calcium chloride treatments show some positive effects in controlling the enzymes related to tissue softening during the later stage of fermentation and storage (York *et al.,* 1985). The shelflife of kimchi can be extended with the radiation treatment of gamma or x-ray, but it has not been successful due to discolouration of kimchi (Kim, 1962; Byun *et al.,* 1989).

- **There are at least 187 types of Kimchi but *Baechu* kimchi (cut Chinese cabbage), *Kakdugi* kimchi (diced radish) and *Dongchimi* kimchi (whole radish in water) are the most popular. *Baechu* kimchi is often referred to simply as "Kimchi".**
- **Combination of pasteurisation and low temperature storage can keep kimchi for up to four months without loss of quality.**

1.3.3 Nutritional Characteristics of Kimchi:

The nutritional properties of kimchi are highly dependent upon the kimchi variety, the ingredients used, preparation methods and fermentation processes. Numerous and complex biochemical and microbiological changes occur during kimchi processing that is associated with the nutritional characteristics of the products.

a) Proximate composition and dietary fibre of kimchi:

The nutritional composition of typical kimchi is shown in Table 17. The contents of crude protein, crude lipid and non-fibrous carbohydrate are approximately 0.7-2.5%, 0.2-0.5% and 1-8% respectively with approximately 87-93% of moisture content. Protein, amino acids and lipids are clearly increased with the addition of raw materials like salt-pickled fish products.

High fibre content clearly indicates that kimchi is a good source of fibre. The total dietary fibre content is approximately 24% on a dry basis. The contents of soluble dietary fibre and insoluble dietary fibre are 7.8% and 16.2% respectively (Park *et al.,* 1996).

Table 17. The nutritional compositions* of major kimchi (in 100 g edible portions).

Composition/Kimchi variety		*Baechu* kimchi	*Kaktuga* kimchi	*Dongchimi* kimchi
Energy	kcal	32	41	9
Moisture	percent	88.8	87.7	93.6
Protein	g	2.2	2.1	0.7
Fat	g	0.5	0.5	0.2
Non-fibrous carbohydrate	g	4.7	7.0	1.1
Fibre	g	0.7	0.8	-
Ash	g	3.1	1.9	0.2
Calcium	mg	45	43	1.0
Phosphorus	mg	28	23	-
Iron	mg	0.4	0.4	-
Vitamin A,	I.U.	210	122	-
Vitamin B1	mg	0.05	0.04	0.01
Vitamin B2	mg	0.08	0.06	0.03
Niacin	mg	0.5	0.4	1.0
Vitamin C	mg	21	20	7

*From Food composition tables, Rural Nutrition Institute, Office of Rural Development, Suweon, South Korea (1991).

b) Vitamins and minerals of kimchi:

Kimchi also contains significant amounts of vitamins and minerals. Particularly, kimchi is an important source of B vitamins, carotene and ascorbic acid. There are approximately 0.04 mg% of vitamin B1, approximately 0.06 mg% of vitamin B2 and 0.4 to 1.0 mg% of niacin in kimchi. *Baechu* kimchi and others contain approximately 120 to 210 IU of vitamin A and the content of vitamin C ranges from 7 to 21 mg% according to the kimchi variety (Office of Rural Development, 1991). These vitamins are mainly from raw materials but some B vitamins and ascorbic acid are synthesised during fermentation. It is interesting to note that the ascorbic acid content increases to a higher level at the optimum fermentation stage and then decreases slowly during the later stage of fermentation (Lee and Lee, 1981; Lee *et al.*, 1984). Carotene content in kimchi also varies depending on the use of red pepper, carrot and green onion (Cho and Rhee, 1979; Kang *et al.*, 1983; Lee, 1986).

In terms of mineral content in kimchi, calcium is a major component but there is a little phosphorus or iron. The calcium content is approximately 43-45 mg% for the kimchi varieties shown in Table 17. The minerals are definitely increased with the addition of raw materials such as salt-pickled fish products, fresh seafood and meat. Generally, kimchi is considered as an important resource for balancing nutrition with the main dish of cereal foods consumed in Korea.

1.3.4. Domestic Production:

Horticulture in South Korea:

South Korea experienced a dramatic change in the 30 years to 1995from being one of the poorest countries in the world to becoming one of the fastest growing industrial countries. As a result the *per capita* income of South Korea increased almost 100-fold from US$105 in 1965 to US$10,037 in 1995.

The agricultural sector in South Korea has also changed. Farming populations reduced from 15.8 million in 1965 to 4.8 million in 1995 and occupied only 11% of the total population of 44.4 million. The contribution of agriculture to Gross National Product (GNP) was almost 40% in 1965 but merely 7% in 1995. The self-sufficiency of cereals decreased from 94% in 1965 to 28% in 1995, resulting in large imports of corn, wheat, and soybean, valued at US$8.2 billion, mainly from the USA, Australia, China and Canada.

The horticultural industry in Korea has boomed during the last decade.The yearly growth rate of overall agriculture was just 1.3% during 1990-1995. But the vegetables, fruit and ornamental industries enjoyed an annual growth rate of 7.5%, 18% and 9.3% respectively during the same period. The proportion of horticulture over total agriculture in terms of production value has steadily increased from 25% in 1980 to 38% in 1995. In 1995, the total value of agricultural and forestry production was US$33.1 billion. Of this, the production value of vegetables was US$8.1 billion (24% of total), fruits US$3.7 billion (11%) and ornamentals US$0.6 billion (2%). The cultivated area of vegetables has increased approximately 2.6 times from 151,000 ha in 1965 to 403,604 ha in 1995 and the cultivated area of fruits approximately four times to 172, 000 ha in 1995. The number of horticultural households increased by 114,600 from 287,900 in 1990 to 402,500 in 1995, compared with a reduction of 269,000 farm households in total during the same period.

In 1995, the average income per household was US$27,774 for vegetable growers, US$37,806 for fruit growers and US$33,667 for ornamentals growers compared with US$21,938 for rice farmers and US$41,743 for those working in the animal husbandries.

Vegetable industry :

The South Korean *per capita* consumption of vegetables tripled during the last three decades and became 153 kg/person/year by 1995 (one of the highest in the world) (Table 18).Vegetable consumption is expected to maintain this level. The 10 major vegetables in terms of production value are hot chilli (US$1,768 million), garlic (US$1,511 million), watermelon (US$1,052 million), oriental melon (US$641 million), Chinese cabbage (US$553 million), strawberry (US$476 million), white radish (US$340 million), cucumber (US$300 million), bunching onion (US$276 million) and onion (US$200 million). Since Korean consumers strongly prefer fresh year-round vegetables, greenhouse vegetable industries for off-season production have rapidly developed with yearly growth rate of 20% for the last five years. The self-sufficiency rate of vegetables is very high. Most of the vegetable varieties grown in Korea now are F_1 hybrids, many of which have been developed locally. The problems to be solved in the Korean vegetable industry are:

i) small-scale farming;
ii) high cost of production;
iii) weak international competitiveness;
iv) great seasonal price fluctuation;
v) poorly-developed market systems; and
vi) very low levels of mechanisation.

A large amount of vegetables are used for kimchi. This explains the high production and importation of hot chilli, garlic, Chinese cabbage, radish and bunching onion within the South Korean vegetable industry (Table 20).

South Korean domestic production of kimchi:

According to a national nutrition survey in 1975, an adult consumes 50-100 g of kimchi per day in summer and 150-200 g per day in winter. This represents 12.5% of total daily food intake. But it is estimated that an adult consumes less kimchi (90 g/day) than in the past. In 1996, the amount of kimchi consumed per year in Korea was about 1,500,000 tonnes. About 290,000 tonnes (19.4%) was produced by commercial kimchi manufacturers. The portion of commercial kimchi production has been increasing by 15-20% per annum. Approximately 75% of commercial kimchi is sold to institutions, 20% to general consumers and the remaining 5% is exported. Most kimchi products sold in the domestic market are packaged in plastic bags, pouches and glass/plastic jars.

Kimchi products consist of 70% cabbage kimchi, 20% diced radish kimchi (Kaktugi) and 10% other kimchi. The average shelflife of commercial kimchi product is 3-4 days, but it can be extended to 15 days if necessary by using a cold-chain distribution system.

Table 18. Consumption of horticultural crops in South Korea, 1995. (unit: kg/person).

	1985 (A)	1995 (B)	B/A
Vegetables	99	153	54.5%
Fruit	36	55	52.8
Flower[1)]	2.3	14.3	6.2
Rice	182 (128)	161 (106)	11.5 (17.0)

1) Flower: $/person

Table 19. Export of horticultural crops, South Korea, 1995. (unit: million US dollars).

Year	Agricultural products (A)	Horticultural products (B)						Ratio (B:A)
		Total	Vegetables	Fruit	Flowers	Ginseng	Mushroom etc.	
1985	652	99	12	13	1	73	-	15.2
1995	1,747	336	111	60	8	140	17	19.2

Main export crops: Frozen strawberry, cucumber, vegetable seed, apple, citrus etc.

Table 20. Import of horticultural crops, South Korea, 1995. (unit: million US dollars).

Year	Agricultural products (A)	Horticultural products (B)						Ratio (B:A)
		Total	Vegetables	Fruit	Flowers	Ginseng	Mushroom etc.	
1985	2,420	20	9	7	4	-	-	0.8
1995	9,677	510	140	300	35	1	34	5.3

Main import crops: Vegetables: Hot chilli, garlic, onion.
Fruits: Orange, banana, pineapple
Flowers: Nursery, bulbs, orchids

1.3.5. Importation:

In 1995, South Korea produced 10,585,923 t of vegetables on 403,386 ha , valued at US$8.1 billion. This represented 24% of the total national agricultural and forest products (US$33.1 billion). Although the self-sufficiency of vegetables is very high, South Korea still imported US$510 million of horticultural products including US$140 million in vegetables in 1995. Of these, materials for the Korean traditional food of kimchi, such as hot chilli, garlic and onions, were the main imported commodities (Table 20).

Because of the importance of kimchi, there may be a need for South Korea to import more materials for kimchi such as Chinese cabbages, daikon radish, hot chilli, cucumber and bunching onion in both fresh and semi-processed forms. Warm summers in South Korea are unsuitable for Chinese cabbage production and its prices in June, July and August are, therefore, three times more expensive than the other periods of the year. Changes in structures such as a decrease in farmer populations and farming areas, ageing of farmers etc., which is happening in South Korea, have also forced the country to import more vegetables.

1.3.6. Exportation:

South Korean international trade in Kimchi :

International trade in Kimchi has been steadily increasing, up by 25-30% annually since the Seoul Olympic Games in 1988. Commercial Kimchi products are now exported to more than 33 countries. These exports amounted to more than US$50 million in value and 12,476 tonnes in quantity in 1995. There was more than a 200% increase in the quantity of international Kimchi trade over the period of 1991 to 1995 (Tables 21 and 22).

Most of the Kimchi products exported to Japan resulted from frequent cultural exchanges between Korea and Japan (Table 23). The amount of Kimchi products exported to the Middle Eastern countries has decreased since 1988 because of a marked decrease in Korean construction workers there. Types of Kimchi exported comprised 92.3% Chinese cabbage Kimchi, 6.1% Kaktugi, 1% Chonggak Kimchi and 0.6% other Kimchi. Export of Kimchi is limited due to the relatively short shelflife of the product.

Kimchi processing factories :

Recently, the Kimchi industry in South Korea has shown rapid growth with the increasing domestic and overseas demand for this product. Kimchi has gained international popularity since the 1988 Seoul Olympic Games during which foreign tourists visiting the country had the opportunity to taste Kimchi. The number of Kimchi plants has increased to meet the demands for export, but most of the processing factories are on a small scale. Only a few plants have more than 100 employees and, at present, there are 337 Kimchi processing factories operating in Korea (April, 1997).

Table 21. Korean export value of Kimchi: (unit: US$1,000).

Exports to:	Year					
	1991	1992	1993	1994	1995	1996
Hong Kong	-	-	99	106	170	267
Japan	13,888	18,922	28,739	37,726	43,301	36,662
Libya	147	162	128	177	546	382
The	52	153	145	125	87	56
Netherlands	66	60	67	141	83	77
Singapore	191	120	250	297	229	56
Spain	293	79	202	180	241	297
The USA	3,442	3,587	4,507	5,435	6,248	1,623
Others						
TOTAL:	18,083	23,088	34,203	44,191	50,909	39,420

Table 22. Korean export volume of Kimchi: (unit: tonne).

Exports to:	Year					
	1991	1992	1993	1994	1995	1996
Hong Kong	-	-	26	34	58	77
Japan	4,203	5,116	6,992	8,723	9,635	10,034
Libya	116	88	81	126	291	236
The	26	63	57	48	30	17
Netherlands	27	28	22	51	29	29
Singapore	122	74	118	100	80	22
Spain	145	32	86	63	59	89
The USA	1,539	1,789	1,927	1,941	2,456	557
Others						
TOTAL:	6,181	7,192	9,313	11,090	12,638	11,061

In 1995, South Korea exported US$113 million of vegetables and related products. Kimchi occupied approximately 46% of export share, valued at US$52 million.

Table 23.Export of kimchi from South Korea to Japan over five years from 1994-1998.

Year	Volume (t)	Value (¥ million)	CIF price (¥/kg)
1994	8,733	3,821	438
1995	9,635	3,971	412
1996	10,034	4,125	411
1997	10,826	4,580	423
1998	15,015	5,576	371

Source: Tsukemono Shimpo, No. 4173 (20th February, 1999).

1.3.7. List of Related Organisations:

A. Government offices and associations:

Agricultural and Fishery Marketing Corporation,
Kukje Center B/D, 191, 2-ga, Hangang-Ro,
Yongsan-Gu,
Seoul, Korea.
TLX: AAFMC K23297; TEL: 02-7958201/5,
02-7985031, 02-7974022
FAX: 02-7905265, 7987513

Chung-San Agricultural Cooperative Association,
198-1, Chosung-Ri, Chungsan-Myeon, Yonchun-Gun,
Kyonggi-Do, Korea.
TEL: 0355-320983/4, FAX: 0355-8351465

Korea Agricultural and Fisheries Food Export Association,
World Trade Center B/D, 159, Samsung-Dong, Kangmam-Gu,
Seoul, Korea.
TLX: KOCAND K24808; TEL: 02-5511935/9;
FAX: 02-5511940

Sungjoo Horticulture Cooperative Association,
Kyungsan-Ri, Sungjoo-Up, Sungjoo-Gun,
Kyongsangbuk-Do, Korea.
TEL: 0544-9334700; FAX: 0544-9334703

B. Main suppliers:

i) Kimchi and pickles:

A-Jin General Foods Co., Ltd.,
537, Pugi-Dong, Chillyang-Myeon, Kyongsan-Gun,
Kyongsangbuk-Do, Korea.
TEL: 054-524351/3; FAX: 054-524354
Other items: Frozen strawberry, Canned peach in syrup, Canned grape in syrup, Onion, Kimchi etc.

Jung-An Nongsan Co., Ltd.
Room 401 Pyonghwan B/D 1579-6, Seocho- Dong,
Seocho-Gui,
Seoul, Korea.
TEL: 02-5871374; FAX: 02-5828580
Other items: Kimchi, Fresh Chinese cabbage, Onion etc.

Masson Co., Ltd.
#1631-4 Seochol-Dong, Seocho-Gu,
Seoul, Korea.
TEL: 02-5850555/9; FAX: 02-5873200
Other items: Kimchi sauce

Samhak Food Processing Inc.
373-4, Kobong-Ri, Sungsan-Myeon, Okku-Gun,
Chollabuk-Do, Korea.
TEL: 0654-646666,6768
Other items: pickled melons

Shinjin Foods Co., Ltd.
IFI, Hoidong B/D #1435-17, Seocho-Dong, Seocho-Gu,
Seoul, Korea.
TEL: 02-5222321; FAX: 02-5861943
Other items: Pickled vegetables (Pickled cucumber, garlic, Rakkyo etc.),
Hard-boiled foods (hard-boiled bean, shrimp, lotus root and dried pollack etc.)

The Wooree Farms Co., Ltd.
Rm, 305, Hyosong B/D, 236, Singil-Dong, Youngdeungpo-Gu,
Seoul, Korea.
TEL: 02-8423948; FAX: 02-8431148
Other products: Pickled radish, Pickled cucumber, Sikhe (sweet rice drink).

Yung Sung Ind. Co., Ltd.
Room 406, Daeyeonkak B/D, 25-5 Chungmuro 1-ga,
Chung-Gu,
Seoul, Korea.
TEL: 02-7763884/7; FAX: 02-7579572
Other items: Kimchi, Radish, Fresh Chinese cabbage etc.

ii) Spices:

Hot, red pepper (chilli) powder:

Agricultural Cooperative An Dong Products Processing Plant,
261-1, Un San-Ri, Iljik-Myeon, An Dong-Gun,
Kyongsangbuk-Do, Korea.
TEL: 0571-8588085/6; FAX: 0571-8587149

Chunghak Foods and Cold Storage Co., Ltd.
1459-11, Seocho-Dong, Seocho-Gu,
Seoul, Korea.
TEL: 02-5875631; FAX: 02-5873304.
Other items: Malt powder, Glutinous rice powder, Roasted sesame.

Pu Ren Sol Food. Co.,
Song Sang Ri, Chungsong-Up, Chungsong-Gun,
Kyongsangbuk-Do, Korea.
TEL: 0575-727289

Young Weol Agricultural Cooperative,

945-17, Young Heong 3-Ri, Youngweol-Up, Young Weol-Gun,
Kangweon-Do, Korea.
TEL: 0373-734400/7, 0373-732250/1.
FAX: 0373-724408, 0373-732252.

Hot, red pepper paste:

Soon Chang Foods Co.
352 Lamam-Ri, Sunchang-Up, Sunchang-Gun, Chollabuk-Do,
Korea.
TEL: 0674-521177. 1188. FAX: 0674-521199
Other items: Soybean paste, Seasoned bean paste.

Sunchang Village Traditional Foods Co.,
3 Floor, Hanil B/D, 56-78 Sun Gin-Dong, Chongro-Gu,
Seoul, Korea.
TEL: 02-7440071; FAX: 00-7440072
Other items: Ssamjang, Chongkukjang, Kimchi, Soybean paste.

Hot, red pepper oil:

Koesan Native Food Co.,
174, Ibam-Ri, Sosu-Myeon, Koesan-Gun,
Chungcheongbuk-Do,
Korea.
TEL: 0445-320430; FAX: 0445-324997
Other items: Sesame oil, Perilla oil.

Garlic:

Gang Jin Co., Ltd.
42-33, Sinsul-Dong, Dongdaemoon-Gu, Seoul (C.P.O. BOX 4359, Seoul),
Korea.
TEL: 02-9240284, 9228449; FAX: 02-9275758

iii) Processing vegetables:

Daekwang Nongsan Co., Ltd.
Rm, 1048, Yulha-Ri, Jangyoo-Myeon, Kimhae-Gun,
Kyongsangnam-Do, Korea.
TEL: 0525-234121/2; FAX: 0525-234123, 051-6478227.

Doosan Foods Co., Ltd.
15-1, 2-Ga, Dangsan-Dong, Youngdeungpo-Gu,
Seoul, Korea.
TEL: 02-6764681, 6312291; FAX: 02-6336240
Other items: Starch, Syrup, Fructose, Feed, Dairy products, Ginseng products,
Health foods etc.

Hankuk Nongsusan Co., Ltd.
#790-138, Hokye-Ri, Naeseo-Myeon, Changwon-Gun.
Kyongsangnam-Do, Korea.
TEL: 0551-910411/3; FAX: 0551-1918044

Jung an Nongsan Co., Ltd.
Room 401, Pyung Hwan B/D, 1579-6, Seocho-Dong, Seocho-Gu,
Seoul, Korea.

TEL: 02-5871374/6/; FAX: 02-5828580.
Other items: Fresh Fuji apples, Fresh Shingo pears, Fresh Mansankil pears;
Chestnuts, Fresh vegetables.
Korea Coop-Trading Co., Ltd.
4th Fl, Seoul City Office, 15-19, 2-Ga, Hangang-Ro, Yongsan-Gu,
Seoul, Korea.
TEL: 02-7128121/3; FAX: 02-7192521.

N.A.C.F. Chojeong Foods Plant,
164-2 Bijung-Ri/Bukil-Myeon Cheongwon-Gun..
Chungcheongbuk-Do, Korea.
TEL: 0431-2224620; FAX: 0431-2224623

Poong Mi Food Ind. Co.
2048 Kunpo-Ri, Nongong-Myeon, Dalsung-Fun,
Kyongsangbuk-Do, Korea.
TEL: 02-6112255; FAX: 02-6112257
Other items: Pickled radish.

Salmi Agricultural Cooperative Foods Plant,
31-6 Seseoung-Ri, Salmi-Myeon Jungwon-Gun,
Chungcheongbuk-Do, Korea.
TEL: 0441-8511008; FAX: 0441-8521683.

Sun Jang Agricultural Cooperative Union,
185-1, Sunchang-Ri, Sunjang-Myeon, Asan-Gun,
Chungcheongnam-Do, Korea.
TEL: 0418-449252; FAX: 0418-420711

Taegu Ind. Inc.
Gurodanji P.O. BOX 38,
Seoul, Korea.
TEL: 02-8557311/3; FAX: 02-867784

2. Pilot Manufacturing of Some Major Pickled and Dried Asian Vegetables

Among the Asian vegetables, white radish (*Raphanus sativus* L.) has become one of the most popular in Australia. White radish is sold in the market in bundles of 2-3 roots. They are consumed fresh in salads or stir-fry and in processed form, dried or in pickles.

White radish is a traditional vegetable with approximately 20 million tonnes per annum produced in Asia (Vinning, 1995). Although increased affluence in many Asian countries has led to an increased demand for western foods, including western vegetables, social changes in those countries such as ageing and diminishing farm populations have, however, fostered a trend that growers are giving up production of bulky root crops. For instance, production of daikon radish in Japan has dropped from 1,902,000 tonnes in 1984 to 1,592,000 tonnes in 1996 (Anon. 1998) and dried daikon is the latest new import commodity into Japan in the last four years from 1995. This has opened up opportunities for Australia to satisfy a demand for this root vegetable in Asia, particularly Japan.

For freshmarket daikon, Harris (1996) and Harris *et al.* (1993a, 1993b, 1995) studied the effect of cultivar and growing season on the development of pithiness and postharvest performance. Cultivar Tomas has been recommended for commercial use to replace the local cultivar Long White, which was the worst keeping cultivar and could not achieve a four-week postharvest life Harris *et al.* (1993b). However, with increased interest in exporting dried and pickled daikon products to Asia, there exists a need for knowledge of growth, postharvest performance and processing technology of this root vegetable.

The aim of this study was firstly to compare growth and root quality of two different types of daikon, ie. processing and freshmarket. Special attention was needed to the development of shoot, root, pithiness, pungency and bolting of the processing daikon cultivars in four different seasons (spring, summer, late-summer and autumn) to determine optimum maturity for harvest targets for the dried and pickling products. A further scientific study has also been organised at the Newcastle University (Ourimbah campus). This will seek to determine the effect of various processing techniques on flavour and texture quality of white radish and to measure the preference of Australian, Korean and Japanese through sensory evaluation to different flavour concentrations and textures in processed white radish. A pilot scale processing system has been developed to slice, dry, salt and pickle white radish into a range of products for the domestic market and as potential export products to Japan (Ph.D Thesis, Rod Coogan, 1999).

2.1 Results from NSW Agriculture's Gosford Horticultural Research & Advisory Station

Takuan (Radish Pickle)

1. Materials and methods:

The experiments were conducted at the Somersby research farm of the Gosford Horticultural Research & Advisory Station (Latitude $33^0$22'S; Longitude 151^0 21'E yellow earth with sandy loam, Chairman, 1978) on the New South Wales Central Coast. The growing seasons studied were spring, early summer, late summer and autumn. Seeds of the Japanese daikon cultivars TOA 9132 (Yasato Riso), Hayatsumari and Hoshiriso of processing type and Fukumi, Tomas, Taishin and Relish Cross of fresh market type were planted into single row raised beds in a seven blocks by seven cultivars in randomised incomplete block design (RIBD). After emergence, each of the 49 plots was thinned to leave approximately 50 plants at a spacing of 15cm. The sowing dates were 17th February, 6th June, 20 October, 28 November, 1995; 20 March, 12 September, 9 October, 4 December, 1997, 6 February, 2 April, 1997 and 16 April, and 27 May, 1998.

Samples were taken over the crop growing period, starting before the crop anticipated harvest date and continuing past the commercially mature stage. A sample of 3 plants from each of the 49 plots was taken 30, 40, 47, 54, 61, 68, 75, 82, 89, 96, 103 and 110 days after sowing. At each sampling, size and weight data were recorded, then samples were immediately examined for quality including pithiness and pungency.

For Takuan and dried daikon experiments, radishes were harvested when they reached approximately 1,000 g fresh weight.

2. Results and discussion:

Planting time had a major influence on the growth rate of daikon. Commercial harvest weight of daikon for both the fresh and processing markets in Asia is approximately 1,000 g. This was reached 60-65 days, 70-80 days and 100-110 days in summer planting, spring and late-summer planting and autumn planting, respectively. Processing cultivars have always achieved a root standard size at about 5-10 days later than those of fresh market cultivars.

The occurrence of pithiness varied among cultivars. However, there was no significant difference between fresh market and processing types in terms of occurrence of pithiness. Daikon tended to develop pithiness early in summer season and late in autumn season.

Daikon root developed pungency during early growth stages and this was closely correlated to cultivars. Processing cultivars such as TOA 9132, Hayatsumari and Hoshirisho showed a higher level of pungency than fresh market cultivars such as Tomas and Fukumi.

Flower bud formation (bolting) varied among cultivars but spring and summer plantings showed the highest risk of bolting. The autumn planting showed the least. Low temperature in the early stage stimulated the formation of flower bud.

3. Processing of takuan:

Commercial Takuwan in Japan is often too salty or too sweet. Too salty is believed an old traditional Takuwan, while sweet Takuwan is considered as a new taste in the Japanese markets.

i) Drying daikon:

Daikon is harvested approximately 75-85 days after sowing when the root is approximately 700-1,000 g fresh weight. The whole daikon (including green leafy top) is hung to dry in a well-ventilated, shady area while dry daikon is hung only until it can be bent into a "U" shape (approximately 50% moisture content stage). To enhance the Takuwan flavour, dried skin from mandarin and/or orange should be used (Steps 1 and 2). Cut off tops with approximately 10mm of daikon so the leaves will stay together (Step 3).

ii) Pickling mixture:

Pickling mixture is a combination of the following items:

* Rice bran (nama-nuka)	22.5%
* Salt	9%
* Sugar	3%
* Konbu (kelp; *Laminaria japonica* ARESCHOUG)	2.5 cm/kg dried daikon
* Hot chilli (dry)	Few
* Mandarin and orange skin (dry)	Few
* Colour[1)] (Food colour No. 2 - 2030L0010)	0.0025%

([1)] Yellowing the Takuwan is sometimes required, but not always).

Mix all the above items together to make a pickling mixture (Step 4).

iii) Pickling procedure:

Pickling procedure is carried out by using the following steps:

1. Chop off top of plants (leafy part);
2. Sprinkle 2 cm of mixture on the bottom of plastic or wooden containers and place daikon alongside container wall. Then cover with mixture (Steps 5 to 7).
3. Repeat layering of dried daikon and cover mixture until almost to top of container, top and fill the gap with dried leaves, then cover again with mixture (Steps 8 to 10).
4. Press down to make surface flat. Place on a drop lid and place a weight two to three times heavier than those of dried daikon on the lid (Steps 11 to 12).
5. As salt penetrates dried daikon, the surface will lower. Remove weight and cover with plastic sheet to protect from dust and insects and/or bad odour. Return weight immediately and keep container in a cool, shaded or dark place (Steps 13 and 14).
6. Approximately 2-3 weeks later, liquid in the container will occur and when it reaches the drop lid, reduce weight to equal the weight of dried daikon. Stand for approximately a month to mature (Step 15).

iv) Matured Takuan:

After 6-7 weeks, takuwan is sufficiently mature and ready to serve. In removing takuwan for serving, remove leafy daikon from around the edges and put aside. Take takuwan from outer edge and refill gaps with leafy daikon again to prevent deterioration of flavour. Re-cover surface with the leafy dried daikon and mister. Press hard and again place on drop lid (Steps 16 to 18).

Four kilograms of dried daikon was used for making takuwan in a plastic container. The flavour of takuwan from this experiment was tested seven and 15 weeks after pickling by seven Japanese including:

1. One representative of Dai-E Group (Mr. Tsukamoto);
2. One representative of JETRO, Sydney Office (Mr. Otsubo);
3. One representative of the Japanese Consulate (Mr. Ishioka); and
4. Four Japanese housewives.

Preliminary results showed that the Takuwan from the above recipes was successful in terms of quality including colour and crunch (crisp) and saltiness. The samples were required by Dai-E Group, JETRO and other Japanese panellists.

Table 24. Nutrient composition of Takuan. Unit based on 100 g product.

	Takuwan
Energy:	
kCal	40
kJ	167
Water (g)	81.5
Protein (g)	1.4
Fat (g)	0.1
Carbohydrate:	
Sugar (g)	7.9
Fibre (g)	1.2
Ash (g)	7.9
Inorganic (mg):	
Calcium	55
Phosphate	65
Iron	0.8
Natrium (sodium)	2,800
Kalium	300
Vitamin A:	
Carotene (mg)	0
RE, Iu	0
Vitamin B_2 (mg):	0.05
Vitamin B_2 (mg):	0.03
Niacin (mg):	0.4
Vitamin C:	15

Source: Nutrient composition of food in Japan. Japanese Bureau of Science and Technology, Tokyo, Japan, 1984.

4. Cost of production:

Rice bran takuan:

i) Cost of ingredients for 5 kg (16 roots) dried radishes:

* Rice bran			N/K[1)]
* Salt	300 g @ $132/tonne		$ 0.04
* Sugar	150 g @ $185/25 kg.		$ 0.11
* Konbu	2.5 cm	)	
* Hot chilli	Few	)	$ 0.50
* Mandarin @ orange skins	Few	)	_____
			$ 0.64
ii) Cost for growing and drying 16 radishes:			$ 5.06
iii) Cost of labour @ $12/hour:			$ 4.00
		TOTAL:	$ 9.70

Cost of one takuan (size 20/450 g. $ 0.61[2)]

Cost of 1 kg. takuan size 20/450 g $ 1.94

Note: 1) The cost of rice bran in Australia is unknown. Rice bran would be available from Leeton Rice Growers' Association, Leeton, NSW;

2) Cost of packaging and shipping are not included.

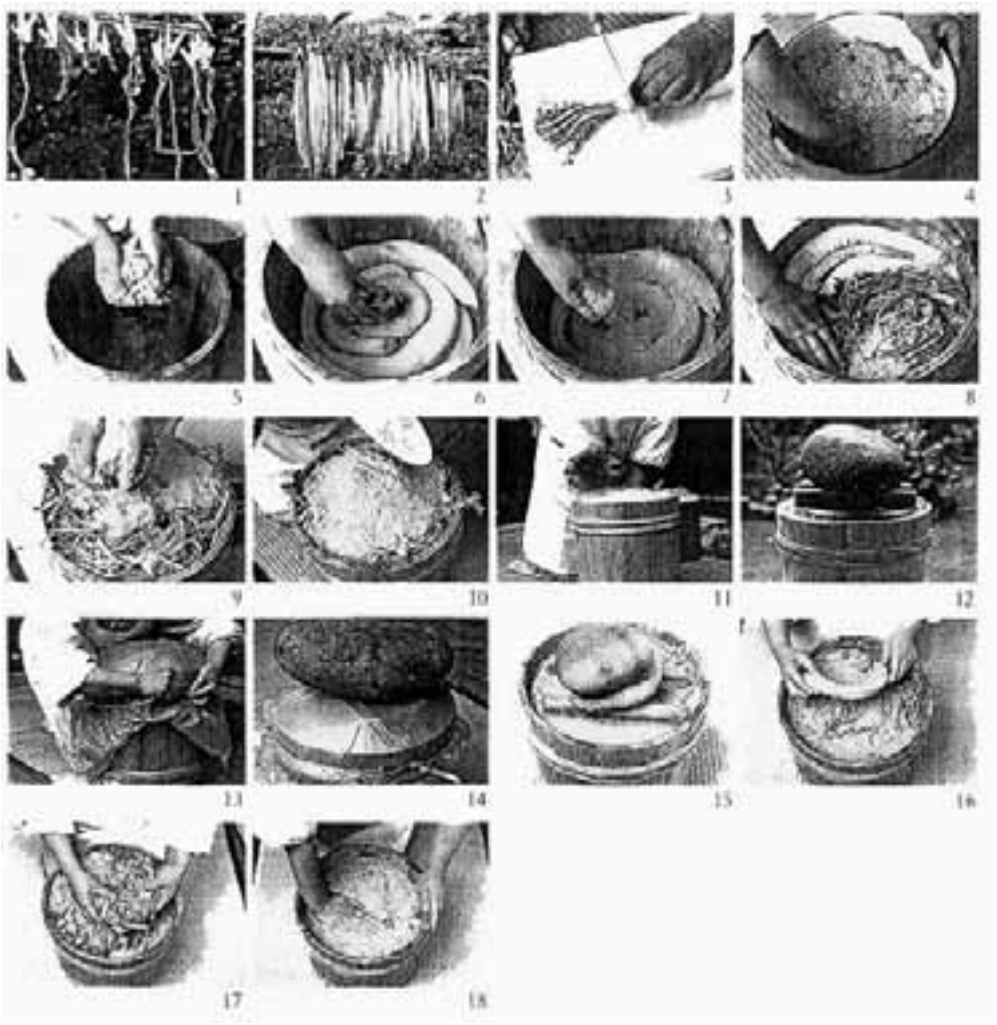
Profit margins:

Australian wholesale market: $3.00/kg. - $1.94/kg. = $1.06/kg

Australian retail market: $5.00/root - 0.6/root = $4.40/root

A Japanese food trading company in Australia is willing to pay A$3-4.00/kg. of takuan. This price would give producers a profit margin of A$1.06/kg. However, since prices in retail markets are high, averaging at $1.50 (Korean takuan) up to $5 (Japanese takuan) per root for takuan, Australian producers may achieve a profit margin of $0.90 to $4.40 per root of takuan if Australian takuan could penetrate directly into retail markets.

It is possible to produce good quality takuan in Australia with a gross margin of A$1.94/kg. This price would give Australian producers a gross margin of approximately A$1,060/tonne in wholesale markets.



Pickling Procedure of ***Takuanzuke*.**
(Source: Shimizu, K. 1993: Tsukemono Japanese pickled vegetables)

Kimchi:

Korean Kimchi is a pungent, fermented and usually highly-spiced pickled vegetable. It can be made with Chinese cabbage, white radish (daikon), cucumber, turnip and other vegetables which are fermented in pickling mixture including salt, sugar, hot chilli, garlic and seafood stuffs (fish guts, shrimp, oyster, fish sauce). The fermentation that begins is the key to Kimchi's long shelflife, complex flavours and heightened vitamin content. Korean scientists have found that when the lactic acid produced by fermentation reaches its optimum level, Kimchi is at its most flavourful and most nutritious stage. Kimchi that has not aged properly has a "sharp" taste, while that which is too old becomes sour.

Low in kilojoules, Kimchi contains such vitamin nutrients as carotene (pro-vitamin A), vitamins B_1, B_2, B_{12}, C and Niacin.

Table 25. Nutrient composition of Kimchi. Unit based on 100 g product.

	Kimchi
Energy:	
kCal	30
kJ	126
Water (g)	88.6
Protein (g)	2.4
Fat (g)	0.2
Carbohydrate:	
Sugar (g)	3.8
Fibre (g)	0.8
Ash (g)	4.2
Inorganic (mg):	
Calcium	55
Phosphate	48
Iron	0.6
Natrium (sodium)	1,400
Kalium	300
Vitamin A:	
Carotene (mg)	110
RE, Iu	60
Vitamin B_2 (mg):	0.04
Vitamin B_2 (mg):	0.11
Niacin (mg):	0.6
Vitamin C:	20

Source: Nutrient composition of food in Japan. Japanese Bureau of Science and Technology, Tokyo, Japan, 1984.

Salted fish and fresh seafood, if added, provide protein and vital minerals such as calcium and iron. Cellulose in Chinese cabbage and radish helps with digestion.

1. Materials and methods:

i) Chinese cabbage:

The experiments were conducted at the Somersby research farm of the Gosford Horticultural Research & Advisory Station on the NSW Central Coast. The growing seasons studied were spring, early summer, summer and early autumn.

The highlights of these experiments are summarised below:

* Observation trials only
* Raised beds 30 m in length x single row
* Spacing 0.8 m x 0.4 m, 75 plants/plot (31,250 plants/ha). Data collected from five plants
* Trickle irrigation system

Cultivars:

1.	Hong Kong	Yates Vegetable Seed, Australia
2.	Super Queen	Mikado, Japan
3.	Super King	Mikado, Japan
4.	Summer Winner	Han Nong, South Korea
5.	Kikunishiki	Tohoku Seed, Japan

From Experiment 5, 11 cultivars were used in a trial that was replicated four times in an incomplete block design. The origin of the tested cultivars were as follows:

1.	Hong Kong	Yates, Australia
4.	Summer Winner	Hang Nung, Korea
5.	Kikunishiki	Tohoku Seeds, Japan
6.	Green Silk	Yates, Australia
7.	Daifuku	Tohoku Seeds, Japan
8.	Daifuku Choki	Tohoku Seeds, Japan
9.	Kigokoro 65	Takii Seeds, Japan
10.	Kigokoro 85	Takii Seeds, Japan
11.	Alpine Summer	Choong Ang Seeds, South Korea
12.	Autumn King	Choong Ang Seeds, South Korea

Planting time:

Exp. 1	S18/07/96	T26/08/96	H24/10/96	98 d	cvs 1,2,3,4
Exp. 2	S05/09/96	T09/10/96	H06/01/97	118 d	cvs 1,2,3,4,5
Exp. 3	S04/12/96	T07/01/97	H N/A	-	cvs 1,2,3,4,5
Exp. 4	S10/03/97	T10/04/97	H02/07/97	114 d	cvs 1,2,3,4,5
Exp. 5	S26/11/97	T20/12/97	H10/03/98	104 d	cvs1,4,5,6,7,8,9,10,11,12,13

2. Results and Discussion:

Results that were obtained from the first four experiments are summarised hereunder:

i) Exp. 1: All cultivars performed well and had good heads. No. 3 was slow bolting

ii) Exp. 2: All cultivars performed well - good compact heads. No. 4 was early bolting

iii) Exp. 3: All cultivars rotted due to hot and humid weather.

iv) Exp. 4: All cultivars performed well but had small heads.

v) Head shape: Hong Kong and Japanese cultivars had close heads while the Korean cultivar had an open head.

vii) Head size: The largest head size of all cultivars was in September-December (spring-summer) showing that this is the best time to grow Chinese cabbages.

viii) Japanese and Korean cultivars were found to be very good in quality and, therefore, suitable for production of kimchi. Hong Kong was not very good in terms of processing quality because of its soft, watery tissues (Table 26).

Table 26. Morphological characteristics of Chinese cabbage in the first four experiments.

Exp.	1.Hong Kong			2.Super Queen			3.Super King			4.Sum.Winner			5.Kikunishiki		
	H[1)] cm	D[1)] cm	FW[1)] g	H	D	FW	H	D	FW	H	D	FW	H	D	FW
1.	25.3	17.7	1854	27.7	17.7	1904	25.3	17.3	1306	24.3	16.3	1614	N/A		
2.	30.5	20.5	2969	27.0	19.8	2886	28.5	19.0	2169	28.0	21.0	2459	27.5	19.8	2794
3.	N/A						N/A			N/A			N/A		
4.	25.0	16.5	1750	24.5	17.5	1950	23.5	16.0	1310	25.0	18.5	1755	26.0	18.5	

Note: 1) H : Plant height; D : Head diameter; FW : Head freshweight

In Experiment 5, results have shown that cultivars Kikunishiki, Daifuku, Kigokora 65, Kogokora 85, Summer Winner, Alpine Summer and Autumn King produced good heads in comparison with the standard cultivar, Hong Kong, which achieved 1.9 kg. per head (Table 27). New cultivars such as Daifuku, Kaifuku Choki, Kigokoro 65, Kigokora 85, Autumn King and New Autumn King were impressive because of their attractive internal yellow colour. New Chinese cabbage cultivars with yellow internal colour contain higher levels of Vitamins A and C.

Table 27. Morphological characteristics of Chinese cabbage in Experiment 5.

Cultivar	Freshweight (kg.) sowing			Head			Structure	Colour
	Whole plant	Outer leaves	Head	Length (cm.)	Width (cm.)	Core (cm.)		
Hong Kong	3.2	1.3	1.9	28.6	17.0	6.4	Compact	White
Green Silk	2.8	1.2	1.6	25.9	17.9	6.4	Compact	White
Kikunishiki	3.7	1.4	2.3	28.5	19.3	4.9	Compact	White
Daifuku	3.6	1.6	2.0	28.6	19.0	4.6	Little loose	Yellow
Daifuku Choki	2.9	1.3	1.6	29.0	16.0	5.2	Loose	Yellow
Kigokoro 65	3.6	1.7	1.9	29.3	18.4	5.4	Loose	Yellow
Kigokoro 85	3.5	1.5	2.0	32.1	18.3	5.3	Loose	Yellow
Summer Winner	3.7	1.8	1.9	25.7	17.7	15.5	Bolting	White
Alpine Winner	4.1	1.8	2.3	30.4	19.0	3.1	Compact	White
Autumn King	4.2	2.3	1.9	28.9	19.3	3.8	Loose	Yellow
New Autumn King	4.0	2.3	1.7	26.3	19.0	4.0	Loose	Lt. Yellow

ii) Hot chilli:

Four hot chilli cultivars, which were given by Choong Ang Seed Company of South Korea, were sown on 26 November, 1997 and transplanted on 20th December, 1997 0.9 m apart with 0.5 cm between plants on raised beds using T-tape irrigation. Harvesting was organised on 7 April, 1998.

Results showed that all four cultivars achieved very high yields (10 t of fresh fruit per hectare - Table 28). However, from my viewpoint, these Korean hot chillies are not hot. They could be used as fresh hot chilli for the Korean meal rather than increasing pungency of Kimchi.

Table 28: Morphological characteristics and yield of hot chilli.

Cultivar	No. Fruit/plant			Average freshweight	Yield (g/plant)
	Green	Red	Total		
Seoul hot	32	43	75	6.2	462
Heirloom	17	28	45	9.1	410
Revival	12	41	53	11.1	587
Tae Myoung	49	24	73	6.4	465

3. Processing of kimchi:

Several samples of Japanese Kimchi were made up in1997. Techniques for the production of Korean kimchi were also developed in co-operation with the Korean women of the Japanese Keirokai Club, Sydney in 1998.

- ***Japanese style kimchi:***

  Chinese cabbages were cut into four pieces and dried in the shading shed for one day. Recipes for kimchi are based on one head of Chinese cabbage and for Japanese taste rather than Korean taste.

Table 29. Performance of four cultivars of Chinese cabbages* used at materials for kimchi.

Cultivar	Head				Takuwan
	Height (cm.)	Diameter (cm)	Freshweight (g)	Leaf No.	
Hong Kong	25.3	17.7	1,854	61.7	Started bolting
Super Queen	27.7	17.7	1,904	61.0	Started bolting
Super King	25.3	17.3	1,306	51.3	Started bolting
Summer Winner	24.3	16.3	1,614	57.3	Bolting (visible)

*Note: Sowing: 18t July, 1996; Transplanting 26 August, 1996; Harvesting 24 October, 1996.

- ***Pickling mixture:***
  - One head of Chinese cabbage (approximately 1,500 g) cut into four pieces)
  - Salt 5 g
  - Rock salt 60 cc
  - Sugar 9 g
  - Sliced carrot 1 only
  - Sliced spring onion 3-4 plants
  - Hot chilli and garlic sauce Optional
  - Fish sauce Few

  Note: The amount of hot chilli and garlic is very much dependent on whether customers prefer light or very pungent kimchi.

  Mix all ingredients together and spread over Chinese cabbages. Press to make surface flat and place on a drop lid and put a weight 2-3 times heavier than that of Chinese cabbage onto the lid. Keep at room temperature for 2-3 days. The fermented kimchi should be stored in a cool temperature such as a refrigerator. The kimchi was tested by four Japanese housewives and a number of Australian housewives and they all agree that taste and flavour are satisfactory. From the viewpoint of quality, Super Queen (Japanese cultivar) and Summer Winner (Korean cultivar) produced a better crispness).

- ***Korean style kimchi:***

Ingredients:

A.	Large Chinese cabbage	1
	Salt	5.6%
	Fish sauce	2 large spoons
	Water	1 cup
	Onion	1/2 bunch
B.	Chilli (three powder, two medium, 1 coarsely ground)	6 large spoons
	Sugar	1 large spoon
	Apple - shredded	1/3
	Garlic - shredded	1 large spoon
	Ginger - shredded	1 teaspoon

A. Pre-pickling Chinese cabbage:

1. Cut Chinese cabbage into four parts
2. Sprinkle salt on under part of all leaves. Roll Chinese cabbage tightly and place in container for storage over one night at room temperature.
3. Rinse and drain thoroughly.

B. Kimchi sauce - mix all the ingredients (B):

4. Spread (B) over all Chinese cabbage leaves (A). Roll tightly and place back into container:
   Winter: Kimchi will be ready to serve in 4-5 days
   Summer: Kimchi will be ready to serve in 1-2 days
5. Cut into eating size pieces (3 cm). Mix with (B), pack into box.
   Summer: Kimchi will be ready to serve in 2 days
   Winter: Kimchi will be ready to serve in 4-6 days

4. Cost of production:

Kimchi:

i) Cost of ingredients for 1 kg Chinese cabbage:

*	Carrot	115 g @ $1.29/kg.	$ 0.16
*	Eschallot	Quarter bunch @ $1.68/bunch	$ 0.42
*	Garlic	38 g @ $3.99/kg.	$ 0.15
*	Garlic chives	Quarter bunch @ $0.98/bunch	$ 0.25
*	Ginger	38 g @ $4.99/kg.	$ 0.19
*	Apple (Granny Smith)	115 g @ $1.99/kg.	$ 0.25
*	Salt	115 g @ $1.65/kg.	$ 0.20
*	Sugar	25 g @ $0.95/kg.	$ 0.03
*	Fish sauce	25 g @ $1.45/L	$ 0.04
			$ 1.69

ii) Cost for growing Chinese cabbage (1 kg.) $ 0.72

iii) Cost of labour @ $12/hour $ 4.23

TOTAL: $ 6.64[1)]

Note 1): The costs would be reduced in large-scale production and with processing performed by machine.
Costs of packaging and shipping are not included.

Profit margins:

In Japan, kimchi is classified as a soy sauce pickle and consumption reached 119,628 t in 1998 and was valued at approximately A$1.5 billion on the retail market.

Japan commenced importing kimchi from South Korea in 1994 with 8,733 t imported. This increased to 15,015 t in 1998 which was valued at ¥5.6 billion (A$71 million) (Table 9). At present, Australia could not compete with South Korean kimchi either in quality or prices. However, since the prices of kimchi in retail markets are up to A$17.00/kg. in Japan, Australia might achieve a profit margin of A$10.36/kg if Australian kimchi could penetrate directly into supermarkets in Japan.

In Australia, the price of kimchi in retail markets was A$10.00/kg. This prices would give producers a profit margin of A$3.46/kg.

The gross margins for kimchi is A$6.64/kg. This price could not compete with South Korean kimchi in Japanese markets, which was at ¥371/kg. (A$4.72) in 1997. However, as prices in retail markets are higher (up to A$17/kg.), Australia may achieve profits if our kimchi could penetrate directly into supermarket chains in Japan.

Photograph 1. New type of Chinese cabbage, cv. Daifuku, Daifuku Choki, Kigokoro 65 Kigokora 85, Autumn King and New Autumn King, are impressive because of their attractive internal yellow colour.

Photograph 2. New type of Chinese cabbage cultivar (bottom) shows better green and yellow colour in comparison with ordinary cultivar (top) even in pickled form.

Umeboshi (Japanese Apricot Pickles)

Japanese apricot (Ume; *Prunus mume*), also called "Japanese plum" in Japanese literature, is one of the important fruit crops for processed products in Asia. There are three products that can be made from Ume; **Umeboshi** (pickles), **Umeshu** (wine) and **Doyobashi** or **Xi-Muoi** (dried and pickled).

In Japan, Umeboshi and Umeshu are also important products. In 1985, Japan produced 22,281 t of Umeboshi valued at approximately ¥14.5 billion (A$186 million) on the wholesale market. In 1995, production of Umeboshi jumped to 37,113 t valued at ¥48 billion (A$615 million). In the same year, however, Japan imported 22,835 t of Ume products including dried, pre-pickled and prepared Ume valued at ¥5.5 billion (A$70.5 million [A$ = ¥78 in 1998]).

Although the intake of pickles *per capita* has been declining in Japan due to a trend towardslower salty food consumption, the use of **Umeboshi** has increased. This is despite the fact that its salinity is the highest in pickles. The reason for this is that demand would be the consumer's recognition of the medical effect of **Umeboshi**, which is classed as a tonic in aiding digestion. The acidic, salty Umeboshi alkalises the digestive system in humans. **Umeshu** (Japanese apricot wine) is also considered a tonic drink.

1. Materials and methods:

Ume fruits were collected from the University of Western Sydney (Hawkesbury) in November and December, 1997 and 1998 including four different lines, namely line P_4, P_5, P_6 and P_9. Umeboshi has been pickled only on two lines, P_5 and P_9, because of their good quality. The ingredients of Umeboshi are as follows:

- Ume fruit	1,000 g
- Salt (18%)	180 g
- Shochu (Japanese Sake 25%)	50 cc

The salt in Umeboshi is 18%-20% of the fresh weight of Ume fruit. Salt could be reduced to 10-15% without any loss of quality in terms of shorter preservation period, but it would be more sour.

2. Results and discussion:

Two types of Umeboshi were produced, ie. Akajiso Umeboshi (Umeboshi with red perilla leaves) and Kanto type Umeboshi, amber in colour without red perilla leaves. Japanese apricot pickled with red perilla results in the Umeboshi becoming a savoury red colour. Red perilla leaves also prevent spoilage.

The taste and flavour of both products were tested by Japanese visitors and staff of Sun-Masamune, a sake company in Penrith, New South Wales, three months after pickling. Results showed that the umeboshi from the above recipes were successful. A further research project with financial support from a Japanese company (Sun-Masamune) has been submitted to RIRDC.

3. Cost of production:

Cost of ingredients for 1 kg. Ume fruit:

* Salt	200 g @ $132/ton	$ 0.03
* Shochu (25°)	50 cc @ $458.05/18L	$ 1.27
		$ 1.30
* Cost of growing Japanese apricot (1 kg.)		$ 0.50[1)]
* Cost of labour @ $12/hour		$ 2.00[2)]
	TOTAL:	$ 3.80

1. Based on prices of apricot growing in Yanco (MIA)
2. Cost of labour will be less in bulk production.

Profit margins:

i) Japanese import market:

Japan imported 22,835 t of ume products in 1995 which were valued at ¥5.5 billion (A$70.6 million [A$ = ¥78 in 1998]). The cif prices of semi-pickles were highest for Taiwanese and lowest for North Korean products with ¥277.9/kg. (A$3.5) and ¥70.7/kg. (A$0.90) respectively (Table 30).

Table 30. Importation of ume products into Japan, 1995 (Inden *et al.* 1997).

	China		Taiwan		North Korea		Thailand		Others		Total	
	Q[1)]	V[2)]	Q	V	Q	V	Q	V	Q[3)]	V	Q	V
Dried and semi-pickled ume	10514	203.6	11879	277.9	50	70.7	31	264	104	209	22579	241.5
Prepared ume	214	192.7	42	350	NIL	-	NIL	-	NIL	-	256	218.6

1) Q : Quantitative, ton; 2) V = Value, CIF price : ¥/kg.; 3) Argentina

Gross margins for Australian umeboshi product would be no good for bulk import into Japan. However, the retail market pays much higher prices (A$17/kg.) compared to $13.2/kg for both Japanese and domestic retail markets.

The gross margins for umeboshi is A$3.80/kg. This price could not compete with either North Korea's or Taiwan's in the Japanese market. However, umeboshi made in Australia has a market domestically and in Japanese supermarkets under our own trade mark.

4. Umeboshu umeshu (Japanese apricot wines):

Ume fruits collected from the University of Western Sydney (Hawkesbury) have also been used for production of Japanese apricot wine.

The Japanese apricot fruits were cleaned and soaked in tap water overnight and well drained. Five to six holes were pricked in each fruit with a strong, thick toothpick. Fruits were then placed in jars which were then filled with crystal sugar and liquor in the following quantities:

- Japanese apricot fruit 1,000 g
- Crystal sugar 500 g
- Japanese Schochu (liquor) 25% 1,200 cc.

Jars were then sealed with lids and kept in a dark and cool place where it will remain for three months until the wine has matured. However, due to the longer storing period producing better taste, these wines are usually served six months after production.

Both the above Umeboshi and Umeshu will be assessed at the companies of Jun Pacific Pty. Ltd., Chatswood, NSW, and Sun-Masamune Pty. Ltd., Penrith, NSW.

DRIED DAIKON:

1. Materials and methods:

Daikon that were produced at the Somersby research farm, at Merriwa, Cowra, Griffith, Narrandera and Dareton in NSW, were all harvested when the root had achieved a fresh weight of approximately 1,000 g/root. Roots were washed and cut longitudinally to a size of 12 mm x 12 mm and using gas, electricity, and sun-dried technologies the radish was dried to 10% moisture. The daikon cultivar used focussed on Hoshiriso, processing type, and Relish Cross, fresh market type.

i) Development of cutter:

A compressor cutter has been developed by Ziga Technical Services, of 54 Kingston Street, Haberfield, NSW 2045, at a cost of $2,000. This cutter can cut radish at a size of 11.8 mm x 11.8 mm and works very well with capacity of cut being 500-600 kg/hr.

ii) Drying technologies:

Four drying technologies were studied - dehumidifying (Merriwa's Hunter Valley Herb Farm), heat (Gosford Horticultural Research & Advisory Station), gas (Darlington Point's Goman Foods) and sun-dried (Dareton Agricultural Research and Advisory Station) systems.

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2. Results and discussion:

Results have shown that:

a) roots brushed when washed, dry faster than roots washed without brushing;
b) finished at 42°C, it took six days to dry the daikon to 10% moisture. It would require 12.5-14.0 kg. of fresh product to produce 1 kg. of dried daikon;
c) in the heating system where temperatures of 50°C, 55°C and 60°C were used, the 50°C treatment showed the best quality in terms of colour. At 50°C it was in the dehumidification (heat pump) system, where temperatures started at 20°C and it was necessary to dry the daikon for 18 hours to produce a product at 10% moisture. It required 16-20 kg. of fresh product to produce 1 kg of dried daikon. Breakeven point for the electricity heat drying is estimated at A$2.26/kg;
d) in the gas system (J.C. Granger & Sons, Kingsvale, NSW, 2587 and Goman Foods, Darlington Point, NSW, 2027) where temperature of 50°C was used, it took 10 hours to produce product at 10% moisture. It required 9-10 kg of fresh product to produce 1 kg of dried daikon. Breakeven point for the gas drying is estimated at A$3.54/kg;
e) in the sun-drying system, a sample of 121 kg of fresh daikon, cv. Hoshiriso, was harvested, washed, sliced and placed on grape racks for sun-drying in the traditional method used for producing sultana grapes in the Sunraysia region. The drying process was completed within 24 hours and the quality of the dried product was excellent with a good white colour, uniformly dried with a 10% moisture content. Breakeven point for the sun-drying is estimated at A$3.31/kg;
f) cultivars suitable for dried daikon were Hoshiriso (white-necked type - Shirokubi) and Relish Cross (green-necked type - Aokubi); and

g) dried daikon samples which were sent to Japan for assessment were considered of high quality. However, some points need to be improved (Appendix I).

3. Shelflife of dried radish:

One experiment was organised at the Gosford Horticultural Research & Advisory Station to investigate the shelflife of dried radish. The radish was cut longitudinally to a size of 10 mm x 10 mm and dried in an electrical dryer at 50°C until the root achieved approximately 10% of initial freshweight. The dried products then were packed into unsealed plastic bags, sealed plastic bags and airtight plastic bags (vacuum). Results showed that the dried products, which carried more than 10% of initial fresh weight (equivalent to 11% moisture), were infected by white mould after 14 days (20%). The dried products, which carried less than 10% of initial fresh weight, and were mould-free up to 10 weeks.

The dried products stored in a freezer (-18°C) and coolrooms (8°C) maintained good colour (yellow/white) for up to six months while the products stored at room temperatures (20°C) turned to a greyed-orange colour within 4-5 weeks.

4. Cost of production:

Table 31. Estimated costs of dried daikon from different drying techniques.

Drying techniques	Tested areas	Estimated cost (A$/kg.)
Electricity heating	Gosford HRAS, Gosford, NSW	2.26
Sun-drying	Dareton ARAS, Dareton, NSW	3.31
Gas heating	Goman Foods, Darlington Point, NSW	3.54
Gas heating	Cowra Export Packers' Co-op, Young, NSW	6.03[1)]
Dehumidification	Hunter Valley Herb Farm, Merriwa, NSW	13.00[2)]

1) FOB price, ex Sydney, calculation of 4 t sample product.
2) FOB price, ex Merriwa, calculation of 1 t sample product.

Profit margins:

i) Australian market:

Sliced, dried daikon sold in Japanese and Korean supermarkets are packed in bags containing 200 g, 250 g and 500 g. Retail prices per Kg for these products as at July 1999 were $5.20, $6.50 and $13.00 respectively. Profit margins (per kg) of sliced, dried daikon in Australian markets is $26.00 minus $3.54 = $22.46. It should be noted that the costs of packaging and transportation were not included.

ii) Japanese market:

Japan imported 2,926 t of dried daikon in 1995. This increased to 3,983 t and 3,163 t in 1996 and 1997 respectively. The main supplier of dried daikon for Japanese markets is China with very low CIF prices of around A$2.50/kg (Table 32). Although Japanese pickle manufacturers are not satisfactory with quality, the low price of the Chinese product has compensated for this low quality. There is no way that Australia can compete with China in Japanese markets. However, if Australia can prove that its dried daikon is of higher quality, there is a reliable supply and reasonable prices, there is a possibility that Australia could supply this commodity to Japan in the future.

Table 32.Importation of dried daikon into Japan in a period of three years (1995-97)

	1995	1996	1997
Volume, ton	2,926 (2,898[1])	3,983 (3,983)	3,163 (3,160)
Value, ¥ million	400	682	608
CIF price, ¥/kg.	137	171	192

1) Figures in parenthesis () are from China.

With different technologies, there is no doubt that Australia can produce high-quality dried vegetables, such as dried daikon. But there is no way that Australia can compete with another supply country, such as China, if we cannot prove our products are of high quality with reliable and reasonable prices.

Table 33. Gross margin for dried daikon radish on the Central Coast (Gosford) - heat drying.

Enterprise: Daikon radish - Unit = 10 ha.		
Tractor costs:		
Slashing	$20/ha	$200
Herbicide	$20/ha	$200
Ploughing	$50/ha	$500
Cultivate x 2	$40/ha	$800
Bed forming	$30/ha	$300
Planting:		
Sowing	$40/ha	$400
Herbicide	$20/ha	$200
Pest control	$20/ha	$200
Disease control	$20/ha	$200
Fertilising	$20/ha	$200
Growing:		
Applying fertiliser	$20/ha	$200
Applying Weed control	$15/ha	$150
Applying pest control	$15/hax4	$600
Applying Disease control	$15/hax4	$600
Harvesting:		
Harvesting	$20/hr.x 160hr.	$3,200
Transport to shed	10 hr.x$15/hr.	$150
Container hire:	$4,000 ea. x 20	$80,000
Packing:		
Plastic liners	20,000 x $0.20	$4,000
Cartons (5 kg/carton)	20,000 x $1.80	$36,000
Stacking	1 hr. x $15/hr.	$15
Transport:		
Loading truck	1hr. x $15/hr.	$15
Transport to ship	$450/container x20	$9,000
Documents:		
Quarantine		$100
Port Service		$100
Import		$100
		$20,000

Enterprise: Daikon radish - Unit = 10 ha.		
Import Duty	(5%)	$150
Inspection		$200
Freight Forwarder		
Materials:		
Fertiliser - Nitram		
- Superphosphate		
- Potassium sulphide		
- Potassium nitrate		
Seed	2.5 kg/ha x $276/kg.	
Herbicide	Glyphosate 3 L/ha x $20/L	
Insecticide	Soil Chlorpyrifos 1L/ha x $20/L	
Foliar		
Fungicide		
Water	5.5 mL/ha x $13/mL	
Electricity:		
Irrigation	7 irr. x 10 hr. x 50 kWh x $0.15/kWh	
Coolroom		$515
Washer		$3,000
Dryer	$0.30/kg.	$1,000
General		$30,000
Labour ($12/hr.):		$300
Slashing	10 hr.	
Herbicide	10 hr.	$120
Ploughing	20 hr.	$120
Cultivating	2 x 20 hr.	$240
Bedforming	20 hr.	$480
Sowing	20 hr.	$240
Irrigating	0.5 hr. x 7 irrigation lines	$240
Weed control	10 hr.	$42
Pest/Disease control	20 hr.	$120
Fertiliser (Base)	10 hr.	$240
Fertiliser (side)	10 hr.	$120
Washing	6 hr. x 3 people	$120
Packing	8 hr./5 people	$216
Harvesting	160 hr. x 3 people	$480
Harvesting trailer	10 hr.	$5,760
Handling	1 hr.	$120
Telephone		$12
Miscellaneous		$200
Insurance:		$1,000
Marine	1%	
Payment	1%	$4,000
		$4,000
TOTAL COSTS:		**$225,682**
DRIED - TOTAL RETURNS FIRST GRADE		
10t/ha x $4000/t		**$400,000**

Table 34. Gross margin for dried daikon radish in the Central West (Cowra/Young) - gas drying.

Enterprise: Daikon radish - Unit = 1 ha. (1996)		
Income:		
50 tonnes fresh (5 t dry) less 20% loss		
4 tonnes dry @ $4.50/kg.		$18,000.00
Variable Costs:		
i) Land preparation:		
Deep chisel x 2	2 hrs/ha @ $13.75/hr.	$55.00
Disc x 3	1 hr/ha @ $13.75/hr.	$41.25
Broadcast	0.3 hrs/ha @ $13.75/hr.	$4.13
Bedforming	1.5hrs/ha @ $13.75/hr.	$20.63
Fertiliser G11	250 kg/ha $520/tonne	$130.00
Weed control - Dactha®	10 kg/ha $32/kg.	$320.00
Contract application	0.5 hrs/ha $25/ha	$12.50
ii) Planting:		
Tractor - contractor	$170/ha	$170.00
Seed	2.5 kg/ha @ $276/kg.	$690.00
		$600
iii) Growing:		$75.00
Tractor - Boomspray (contractor)	3 @ $25/ha.	$69.00
Fertiliser - Nitram®	125 kg/ha @ $460/tonne	$55.00
Weed control (cultivate)	2 hrs/ha @ $13.75/hr.	$24.00
Pest control (insecticide - Rogor®)	3 x 2.4L/ha @ $6.25/kg.	$26.00
Fungicide (Mancozeb®)	2 x 2kg/ha @ $6.25/kg.	$120.00
iv) Irrigation:		
Eight (8) applications	4.00 mL/ha @ $30/mL.	$2,500.00
v) Harvesting:	$4,000 ea. x 20	$250.00
Hand harvesting (contract)	100 bins/ha @ $25/bin	$500.00
Bin hire	$5/tonne fresh	
Truck cartage	10 tonnes/load @ $10/t	$2,250.00
vi) Postharvest:		
Washing and brushing	3 people @ $15/hr.	$750.00
		$50.00
vii)Freight to Young:		
Freight to Young	200 km @ $15/tonne	$1,250.00
Casual forklift labour		
viii)Slicing:		
Two (2) people + machine	2 tonnes/hr. @ $50/t	$2,000.00
		$2,480.00
ix) Drying:		$2,480.00
1,400 kg. fresh	10 hrs/14000 @ $7/hr.	
Loading drying trays (1 min/tray)	250 trays/t @ $0.06/kg.	$1,200.00
Unloading trays and packaging		
x) Packaging:		$600.00
Container plus polyliner	$0.30/kg + 2 kg./box	$1,800.00
xi) Freight:		$19,922.51
Blayney/Sydney	6M container	$23,907.01
To Japan		$25,907.00

TOTAL GROWING/PROCESSING COSTS:	**($4.98/kg.)**	
20% CANNERY MARGIN	**($5.98/kg.)***	
TOTAL:	**($6.48/kg.)**	
Ñ		

COSTS SUMMARY: Total growing and harvesting: $ 5,062.51
Postharvest $ 12,460.00

*Add margin for cannery; ∇ Involves $40/tonne fresh, ie. $140.00/tonne for grower.

Freight $ 2,400.00

Note: $ 19,922.51

i) If freight to Sydney only $24,107 and excluding container Sydney/Japan ($6.03/kg), ie. Japanese pay freight Sydney to Japan.

ii) Error and omissions excepted for above costings $6.50 delivered Japan is an indicative estimate.

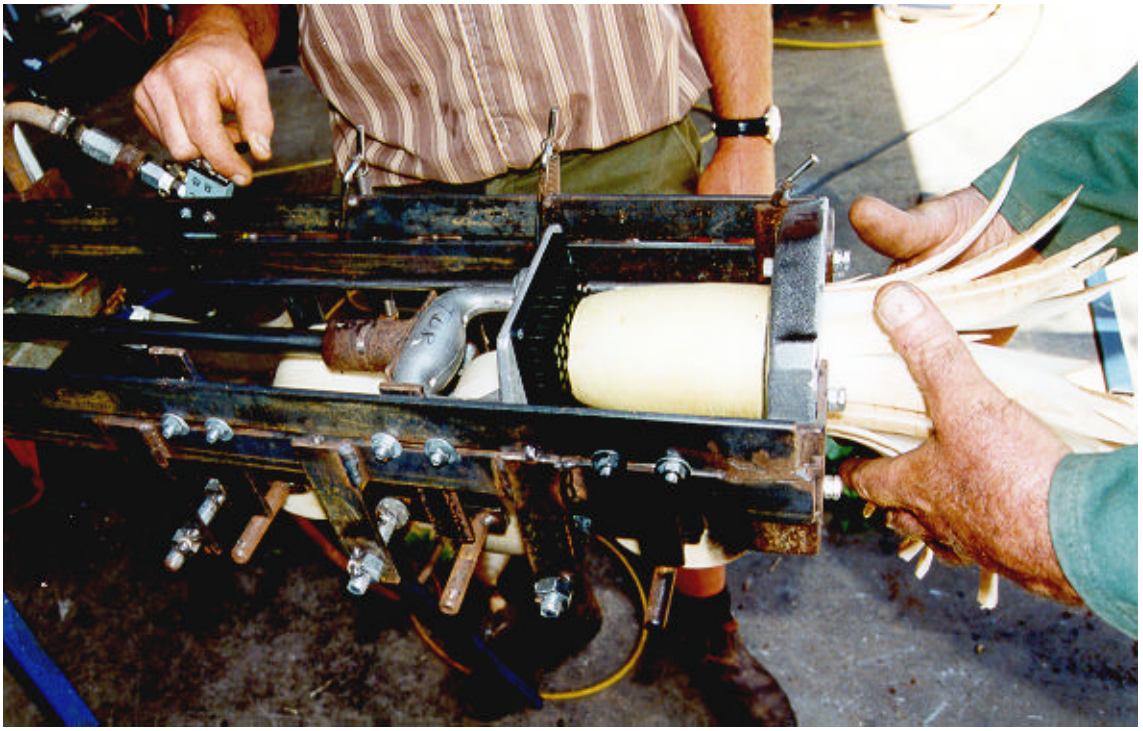
Table 35. Gross margin for dried daikon radish in the MIA (Darlington Point) - gas drying

Enterprise: Daikon radish - Unit = 1 ha. (1997)		
Income:		
50 tonnes fresh (5 t dry) less 20% loss		
4 tonnes dry @ $4.50/kg.		$18,000.00
Variable Costs:		
i) Land preparation:		
Spray x 1	$20/ha	$20.00
Roundup®	3 L/ha @ $10.50/L	$31.50
Scarify x 1	$50/ha	$50.00
Cultivate x 2	$40/ha.	$80.00
Ripping x 1	$50/ha.	$50.00
Pivot 900® (with above)	120 kg/ha @ $480/tonne	$57.60
ii) Planting:		
Sowing	$40/ha	$40.00
Seed	2.5 kg/ha @ $276/kg.	$690.00
iii) Growing:		
Boomspray x 4	$15/ha.	$60.00
Rogor® x 4	3 L/ha @ $10/L	$30.00
Endosulfan (with above)	6.5 L/ha @ $14.10/L	$91.65
Tractor	$15/ha	$15.00
Dacthal	24 kg/ha @ $32/kg.	$768.00
Cultivate	$40/ha	$40.00
Side dressings	$20/ha	$20.00
Pivot 900® (with above)	120 kg/ha @ $480/tonne	$57.60
iv) Irrigation:	5.5mL/ha @ $30/mL	$165.00
v) Harvesting:	$4,000 ea. x 20	
Hand harvesting (contract)	100 bins/ha @ $25/bin	$500.00
Bin hire	50 tonnes @ $5/tonne	$250.00
Truck cartage	50 tonnes @ $10/tonne	$2,500.00
vi) Postharvest:		
Washing and brushing	3 people x 6 hrs @ $12/hr.	$216.00
vii)Freight to Darlington Point:		
Freight to Darlington Point	$15/ha	$15.00
viii)Slicing:		
Two (2) people + machine	2 tonnes/hr. @ $50/hr.	$1,250.00
ix) Drying:	357hrs @ $7/hr.	$2,499.00
Loading drying trays (1 min/tray)	250 trays/t @ $0.06/kg.	$3,000.00
Unloading trays and packaging	40 hrs./ha @$12/hr.	$480.00
x) Packaging:	4 t/ha @ $0.30/kg.	$1,200.00

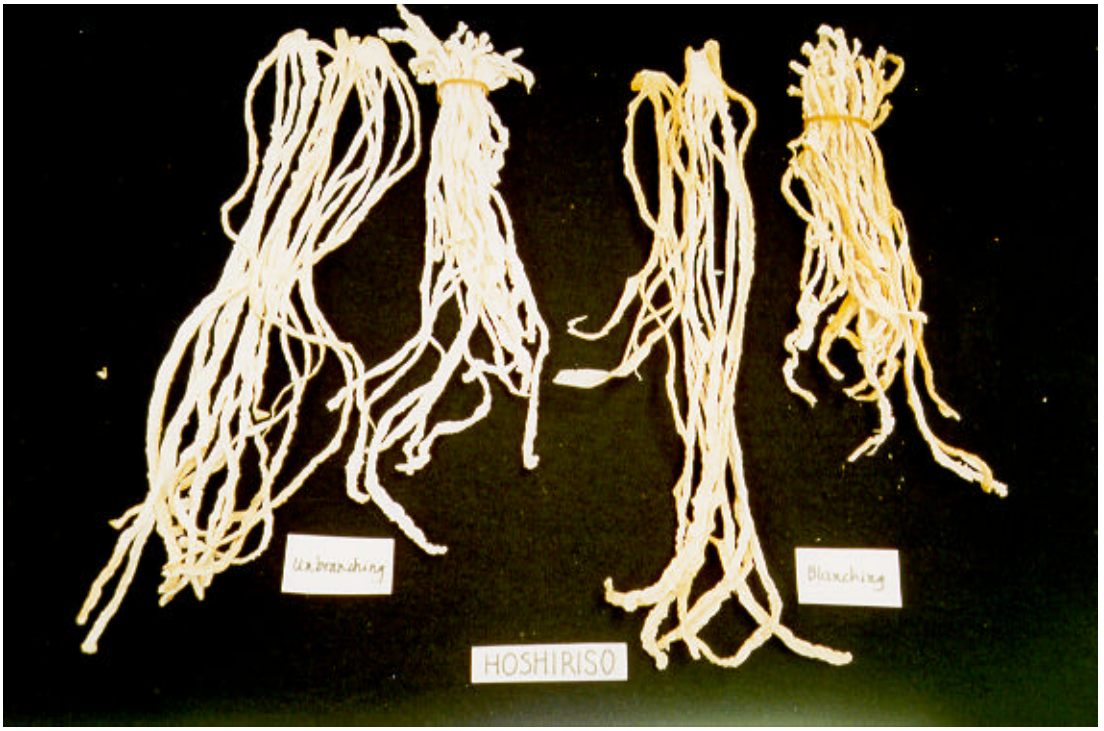
TOTAL VARIABLE COSTS:	$14,176.35
GROSS MARGIN/HA	$3,823.65
GROSS MARGIN/ML	$695.21

Photograph 3. Cultivar Hoshiriso is the most suitable cultivar for dried daikon.

Photograph 4. Pithiness (left) is a quality problem in dried daikon production.
To achieve high quality, daikon should be pithiness-free (right) when harvested.



Photograph 5. Cutter machine has been developed by a private company to mechanise processing.



Photograph 6. Blanching of raw material at 80°C for one minute would eliminate pungency of daikon. Colour of final products, however, are badly affected (right).

Gobu-Gobu Pickle

1. Materials and methods:

ii) Field trials:

Gosford Horticultural Research & Advisory Station:

Four replicated trials were undertaken in which growing parameters including growth (fresh and dry weight of foliages and roots), bolting, pithiness and pungency of seven daikon radishes were investigated. These studies provided knowledge of root quality of daikon radishes growing in different seasons on the Central Coast of New South Wales.

The sowing dates of these trials are shown in Table 36.

Table 36: Experimental trials on daikon radishes in different seasons

Experiment No.	Sowing date	Investigation No.	Completion date	Cultivar used
1	9th October, 1996	12	27th January, 1997	7
2	4th December, 1996	12	25th March, 1997	7
3	6th February, 1997	12	27th May, 1997	7
4	2nd April, 1997	12	21st July, 1997	7

The outcomes of these studies were published in the International Symposium on "Quality of Fresh and Fermented Vegetables", which was held in Seoul, Korea on 27-30 October, 1997.

MIA:

Two experimental trials were organised at Narrandera on the property of Mr. Mark Robertson -a grower producing vegetables and flowers for the domestic fresh market. The trials were sponsored by NSW Agriculture, Goman Foods (Darlington Point, New South Wales) and Robertson Farm. The aim was to produce samples of dried radish (gas drying) and Gobu-Gobu pickles for the Japanese market. Cultivars Hoshiriso and Relish Cross were planted on 13 and 27 November 1996 for 29 January and 12 February 1997 harvesting respectively.

Dareton Agricultural Research & Advisory Station:

One experimental trial was organised at the research farm of the Dareton Agricultural Research and Advisory Station to produce samples of dried radish (sun drying) and Gobu-Gobu pickles for the Japanese market. Only one cultivar, Hoshiriso was planted, on 10 December 1996 for 26 February 1997 harvesting.

2. Processing of Gobu-Gobu pickle:

Daikon (cvs Hoshiriso and Relish Cross) were harvested when root had achieved a fresh weight of approximately 1000 g/root. Roots were washed and cut longitudinally to a size of 12 mm x 12 mm. They were dried either by gas drier at 50°C (Kingsvale), heat drying at 50°C (Gosford Horticultural Research & Advisory Station) or sun-drying (Dareton ARAS) to reduce the moisture content to 10%. Dried daikon strips were cut again into pieces 4 cm in length and pickled in a pickling solution that was boiled ready for sterilising.

The dried daikon pieces absorbed the pickling solution over a period of at least 10 days prior to serving. When the pickling process was completed, the strips had returned to the original size and shape of the fresh product and should have had a crunchy texture.

Pickling solution for Gobu-Gobu pickling (for 1kg. dried daikon):

* Soy sauce	1,333 cc	)	
* Sugar	1,000 g	)	boiled and cooling
* Salt	133 g	)	prior to pickling
* Water	6,666 cc	)	

With the above materials 7 kg of Gobu-Gobu product can be made.

3. Cost of production:

Gobu-Gobu pickle :

i) Cost of ingredients for 1 kg. dried daikon:

* Soy sauce	1,333 cc @ $5.78/L	$ 7.70
* Sugar	1,000 g @ $0.97/kg.	$ 0.97
* Salt	133 g @ $1.65/kg.	$ 0.22
		$ 8.89

ii) Cost for growing and drying radish (1 kg.) $ 3.54

iii) Cost of labour @ $12/hour $ 12.00

TOTAL: $ 24.43[1)]

The cost of Gobu-Gobu production is considered high, caused by a high proportion of soy sauce and sugar. However, through discussion with Mr. Murai, Manager, Jun Pacific Corporation Pty Ltd, we have found a way to reduce the cost by cutting the quantities of these two ingredients. If this proves to be the case, salt may be increased to maintain the balance of salt in the product, with the result being dramatically decreased cost.

Another way to reduce the production cost is to purchase materials in bulk. In this circumstance, the cost of ingredients for 1 kg of dried daikon is listed below:

* Soy sauce	1,333 cc @ $56.60/18 L	$ 4.19
* Sugar	1,000 g @ $18.50/25 kg.	$ 0.74
* Salt	133 g @ $132/tonne	$ 0.02
		$ 4.95
* Cost for growing and drying radish (1 kg.)		$ 3.54
* Cost of labour @ $12/hour		$ 12.00
	TOTAL:	$ 20.49[1)]

The above dried daikon materials and ingredients will make 7 kg of Gobu-Gobu product. Production cost of Gobu-Gobu product (per kg.) is therefore A$2.93[1)].

Profit margins (per kg.):

Australian market : $ 7.50 - $2.93 = $4.57[1)] (156%)

Japanese market : $15.40 - $2.93 = $12.47[1)] (425%)

[1)] Cost of packaging and shipping not included.

2.2.2 Results from the Newcastle University (Ourimbah Campus):

(This contribution was prepared by R. Coogan as one part of his Ph.D thesis)

Factors of Quality in Fresh and Processed Japanese White Radish (Raphanus Sativus L.)

Introduction:

Japanese White radish is consumed daily in Japan both fresh and in a range of different preserved products. Subsequently, development of processed radish products has potential both on the domestic market and as an export opportunity. As a fresh product, Japanese white radish has limited potential due to its low value, high water content and the requirement in the Japanese market for the first 100 mm of the vegetative top to remain on the roots as an indicator of freshness. However, there is a significant increase in value if radish is processed. The processing techniques investigated in this work included slicing, drying, salting and pickling as methods of preserving and modifying radish flavour and texture. This work determined the effect of various processing techniques on flavour and texture quality of white radish and also measured the preference of Australian, Korean and Japanese - through sensory evaluation - to different flavour concentration and texture in processed white radish. A pilot scale processing system was developed to slice, dry, salt and pickle white radish into a range of products for the domestic market and as potential export products to Japan.

1. Flavour:

The primary compound responsible for the pungent, fresh flavour in Japanese white radish is 4-Methythio-3-trans-butenyl Isothiocyanate (MTBITC). It is generated in the presence of water from glucosinolate by the enzyme myrosinase when root tissue is disrupted. Once formed MTBITC degrades quickly to form sulfur compounds and nitriles with characteristic off-flavours and aroma. Pungency differs throughout radish roots with the lowest concentration in the vegetative top of the root increasing to the highest concentration in the distal tip. Additionally, higher concentrations occur in the 'skin' compared with the xylem and phloem regions of the root. Average pungency in radish roots is determined by variety and by soil nutrition.

In this work average pungency was measured in five varieties trialed by NSW Agriculture (Table 42). The effect of planting time on pungency of 'Hoshiriso' radish roots was determined in 'Hoshiriso' which was planted in spring, summer, autumn and winter.

For measuring the effect of planting time on pungency of white radish and measurement of average pungency concentration in five varieties of Japanese white radish, varieties were randomly planted in four replicate groups throughout the same plot at NSW Agriculture Farm, Somersby. One root from each replicate group was harvested at days 47, 61, 75, 89, and 103 through the crop development period.

The five varieties measured had average values between 630 μmol/ 100 ml and 419 μmol/100 ml. The three processing varieties of Hayazumari, TOA9132 and Hoshiriso were not significantly different from each other, ranging from 598 μmol/100ml to 630 μmol/100 ml. The two fresh market varieties of Fukumi and Relish Cross were not significantly different from each other. They ranged between 419 μmol/100 ml to 464 μmol/100 ml. Average values between processing

varieties and fresh market varieties differed significantly, with processing varieties showing higher average concentrations overall than fresh market varieties.

There is no apparent relationship between root weight/age, time, or temperature in summer, autumn or winter. But significance is displayed between MTBITC and all these factors in the spring trial. It is clear that there is a seasonal effect upon root weight. However there is no evidence to suggest this effects MTBITC concentration. The range of concentrations that exist within the distal end of each root of a given cultivar and in roots of the same cultivar grown in different seasons indicates great inaccuracy in determining a significant difference in MTBITC for whole roots between cultivars. The lack of relationship between MTBITC concentration and season or root weight indicates that MTBITC concentration in white radish roots is determined by factors such as soil nutrition or an interaction of climatic factors.

2. Effect of Various Processing Techniques on Flavour of White Radish:

The effect of processing techniques on flavour of white radish was measured. Fresh radish root was dried using a freeze-dryer and a hot air dryer at 40, 50, 60 and 70°C. The results for hot air drying show a significant decrease in radish flavour at increased drying temperatures. The greatest percentage loss (94%) occurred at 70°C. The smallest percentage loss in MTBITC occurred in the freeze-dried treatment (17%). Fresh roots were salted in 5, 15 and 25% solutions for 72 hours, with 30 kg of pressure applied to determine the effect of salting dehydration on radish flavour (Fig. 7). The results show that with increased salt concentration, radish flavouring decreases, with the highest percentage loss in radish flavouring occurring at the highest concentration (15%).

3. Sensory Preferences to Flavour and Texture or White Radish:

Sensory evaluation of fresh radish flavour was conducted on Australians, Japanese and Koreans to determine preferences. The results showed that with increased concentration, the Australian and Korean preference for radish decreased. Preference of Australians and Koreans was for very little or no radish flavour, however Japanese preferred radish flavour in the concentration range of 80-160 μ/100 ml. The Japanese panellists showed no significant difference in preference to all treatments, except 110 μmol/100 ml that showed significantly higher preference (8.2). These results indicate a difference in preference among Japanese, Koreans and Australians to radish pungency. This is important in variety selection and radish processed product development for domestic and export markets.

4. Texture:

Instrumental texture measurement was conducted on pieces of fresh radish, (10 mm x 10 mm x 50 mm) and pickled radish dried to different moisture levels, radish salted with different salt concentrations, and freeze-dried radish. Results were compared with sensory evaluation of Japanese, Australian and Korean taste panels. This was to determine preference of treatments to compress the sample and measure force required to compress sample (kgf) to indicate crunchiness of samples.

The crunchiest treatments were the 2%, 5% and 10% salted, and the samples dried to 10%, 20% and 40%, all of which were not significantly different from each other. The least crunchy treatment was the freeze-dried, which was significantly lower than the fresh and dried to 10% treatments. The results for sensory evaluation of texture in dried and salted radish showed that Australians and Japanese preferred the dried to 20% and 40% treatments with no significant

difference between scores. Significantly, Australians, Japanese and Koreans least preferred the freeze-dried treatment. Koreans also preferred the dried to 20%, and 40% treatments although the 40% treatment did not significantly differ from the dried to 10% treatment. These results show that Koreans, Japanese and Australians prefer crunchy pickled radish to softer pickled radish. In Korea and Japan where consumers are very familiar with quality definitions, this is not surprising, but Australians are far less familiar with this food product and still show significant preference for crisp pickled radish.

Drying Technologies and Products

The time (hour) taken and power (kWhr) used to dry white radish strips (10 mm x 10 mm x root length), pieces (10 mm x 10 mm x 50 mm), and shreds (Kirriboshi - 3 mm x 3 mm x 50 mm), until they contained 10% moisture was measured by using a hot air cabinet dryer at 40°C, 50°C, 60°C and 70°C. The same measurements were taken using a heat pump dryer at 35°C, 40°C, 45°C and 50°C. The effect on size and shape of drying white radish pieces to different moisture levels and its influence on the final piece size and visual appearance of reconstituted 'GobuGobu' pickles was measured.

Table 37: Time taken (hour) and power used (kWh) to dry 2 kg of shreds (3 mm x 3 mm x 50 mm), pieces (10 mm x 10 mm x 50 mm) and strips (10 mm x 10 mm x root length) using cabinet hot air dryer at various temperatures.

% H_20	40°C 10%	50°C 10%	60°C 10%	70°C 10%
Shreds kWh	18 6	11 11	7.8 8.9	7.2 11.1
Pieces kWh	18 5.9	10.9 9.2	9.5 10.9	8 11.9
Strips kWh	17.5 5.8	11.9 10.1	11 12.5	9.5 13.8

Table 38: Time taken (hour) and power used (kWh) to dry 2 kg of shreds (3 mm x 3 mm x 50 mm), pieces (10 mm x 10 mm x 50 mm) and strips (10 mm x 10 mm x root length) using heat pump dryer at various temperatures.

	35°C	40°C	45°C	50°C
% H_20	10%	10%	10%	10%
Shreds	12	7.9	6.9	4.2
	8	5.5	5.3	4.1
kWh				
Pieces	12	8.9	8.5	7.9
	8	6	6.1	6
kWh				
Strips	17	12.2	10.3	8
	11.3	7.7	6.9	6.3
kWh				

Using the food processing pilot plant available at Newcastle University Centre for Food Science and Industry Development, several radish products were made from either dried or salted radish as described below.

1. Dried Radish Strips:

A semi-processed product, originating from requests by a Japanese food company for dried radish to be exported to Japan and reconstituted in soy pickle solution, was produced. Dried strips measuring 10 mm x 10 mm x root length packed in large polyethylene bags were the preferred form by this company. Strips of white radish were sliced using a custom made hydraulic 'ram' (Nguyen, 1996), which forced the root through a blade matrix using compressed air. Strips measured 10 mm x 10 mm x root length. These strips were dried to about 10% moisture level and packaged in polyethylene bags for trial shipment to Japan for appraisal. The dried strips are a semi-processed form to be later reconstituted in soy solution and sliced into pieces (approx. 10 mm x 10 mm x 50 mm). Quality from Australia was considered high and this product development work prompted much interest in radish as an export product. However, production costs at the time, were too high for the product to be profitable to the company involved.

2. Dried Radish Pieces:

Pieces of white radish measuring 10 mm x 10 mm x 50 mm were sliced cross-sectionally using a vegetable slicing machine (Kronen, Willstat Germany), and dried to 10% moisture level. The pieces were then reconstituted in the form mentioned above. They were then combined with a soy solution (50:50), sealed in polyethylene bags and stored at 0-5°C for pickling over 14 days.

3. Shreds (Kirriboshi):

Thin strips (approx. 3mm x 3 mm x varying length) of dried shredded radish is called 'Kirriboshi' in Japan. It is added to soups and stew dishes where it reconstitutes, adding flavour and texture to the dish. It is a low value/high volume product that is currently available in Asian grocery shops in Australia (70-150 g quantities). This product is known to other Asian cultures including Koreans and Chinese. In this work, Radish shreds were produced and compared both by

instrumentally and through sensory evaluation of Japanese with product purchased in Asian supermarkets (Sydney). Colourimetric and physical measurement of radish shreds (Kirriboshi) was carried out on Korean, Chinese, two different brands of Japanese and a sample made in Newcastle University Centre for Food Technology and Industry Development Pilot Plant. Visual sensory evaluation was conducted, using a Japanese panel to determine preference for colour and piece size among the five samples measuring colour and piece size of the samples.

4. Survey of Commercial Radish Shreds (Kirriboshi) Sold in Australia:

A survey of four different brands of radish shreds (Kirriboshi) currently available in Sydney, and shreds produced in the Newcastle University food processing pilot plant (Australian), was conducted to compare colour and shred size quality. The brands were produced either by or in Korea, Japan and China. The whitest product was Australian followed by two Japanese brands (Japanese 1 and Japanese 2), then the Korean one. The least white colour was the Chinese product. Both Japanese products had the longest and widest shred size followed by the Chinese, Korean and Australian ones which had the shortest and narrowest shred size. Sensory evaluation was conducted on Japanese to determine preference in colour and shred-size. The Japanese 1 product was significantly preferred for colour, with the Australian, Japanese 2, Korean and Chinese shreds next in that order. For shred size, Japanese 1 was most significantly preferred, followed by Japanese 2, Korean, Australian and Chinese. Given that Australian shreds were significantly shorter and narrower than the other samples, in order for the Australian sample to be more favoured by Japanese consumers, the shred size needs to be longer and wider. The colour of Australian product is very white with the Japanese product more yellow. Colour change is caused by temperature of drying, age of product and higher water content in the dried product, resulting in degradation of the flavour compound in white radish (MTBITC) to sulphur commpounds and nitriles producing yellow colours and off aromas. A slight green colour in the shreds is caused by the colour of the upper ‘shoulder’ section of the variety used being green.

5. Dried Radish Seasoning:

Small and misshapen roots were shredded twice to produce finely diced particles that were then dried to 10% moisture and packed in polyethylene bags (100g). This was a new product made from fresh radish material unsuitable for other processed forms. It was to be promoted as a seasoning added to soups and stir-fries for flavour and texture in a similar way to kirriboshi.

Pickled Radish

1. Salting Radish Roots:

Osmotic drying is commonly used to remove water from fruit, vegetables, fish and meat. In Japan, vegetables including white radish are preserved using salt. Magnesium found in impure salt, acts on the pectic substances in radish roots, changing the texture of the root through salting to a crisper texture. Although this is a biproduct of salt preservation, crisp texture in salted vegetables has become a factor of quality especially in recent times in Japan. Due to an increased concern for health among Japanese, reduced salt levels in pickled vegetables (tsukemono) is also a recent trend with average salt concentrations reducing from 3.5% (1975) to 2.5% in 1995. As a result, low salt pickles with a shorter shelf-life and milder taste called ‘asa-zuke’ have become more popular in Japan.

A range of products was prepared from salted radish roots. For all salted radish products, fresh whole radish roots had the vegetative tops and distal end removed. They were then washed. Roots were laid horizontally in the bottom of a plastic container to form layers. Salt was added (2.5% solution) to the roots and a 30 kg weight was placed on top of the layer of roots. Salting duration at this concentration was 72 hours. Salted roots were then soaked for one hour in cold fresh water to remove excess salt. Whole roots were then packaged in polyethylene bags and stored at 5°C for no more than two weeks.

2. Salted Sliced Radish:

Salted whole radish roots were sliced into pieces (10 mm x 10 mm x 50 mm), combined with soy pickle solution in polyethylene bags, sealed and stored at 0-5°C for 14 days to pickle.

Whole salted roots were sliced either cross-sectionally or into rectangular pieces (10 mm x 10 mm x 50 mm). The rectangular pieces were then pickled in a soy based pickle solution to make a regional Japanese pickle product called 'gobugobu'. The salted radish pieces and solution were combined into polyethylene bags and stored at 0-5°C during pickling for two weeks. In Japan, 'GobuGobu' pickles are currently available in two packaging types. A tray pack (200 g) where pieces are arranged in two rows emersed in pickle solution. This is the highest priced product. Vacuum-packed pieces of varying size and shape also are available (200 g) for a lower price. In this form, many different versions such as bonito flavouring are available.

3. Pickling:

Two recipes for pickling white radish were used. The first was contributed by Dr. Nguyen and formed a basic soy pickle solution in which dried radish could be reconstituted. The second pickle recipe was developed from consultation and trials by Rod Coogan. It was for use with radish containing higher than 10% moisture and salted radish ensuring the pH and water activity thresholds were below minimum food safety guidelines. The primary difference between the two recipes was flavour and pH.

Table 39.'GobuGobu' soy pickle recipe supplied by Nguyen (NSW Agriculture).

Ingredient	Concentration
Light Soy Sauce	100 ml
Sugar	150 g
Salt	40 g
Seaweed (Konbu)	15 x (100 mm x 5 mm) strips
Small hot chilli (dried)	20 g
Fresh Water	Added to increase volume to 1 L

Table 40. Modified GobuGobu soy recipe for dried and salted radish.

Ingredient	Concentration
Light Soy Sauce	100 ml
Sugar	150 g
Salt	40 g
White Rice Vinegar	50 ml
Seaweed (Konbu)	4 x (100 mm x 5 mm) strips
Sesame Oil	10 ml
Sesame Seeds	3 g
Chilli Powder	20 g

Monosodium Glutamate (99%)	3 g
Tartrazine	3 g
Fresh Water	Added to bulk solution to 1 litre

The two main pickled radish products that resulted from this work were soy pickles, requiring different water removal techniques, and pickle recipes resulting in significantly different final appearance. The salted soy pickle was developed to closely resemble a commercial product manufactured in Japan in an attempt to gain greater understanding of processing techniques and quality of pickled radish (Fig. 6). Informal tasting trials resulted in good acceptance of both products among Australians and Japanese, with Australians preferring the product created from this work to the commercial product from Japan.

4. Processing:

A processing model was developed for white radish using the food processing pilot plant at Newcastle University Centre for Food Technology and Industry Development (Fig. 3 and 4). This model provides the basis on which more efficient processing systems could be developed with more automation of processing steps in the system reducing time and labour. Using this model, eight different processed and semi-processed radish products were developed, all of which are commonly consumed in Japan and among Japanese people in Australia.

In conclusion, flavour, texture and colour as factors of quality in processed radish were significantly affected by different processing techniques. These are important considerations when developing processed radish products for domestic and export markets. Additionally, they are an important factor in determining optimum processing conditions and hence accurate costing of production. The processing model developed and used in this work provides a basis from which to diversify to process other vegetables in similar style according to market opportunities. Technical details of processing radish can be found in the Ph.D thesis ‘Factors of Quality of Fresh and Processed Japanese White Radish (Raphanus sativus L.) for Domestic and Japanese Markets’, R.Coogan (1999). The findings of this work have resulted in domestic markets developed for fresh, dried and pickled radish, with export markets currently being investigated.

Fig. 3. Processing diagram for processing of Soy Pickles (Hot Air Dried), times based on 60kg batches.

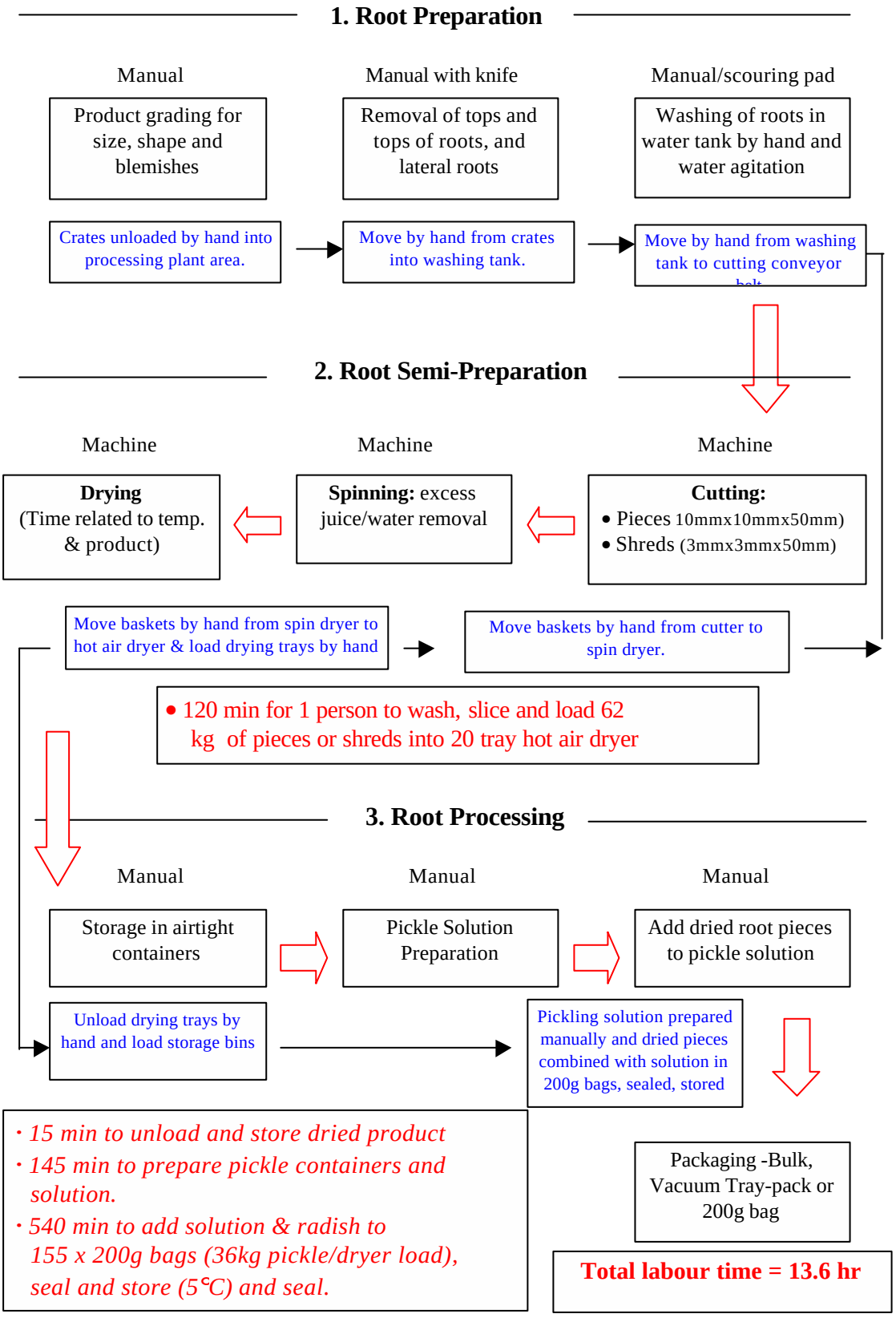


Figure 4. Product type from piece – size of cut white radish root.

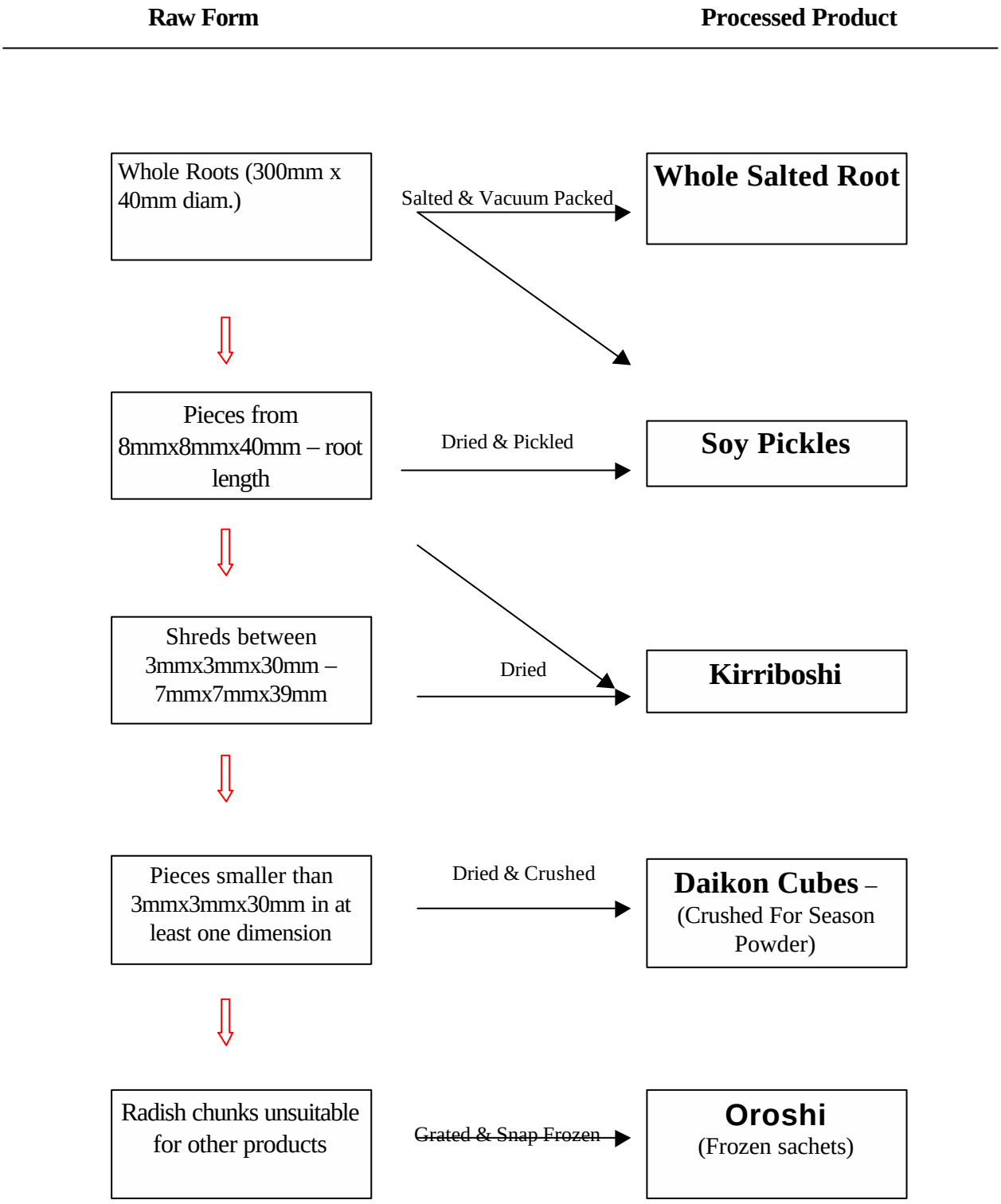


Figure 5. Left: Soy pickled radish made from radish pieces (10 mm x 10 mm x 50 mm) dried to 10% moisture. Right: Soy pickled radish made from radish pieces (10 mm x 10 mm x 50 mm) salted in 2% salt for 72 hr.

Figure 6. Left: Soy pickled radish made from salted radish in Newcastle University Food Processing Pilot Plant. Right:Soy pickled radish commercially produced and purchased in Japan.

3. Development of Pickled and Dried Asian Vegetables for Australia

A remarkable increase in demand for agricultural and food products is underway in North East and South East Asia. Rapid economic growth and continued population growth in the region are driving expansion of both volume and diversification of pattern in demand. As a result, in 1992/93 North East and South East Asia imported almost US$73 billion of agricultural and food products (Table 41) of which horticultural products, including vegetables and fruits, occupied 12% valued at US$8.8 billion (Table 42).

Table 41. Asia-Pacific agricultural and food trade in 1992/93[1] (US$ million).

Location	Imports	Exports
North East Asia:		
Japan	40,158[2]	1,447[2]
Hong Kong	4,200	N/K
South Korea	9,677[3]	1,747
China	49	3,200
Sub-Total:	54,084	-
South East Asia:		
Singapore	4,776	4,390
Thailand	4,478	9,891
Malaysia	3,262	8,325
Indonesia	3,103	8,481
Philippines	1,570	1,867
Brunei	205	10
Vietnam	223	829
Myanmar	108	413
Laos	20	54
Cambodia	33	38
Sub-Total:	**18,778**	**34,298**
Oceania:		
Australia	1,550	11,838

1) Subsistence to supermarket. Food and Agricultural transformation in South East Asia. East Asia Analytical Unit. Department of Foreign & Trade, Australia, 1994.
2) Statistic of Trading, Ministry of Finance, Japan, 1994. In 1994, food imports amounted to US$47.12 billion, a record high.
3) Agricultural products only, data in 1995.

Table 42. Asia-Pacific import market of vegetables and fruit, 1993.

Location	Importation markets (US$ million)		
	Vegetables	Fruit	Total
Japan	2,243[1)]	2,250[1)]	4,493
Singapore	367	296	662
Australia	117	228	345
Hong Kong	1,625	675	2,300
China	49	N/K	49
South Korea[2)]	174	300	474
Brunei	4,000 t	N/K	191
Malaysia	N/K	N/K	190
Thailand	N/K	N/K	59
Philippines	N/K	N/K	43
Total:			8,806

1) In 1996, Japan imported US$3,146 million and US$3,162 million of vegetables and fruit respectively. Shokuhin Trend '98, 1998.
2) Data in 1995.

Most Asian consumers prefer to shop on a daily basis for fresh foods. However, due to limited space in the home and no back garden storage, food consumption behaviour is changing. There is a rapid increase in demand for more convenient processed products. In Japan, for instance, processed foods occupied up to 61.3% of daily meals, becoming the most important part of the Japanese food trade business (Table 43).

Table 43. Percentage of food consumption of Japanese meals[1)] during a period of 30 years.

Commodity	1966	1976	1986	1996
Cereals	18.1	10.1	9.3	6.2
Fresh foods	34.0	38.2	35.0	32.5
Processed foods	47.9	51.7	55.7	61.3

1) Except eaten out type meals.
Source: Shokuhin Trend '98. Nihon Shokuryo Shimbunsha, Tokyo, 1998.

3.1 Japan - The Prime Market for Processed Asian Vegetables

Among countries in North East Asia, Japan, with its import market of A$4.4 billion including A$1.36 billion for fresh and A$3.08 billion for processed vegetables, offers the best opportunity for Australian horticulture.

Research in Japan in 1993 (Ministry of Finance) has shown that during the period of four years from 1988 to 1992 there was a clear tendency to increase importation of supplementary and processed foods while imports of staple foods decreased. Imports of spices and drinks were unchanged (Fig. 7). The reason for this was social change in Japan and other North East Asian countries, including urbanisation of traditional farming land, younger generations leaving country areas to live in cities, reducing farmer number with older age (Fig. 8), an awareness of healthy food, increased numbers of women working, population increase and women with full-time occupations spending less time cooking. This has resulted in a higher demand for microwavable, processed, frozen, healthy and convenience foods.

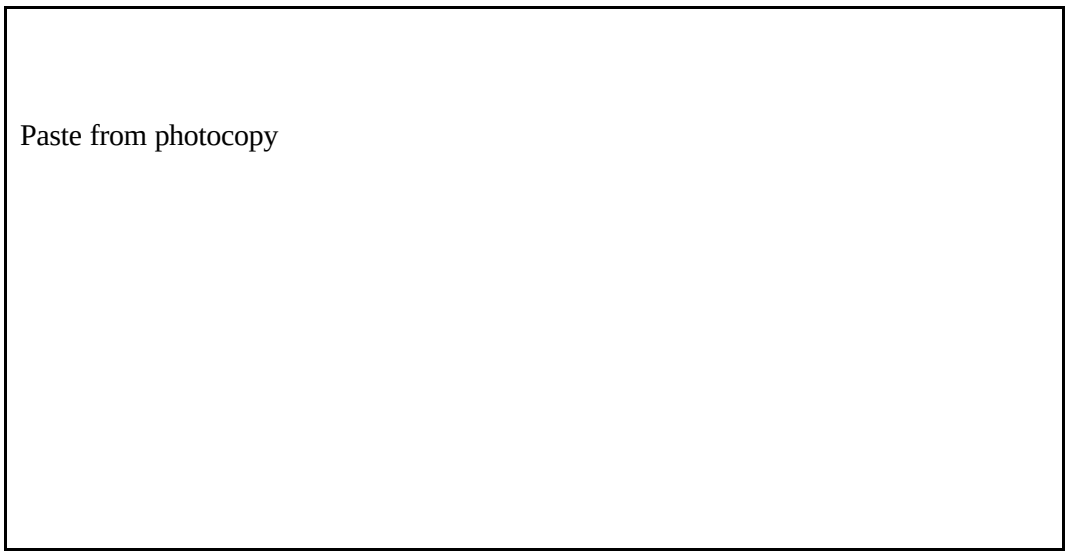


Fig. 7. Food commodities imported into Japan during a period of four years from 1998.

Notes:
1. Staple foods: cereals, oilseed, foodstuffs, animal and plant oils and sugar.
2. Supplementary foods: meats, seafoods, seaweeds, eggs, silk worm and vegetables.
3. Processed foods: raw and/or semi-processed materials for processing foods.
4. Spices and drinks: vegetables and fruit juices, cacao, coffee, tea, spices, ice cream, honey and alcohol.

Source: Statistics of Trading, Ministry of Finance, Japan, 1992.

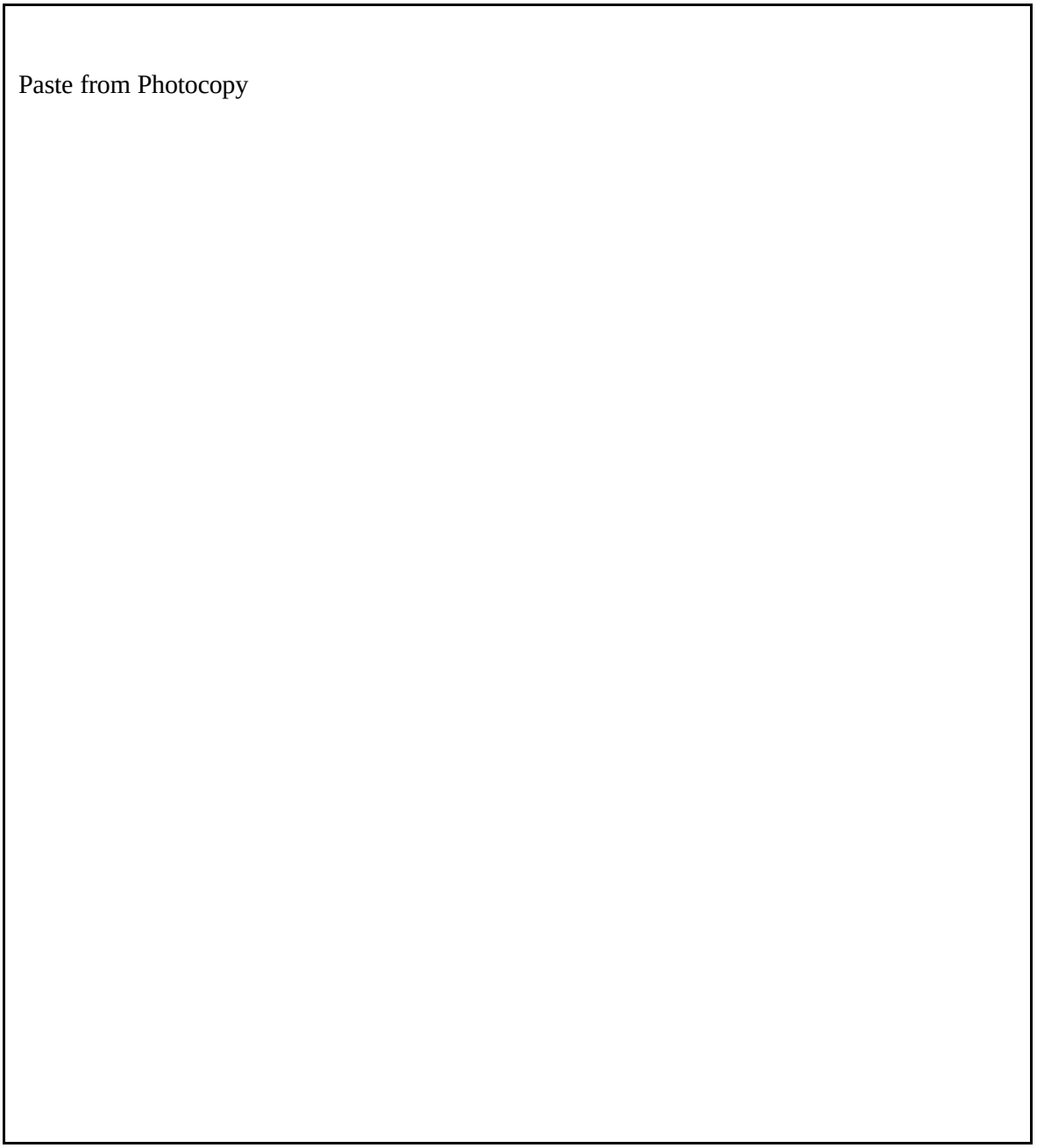


Fig. 8. Japanese full-time farmers by age group.
Source: Journal of Japanese Trade and Industry No. 5, 1995.

Research in 1998 (Shokuhin Trend ‘98) has again confirmed Japanese import trends. Processed vegetables such as pickles tsukemono, dried vegetables, canned vegetables and frozen vegetables have been increased in both volume and value (Table 42). Frozen food is still increasing in Japan although still low by comparison with other developed countries (Table 43).

Table 42: Importation of processing vegetables into Japan over a period of 10 years from 1988-1997.

Commodity	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Salted vegetables:										
Volume (tonne)	206,728	227,000	197,240	216,170	223,440	210,693	220,283	254,880	263,054	227,992
Value(¥ million)	22,675	25,220	22,083	22,325	23,176	18,987	17,550	19,978	28,587	24,399
Dried Vegetables:										
Volume (tonne)	27,294	27,189	25,581	29,731	36,075	39,206	44,241	45,596	48,779	49,801
Value(¥ million)	19,002	19,047	21,389	23,254	25,716	25,875	25,753	23,276	28,205	34,733
Vinegar vegetables:										
Volume (tonne)	6,216	6,421	5,737	8,162	19,054	38,596	34,537	26,141	26,471	24,627
Value(¥ million)	868	994	1,048	1,251	2,328	3,735	2,926	2,874	4,403	4,518
Others:										
Volume (tonne)	186,279	160,734	148,177	175,134	196,548	221,843	254,569	312,432	305,017	309,843
Value(¥ million)	31,961	30,270	28,720	34,113	38,689	39,406	47,434	54,783	60,255	60,819
TOTAL:										
Volume (tonne)	857,560	860,866	830,817	947,766	1,009,592	1,084,255	1,218,456	1,385,757	1,437,526	1,423,910
Value(¥ million)	134,026	150,080	158,279	165,017	170,991	164,350	177,879	188,221	228,034	241,946

Source: 1997 Yasa: Yunyu no Doko. Vinas Booklet 14. Norin Toke Kyokai, Tokyo, 1998.

Table 43. Consumption of frozen food *per capita* in 1995.

Rank	Country	Consumption (kg)	Rank	Country	Consumption (kg)
1	USA	57.5	6	Norway	27.6
2	Denmark	50.2	7	Germany	23.8
3	United Kingdom	44.2	8	The Netherlands	17.9
4	Sweden	34.9	9	Japan	15.2
5	French	29.8	10	Finland	15.0

(Source: Shokuhin Trend '98).

3.1.1 Japanese Import Market Trend

Salted vegetables:

Importation of tsukemono materials, such as salted and vegetables pickled in vinegar, still plays an important role in the Japanese processed vegetables import market. This market occupied 33% of the value of all imported vegetables for processing in 1997. However, it should be noted that there has been a change in the Japanese diet with regard to tsukemono consumption in recent years.

Consumption of takuan - a traditional Japanese tsukemono - has dropped dramatically from 22.2% in 1987 to only 10.7% in 1997 (Table 45). In 1996 the Japanese spent only ¥1,760 per annum for takuan compared to ¥2,079 in 1992 (Fig. 9). This trend was due to reduced use of highly-salted pickles of which takuan is one. However, umeboshi, one of the shiozuke group with one of the highest salinity contents in pickles, increased from 2.1% to 4.1% during 1997 (Table 45), resulting in higher import volume of 27,396 t in 1997 (Table 44).

Table 44. Production and importation of umeboshi into Japan.

Year	Production (t)	Importation (t)
1975	14,645	-
1980	22,095	-
1985	22,281	-
1990	40,817	-
1995	37,113	22,835
1996	41,053	-
1997	43,538	27,396

Source: Tsukemono Shimpo, Shokuhin Kenkyu Centa 1999, Tokyo, Japan.

In 1996, the Japanese paid more for umeboshi, ie ¥811 per annum, than in 1992 (Fig. 8). Consumption of kimchi has also increased from 34,059 t in 1980 to 134,643 t in 1998, an increase of 395% in a period of only 19 years (Table 45). South Korean exports of kimchi to Japanese markets have been dominant. In 1998, South Korea exported 15,015 t of kimchi valued at ¥5,576 million (A$71 million). Major salted vegetables imported into Japanese markets are cucumbers, gherkin, ume, lotus, scallion, ginger, eggplant and warabi (Tables 5 and 6).

Table 45. Change of tsukemono consumption in the Japanese diet between 1987 and 1997.

Commodity	1987 (%)	1997 (%)
i) Shoyuzuke:	**24.5**	**30.9**
Kizamiyuke	8.3	11.3
Kimchi	6.0	11.3
Fukushinzuke	5.9	5.5
Others	4.4	2.8
ii) Shinzuke:	**24.3**	**27.8**
iii) Takuan	**22.2**	**10.7**
iv) Shiozuke:	**12.9**	**17.7**
Umeboshi	2.1	4.1
Scallion	1.5	2.2
Others	9.3	11.4
v) Suzuke	**7.4**	**7.6**
Ginger	4.6	4.4
Others	2.8	3.2
vi) Nukazuke:	**4.7**	**4.2**
vii) Misozuke:	**1.3**	**1.1**
viii) Others:	**2.7**	**0**
TOTAL:	**100.0**	**100.0**

Source: Shokuhin Trend '98, Nippon Shokuryo Shimbunsha 1998, Tokyo, Japan.

Vegetables in vinegar:

In the Japanese diet there has not been much change in consumption of suzuke, which was found recently to be approximately 4-5% (Table 47). However, importation of cucumber and gherkins has increased from 343 t in 1988 to 3,941 t in 1997 - an increase of 1149% in a period of ten years. Ginger in vinegar, which is used with "Shushi" (raw fish) reached its peak in 1995 with the importation of 14,288 t and then slightly decreased to 13,999 t and 11,824 t in 1996 and 1997 respectively. Major vegetables in vinegar imported into Japanese markets are ginger, cucumber and gherkin (Tables 5 and 6).

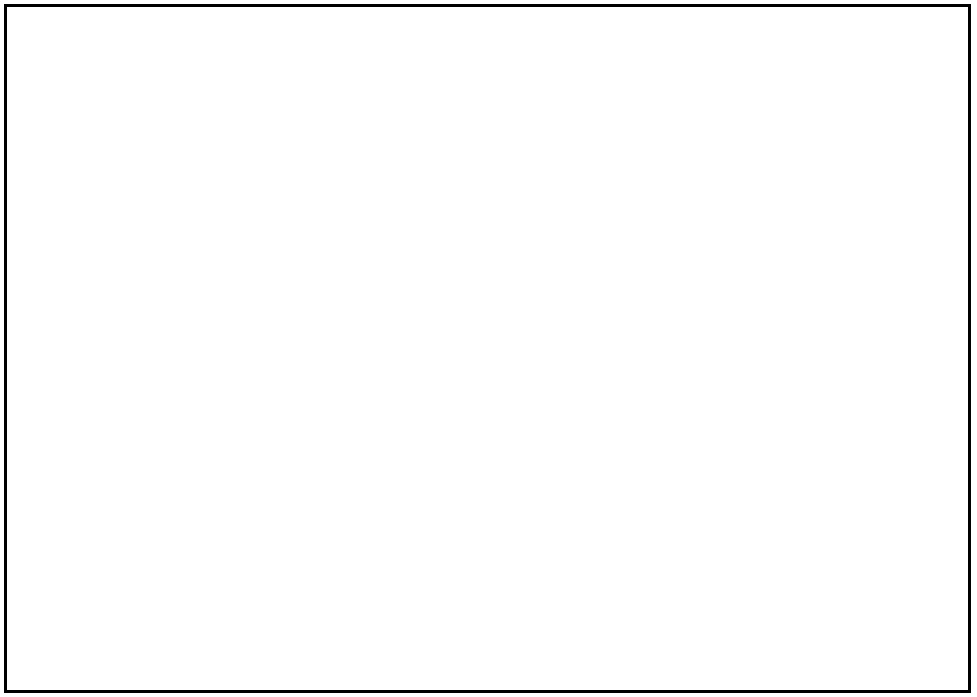


Fig. 9. *Per capita* consumption of umeboshi in Japan during a period of five years from 1992-96 (Unit = g)

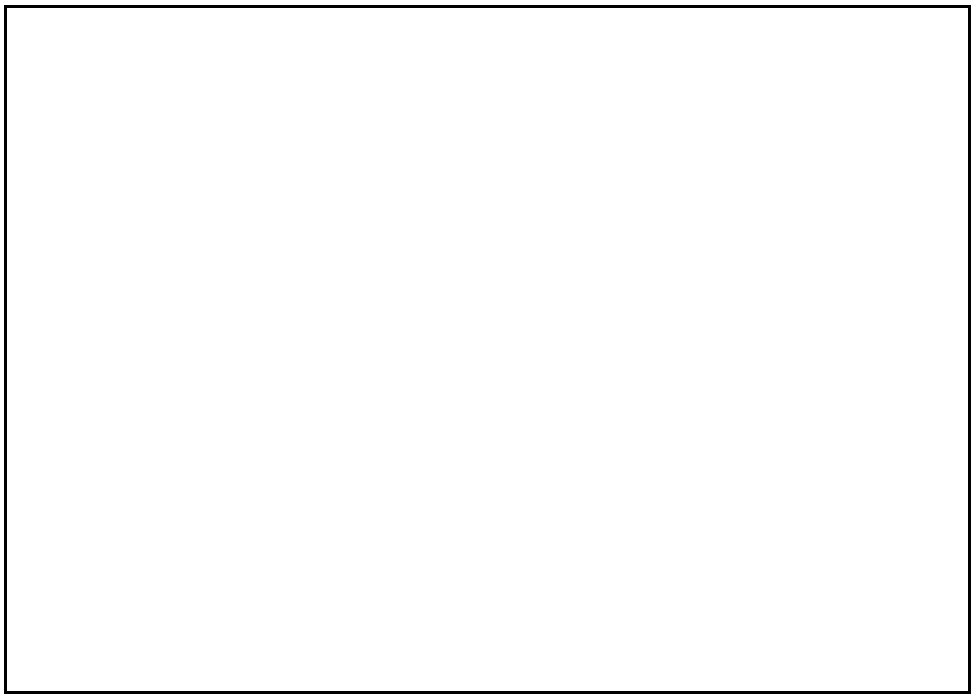


Fig. 10. *Per capita* consumption of takuan in Japan during a period of five years from 1992-96 (Unit = g)

Dried vegetables:

Japan is the largest import market for dried vegetables in the world and was valued at almost US$1.1 billion in 1992 (Table 46). Importation of shiitake mushroom has increased in a period of 10 years from 1,866 t in 1988 to 9,400 t in 1997 and is valued at approximately ¥11 billion (A$146 million). Dried onion is also an important commodity and has increased from 4,026 t to 5,726 t. Dried daikon has recently become a large import item at around 3-4,000 t per annum (Tables 47 and 48). Major dried vegetables imported into Japanese markets are shiitake mushroom, onions, daikon, bamboo shoot, black fungus and zenmai (Table 47).

Table 46. Countries from which dried vegetables are imported into Japan.

	1988	1990	1992	
Country	**Values (x US$1,000)**		**Values**	**Percent**
Japan	158,215	151,465	208,422	19.7
Hong Kong	128,592	163,361	171,200	16.2
Germany	68,264	89,979	107,805	10.2
USA	70,874	106,456	96,058	9.1
Singapore	52,573	55,835	58,242	5.5
Italy	50,088	50,632	48,636	4.6
France	38,346	43,353	46,600	4.4
Great Britain	40,398	48,445	46,550	4.4
Canada	27,669	33,516	37,032	3.5
Switzerland	36,958	32,694	34,783	3.3
Holland	24,459	31,565	33,189	3.1
South Korea	3,771	22,735	29,616	2.8
Australia	11,342	15,707	14,040	1.3
Austria	7,372	10,722	13,689	1.3
Spain	5,826	9,262	11,233	1.1
Malaysia	7,828	9,044	9,447	0.9
Belgium	7,215	9,044	9,447	0.9
Norway	5,710	6,987	8,571	0.8
Sweden	6,486	7,155	7,022	0.7
Israel	4,359	5,751	5,762	0.5
Others	-	-	59,650	5.6
TOTAL:	1,057,000			100.0

Table 47. Volume of imported dried vegetables into Japan during a period of 10 years from 1988-1997 (unit = tonne).

Commodity	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Dried vegetables:	**27,294**	**27,189**	**25,581**	**29,731**	**36,075**	**39,206**	**44,241**	**45,596**	**48,779**	**49,801**
Potatoes	420	400	249	260	264	241	147	188	187	182
Shiitake mushroom	1,866	2,201	2,404	2,813	4,799	7,208	7,804	7,539	7,206	9,400
Black fungus	1,726	1,987	2,150	1,790	2,136	2,187	2,194	2,075	2,197	2,218
Mushroom	593	120	61	11	22	44	242	106	186	147
Onions	4,026	4,684	4,241	4,069	4,584	4,773	4,409	5,054	5,526	5,726
Bamboo shoots	3,99	3,633	3,610	3,452	3,349	3,506	3,339	2,920	3,138	2,674
Zenmai[1)]	3,932	2,100	2,298	2,328	2,866	2,610	2,611	2,244	2,583	2,071
Daikon	-	-	-	-	-	-	-	2,926	3,983	3,163
Strawberry	83	106	96	30	80	102	71	149	122	277
Others	11,630	11,958	10,473	14,978	17,976	18,535	23,424	22,393	23,649	23,943

1) Note: Zenmai: Fern, *Osmunda japonica* THUNB.

Table 48. Values of imported dried vegetables into Japan during a period of 10 years from 1988-1997 (unit = ¥ million).

Commodity	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Dried vegetables:	**19,002**	**19,047**	**21,389**	**23,254**	**25,716**	**25,875**	**25,753**	**23,276**	**28,205**	**34,733**
Potatoes	78	93	839	72	66	56	30	37	43	42
Shiitake mushroom	2,822	3,274	4,092	4,460	6,929	8,041	8,029	6,845	7,524	11,460
Black fungus	1,813	2,158	2,521	1,761	2,197	2,004	1,680	1,354	1,608	1,954
Mushroom	346	194	163	138	162	152	300	238	550	1,026
Onions	1,072	1,398	1,529	1,398	1,481	1,385	1,240	1,404	1,717	1,966
Bamboo shoots	6,148	4,305	5,654	6,870	4,872	5,044	3,864	2,850	3,293	3,346
Zenmai	3,122	2,386	2,340	2,454	3,084	2,478	2,566	2,217	2,701	2,132
Daikon	-	-	-	-	-	-	-	40083	682	60863
Strawberry	29	135	120	61	70	110	8523,424	119	137	402
Others	3,573	5,103	4,886	6,039	6,855	6,604		7,812	9,949	11,798

Table 49. CIF prices of imported dried vegetables into Japan during a period of 10 years from 1988-1997 (unit = ¥/kg).

Commodity	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Dried vegetables:	**696**	**701**	**836**	**782**	**713**	**660**	**582**	**510**	**578**	**697**
Potatoes	187	233	332	278	252	233	203	195	228	228
Shiitake mushroom	1,512	1,488	1,703	1,586	1,444	1,115	1,029	908	1,044	1,219
Black fungus	1,051	1,086	1,173	984	1,028	916	766	652	732	881
Mushroom	583	1,609	2,697	12,238	7,479	3,475	1,239	2,241	2,951	6,991
Onions	266	299	361	344	323	290	281	278	311	343
Bamboo shoots	1,569	1,185	1,566	1,990	1,455	1,439	1,157	976	1,049	1,251
Zenmai	1,030	1,136	1,018	1,054	1,076	919	983	988	1,046	1,029
Daikon	-	-	-	-	-	-	-	137	171	192
Strawberry	346	1,272	1,244	2,072	871	1,075	1,191	801	1,121	1,452
Others	307	427	467	403	381	356	340	349	421	493

Table 50. Volume of imported prepared vegetables into Japan during a period of 10 years from 1988-1997 (unit = tonne).
Source: 1997 Yasai Yunyu no Doko. Vinas Booklet No. 14,Tokyo, Japan.

Commodity	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Prepared vegetables:	**186,279**	**160,734**	**148,177**	**175,134**	**196,548**	**221,843**	**254,569**	**312,432**	**305,017**	**309,843**
Potatoes	245	511	718	688	1,129	2,131	11,930	19,919	15,287	10,432
Snowpeas	55	16	-	-	-	-	2	-	-	-
Peas	17	37	24	14	8	8	101	19	76	94
Beans	1,285	250	406	784	129	70	99	63	29	29
Asparagus	2,944	3,696	5,394	4,735	5,272	5,928	8,036	7,698	5,971	4,396
Sweetcorn	45,635	40,953	36,905	36,287	45,583	58,537	61,694	61,945	55,707	61,058
Bamboo shoot	85,051	65,902	68,936	86,569	95,038	100,155	102,102	121,269	125,753	112,357
Baby corn	3,840	3,383	2,924	4,109	3,470	3.234	3,635	3,851	3,420	4,112
Mushroom	6,901	5,092	4,910	6,155	5,900	7.090	9,704	9.962	10,324	12,869
Trifle	2	4	2	2	3	2	3	3	3	2
English mushroom	16,376	17,448	5,564	9,166	8,021	9,702	11,459	14,752	12,391	12,952
Ginger	18	-	-	59	-	1	573	107	387	545
Ginger	1,417	1,293	1,112	840	1,143	1,728	1,129	11,686	17,877	27,302
Jam	3,849	3,444	2,983	3,119	2,720	2,412	3,110	5,343	3,530	4,384
Strawberry	176	244	249	232	197	317	359	455	563	655
Vegetable soup	1,786	1,479	1,307	1,231	1,530	1,653	2,654	2,773	3,676	4,536
Vegetable juice	32	214	174	287	490	1,724	8,857	16,314	8,093	4,605
Others	16,325	16,401	16,132	20,399	25,446	26,818	28,788	35,930	41,671	49,181

Table 51. Value of imported prepared vegetables into Japan during a period of 10 years from 1988-1997 (unit = ¥ million).

Commodity	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Prepared vegetables:	**31,961**	**30,270**	**28,720**	**34,113**	**38,689**	**39,406**	**47,434**	**54,783**	**60,255**	**60,819**
Potatoes	118	183	256	228	449	1,127	6,881	6,968	5,702	4,495
Snowpeas	9	3	-	-	1	-	-	-	-	-
Peas	6	12	6	4	3	2	18	4	14	14
Beans	157	42	82	161	37	14	13	24	11	12
Asparagus	980	1,285	1,836	1,642	1,862	1,592	1,733	1,479	1,283	1,047
Sweetcorn	5,845	6,863	6,950	5,911	6,579	7,311	7,414	6,995	7,666	8,861
Bamboo shoot	13,719	9.873	10,480	14,958	17,501	16,446	14,126	16,411	19,902	17,704
Baby corn	534	580	471	695	554	504	541	546	566	722
Mushroom	1,703	1,474	1,355	1,740	1,753	2,115	2,490	2,802	3,990	4,259
Triffle	133	236	200	206	283	133	158	164	128	87
English mushroom	3,728	4,341	1,460	1,869	1,563	1,552	1,884	2,394	2,244	2,269
Ginger	2	-	-	7	-	-	96	13	156	176
Ginger	344	403	330	419	406	413	256	1,822	3,584	5,234
Jam	1,201	1,276	1,576	1,384	1,398	1,066	1,218	1,618	1,806	2,151
Strawberry	68	91	97	128	88	77	94	143	217	316
Vegetable soup	270	265	246	213	247	233	432	413	593	781
Vegetable juice	20	63	71	99	200	766	3,823	5,846	3,633	2,669
Others	3,034	3,193	3,221	4,370	5,691	6,006	6,206	7,084	8,717	9,954

Table 52. CIF prices of imported prepared vegetables into Japan during a period of 10 years from 1988-1997 (unit = ¥/kg).

Commodity	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Prepared vegetables:	**172**	**188**	**194**	**195**	**197**	**178**	**186**	**175**	**198**	**186**
Potatoes	483	357	356	331	398	529	577	350	373	431
Snowpeas	160	182	-	-	1,420	-	142	-	-	-
Peas	319	317	238	288	347	198	177	211	182	148
Beans	122	168	201	205	290	204	133	390	375	432
Asparagus	333	348	340	347	353	268	216	192	215	238
Sweetcorn	128	168	188	163	144	125	120	113	138	145
Bamboo shoot	161	150	152	173	184	164	138	135	1`58	158
Baby corn	139	172	161	169	160	156	149	142	166	176
Mushroom	247	289	276	283	297	298	257	281	387	331
Triffle	63,350	62,908	88,245	86,547	84,330	55,642	51,839	56,744	50,448	34,667
English mushroom	228	249	262	204	195	160	164	162	181	175
Ginger	119	-	-	118	-	890	167	125	404	323
Ginger	243	311	296	499	355	239	227	156	200	192
Jam	312	371	52876	444	514	442	392	303	512	491
Strawberry	388	374	388	552	445	243	262	313	386	482
Vegetable soup	151	179	188	173	161	141	163	149	161	172

Vegetable juice	610	296	407	345	408	444	432	358	449	580
Others	186	195	200	214	224	224	216	197	209	202

Prepared vegetables:
Most prepared vegetables are canned and bamboo shoot is, and always has been, the largest imported commodity, demanding more than 100,000 t per annum (Tables 50, 51 and 52).

3.1.2 Requirements of Imported Tsukemono Materials

Japan has strict product requirements and exporters are required to comply with specifications set out by individual Japanese manufacturers. Typical product requirements of commonly-imported bulk items are as follows:

Salted cucumbers:

1. Harvest Requirements:

Cucumber material should be fresh and harvested prior to formation of seed shape and free of internal hollows.

i) Size:

Depends on cucumber varieties, but on average, they measure 200 mm to 400 mm long, have a maximum diameter of 25 mm to 28 mm, and must have excessive stems and flowers removed.

2. Preservation Requirements:

i) Brining:

Cucumbers must be brined in a barrel or other container and pressed with stones on the same day as harvesting. Once brining begins, no new materials can be added.

ii) Volume of salt and brining procedure:

A regular amount of salt must always be used being careful to use the correct volume of salt (40% in the lower half and 60% in the upper half) in the first brining which is different from the second brining. During the first brining, use a stone or stones weighing more than 35% of the material weight to squeeze out water as quickly as possible. Salted water must be discarded from the first brining after five days.

In the second brining, the stone weight is reduced to 20% and brine must be changed twice during this stage with brining extended to more than one month. The yield ratio should be less than 55% of original weight.

iii) Product requirements:

After brining, the level of saltiness should be more than 23 degrees and product should have a peculiar colour, crispness and flavour as well as being free of a mouldy odour or a bitter taste. Product with a black colour and/or poor glossiness should not be included and the salt solution should be clear and free of impurities. Additives other than salt should not be used and foreign substances should be avoided. The content weight shown on the package should be exclusive of the brine weight.

Salted ginger:

1. Salting Requirements:

i) Material:

The material should be harvested at the appropriate time, be fresh and have softness with uniformity of shape. Any gingers harvested or hardened after the appropriate time should be removed. Materials should be classified in accordance with the uses - ginger stems, new ginger and old ginger. Thin roots and the upper halves of stems should be removed along with any infested or damaged material.

ii) Salting:

Sanitary precautions should be taken prior to preservation with plum vinegar or citric acid (called lemon acid in Taiwan) and should be longer than 15 days. Food additives or other organic acids other than the standards prescribed in the Food Sanitation Law of Japan should not be used and artificial preservative or colorant are prohibited.

2. Product Requirements:

i) Product selection:

Products are divided by weight into four types:

Classification	**L**	**M**	**S**	**SS**
Unit weight	Over 120	Over 80	Over 40	Below 40

Product classification is made in the same manner as material classification. Avoid inclusion of damaged or infested materials, grit and sand, straws and stems etc.

ii) Quality:

Product should have a peculiar flavour of shogzauke and be free from a mouldy odour or bitter taste. Quality should be fresh with a shiny, pink look. Avoid inclusion of inferior, infested or deteriorated ginger as well as softened or fallen stems. An ideal preservation solution should have a salt percentage of more than 18%, a pH value of <2.8 and look clear at the time of delivery.

Salted eggplant (medium sized):

1. Harvest Requirements:

Materials should be fresh, look bright and be well shaped, free of scratches and undamaged by disease or insects and should be harvested before seeds begin to harden. Unit weight should be 40-60 g (S size), 60-80 g (M size) or 80-100 g (L size)

2. Brining Requirements:

Eggplants have to be pickled early in the morning. Brining begins during the afternoon but avoid additional brining. Mix precise quantities of salt, alum and eggplants and stir well. Rebrining in new containers should be carried out three or four days later and the weight or yield should be less than 50% of original fresh materials.

3. Product requirements:

After brining, the level of saltiness must be more than 23 degrees. Product that is damaged, discoloured, deformed or of dull appearance should be rejected. Each eggplant should be pierced before packaging and the weight shown on the package is exclusive of the liquid. When eggplants are placed in the package, sprinkle 5% salt over the top. The use of preservatives should be avoided.

Umeboshi (Japanese apricot pickles):

1. Salting Requirements:

Raw Japanese apricots should be classified into five difference sizes according to diameter and should be fresh with a ripeness level of approximately 80%. Overripened, unripened and infested fruits are to be excluded.

Classification	**LL**	**L**	**M**	**S**	**SS**
Diameter	Over 29	Over 26	Over 21	Over 18	Below 18

Before beginning the salting process, materials should be washed thoroughly and all salting tanks and associated equipment in the vicinity must be sterilised with hot water to prevent development of mould and so maintain a sanitary environment. The volume of salt used depends on material size and sprinkling of salt should be heavy on upper layers and light on lower layers with the length of salting more than 15 days.

2. Drying:

This is done naturally using sunshine and is necessary for two to four days but this depends on material size. Half dried Japanese apricots should be spread out to absorb dew during the night and must be turned over more than twice a day to maintain uniformity in drying. Baskets, nets etc should be used to keep product clean and to avoid mixing sand and grit with the product. Direct drying on concrete floors should also be avoided.

3. Product Requirements:

i) Product selection:

Materials are divided into five classes according to size. Japanese apricots which are damaged, infested and crushed or are waste fruits with little meat are to be rejected and never included.

ii) Quality:

Japanese apricots should have an intrinsic flavour of umeboshi, good meat quality, colour and lustre. Drying should have reduced the weight of the fresh fruit to less than 55% of its original weight. Avoid development of salt crystallisation on the surface and inclusion of foreign matter such as grit and sand. No food additive or artificial colorant should be used.

Salted Rakkyo (scallions):

1. Harvest Requirements:

The correct harvesting time for scallions is when 70-80% of leaves are dead. Materials should be harvested using a fork, soil completely brushed off and direct sunshine should be avoided as much as possible. Adjustments are made by cutting off roots and stems. Well-ventilated bags should be used for transportation which should be carried out as quickly as possible.

2. Salting Requirements:

Scallions should be rinsed well in water and have prescribed amount of salt spread evenly and stones placed on the cover of the container. At the end of 60 days salting, both ends of each scallion are cut.

3. Product requirements:

Standard weight of a finished scallion should be 4-5g (L), 3-3.5 g (M) or 1.5-2.0 g (S). Saltiness after pickling is completed should be 18 degrees with a pH of 4.5 to 5.0. Outer skins and green

necks have to be removed. The weight shown on the package does not include that of the liquid and the pickling liquid used for production is not the same as in the finished product. Only salt should be used.

3.1.3 Import Systems

Import-related regulations:

The tsukemono varieties covered by the current survey can be imported freely and no quantitative restrictions are imposed. But all importers of food items into Japan are required to make import notifications in accordance with the provisions of the Food Sanitation Law.

That is, an importer prepares a "Notification Form of Food Importation" for a food item he intends to import and submits this information to the quarantine office in his area. This is then transferred to the Minister of Health and Welfare. If necessary, the quarantine office is authorised to make a sampling inspection and if the product is disqualified, it cannot be imported and is, as a rule, shipped back to the country of origin or discarded. Imports from cholera-infected areas must be accompanied by certificates issued by the government of the nation in question certifying that the product is not contaminated with cholera germs. As in the case of bacteria and food additives, consumers' attention is again focused on residual agricultural chemicals. Therefore, exporting nations are required to pay careful attention to the cultivation of tsukemono materials.
In Japan, production and marketing of food items not conforming with the Food Sanitation Law is prohibited. As a general provision, the Law prohibits production and marketing of what is hazardous. As for the use of food additives, including antioxidants and bleaching agents, enforcement by-laws of the Food Sanitation Law sets standards and specifications for food additives. These standards indicate what is useable and how they should be used. As each country has its own rules and standards for food additives, a comprehensive study is required in advance. As for residual insecticides, precaution is also necessary.

As for the labelling, these are governed by the following:

Japan Agricultural Standard of the Ministry of Agriculture,
Forestry and Fisheries,
Food Sanitation Law,
Nutrition Improvement Law
Pharmaceutical Affairs Law of the Ministry of Health and Welfare,
Measurements Law of the Ministry of International Trade and Industry,
"Act Against Unjustifiable Premiums and Misleading Representations" of the Fair Trade Commission, and
Consumer protection ordinances of local government.

Typical indications required include product variety, materials used, net weight, date of manufacture, name of manufacturer, food additives used and others.

Table 53. Import code number of processed vegetables, Japan, 1997.

Commodity	Code prefix	Code No.	Description
Salted vegetables:			
Cucumber and Gherkin	700	0711.40.000	Cucumber and Gherkin (salted)
Small eggplant	705	0711.90.012	Small eggplant (salted - less than 20 g)
Scallion	707	0711.90.013	Scallion (salted)
Eggplant	712	0711.90.091	Eggplant (salted)
Lotus	713	0711.90.092	Lotus (salted)
Warabi	720	0711.90.019	Warabi (alted)
Ginger	730	0910.10.100	Ginger (salted)
Strawberry	735	0812.20.000	Strawberry (salted)
Onions	740	0711.10.000	Onions (salted)
Others	740	0711.90.099	Others (salted)
Dried vegetables:			
Potatoes	800	0712.10.000	Potatoes (dried)
Shiitake mushroom	810	0712.30.010	Shiitake mushroom (dried)
Black fungus	813	0712.30.091	Black fungus (dried)
Mushroom	815	0712.30.099	Mushroom (dried)
Onions	820	0712.20.000	Onions
Bamboo shoots	830	0712.90.010	Bamboo shoots (dried)
Zenmai	840	0712.90.020	Zenmai (dried)
Daikon	841	0712.90.040	Daikon (dried)
Berries	845	0813.40.010	Berries (dried)
Sweetcorn	850	0712.90.039	Sweetcorn
Others	850	0712.90.090	Other vegetables
Vegetables in vinegar:			
Cucumber and gherkin	900	2001.10.100	Cucumber & gherkin (in vinegar - with sugar)
Cucumber and gherkin	900	2001.10.200	Cucumber & gherkin (in vinegar - no sugar)
Onions	910	2001.20.100	Onions (in vinegar - with sugar)
Onions	910	2001.20.200	Onions (in vinegar - no sugar)
Sweetcorn	920	2001.90.120	Sweetcorn (in vinegar - with sugar)
Sweetcorn	920	2001.90.230	Sweetcorn (in vinegar - no sugar)
Baby corn	930	2001.90.230	Baby corn (in vinegar - with sugar)
Baby corn	930	2001.90.240	Baby corn (in vinegar - no sugar)
Ginger	931	2001.90.250	Ginger (in vinegar - no sugar)
Others	940	2001.90.140	Others (in vinegar - with sugar)
Others	940	2001.90.290	Others (in vinegar - with sugar)
Prepared vegetables:			
Bamboo shoot	1170	2005.90.210	Bamboo shoot (unfrozen - no sugar)
Baby corn	1180	2005.90.221	Baby corn (unfrozen - airtight)
Baby corn	1180	2005.90.229	Baby corn (unfrozen - non-airtight)
Ginger (small containers)	1191	0910.10.210	Ginger (small container)
Ginger (others)	1192	0910.10.239	Ginger (others)
Vegetables - soup	1345	2104.10.010	Vegetables - soup (airtight)
Vegetable juices	1350	2009.80.210	Vegetable juices (with sugar)
Vegetable juices	1350	2009.80.221	Vegetable juices (no sugar - airtight)
Vegetable juices	1350	2009.80.229	Vegetable juices (no sugar - airtight)
Others	1390	2005.90.291	Others (no sugar- airtight)

Tariff Rates:

No.	Stat. Code No.	Description	Rate of duty				Unit
			General	GATT	Preferential	Temporary	
0711		**Vegetables provisionally preserved (for example) by sulphur dioxide gas, in brine, in sulphur water or in other preservative solutions), but unsuitable in that state for**					
0711.10	000	**immediate consumption:**	**15%**	**12%**			**KG**
0711.20	000	Onions	**15%**				**KG**
0711.30	000	Olives	**15%**				**KG**
0711.40	000	Capers	**15%**	**12%**			**KG**
0711.90		Cucumbers and gherkins	**15%**				
		Other vegetables; mixtures of vegetables	**10%**	**8%**			
		Aubergines (eggplants), weighing not more than 20 g per piece, scallion and bracken	**10%**	**8%**			**KG**
	011	Aubergines (eggplants) and scallion	**10%**	**8%**			**KG**
	019	Bracken	**15%**	**12%**			**KG**
	099	Other ((Eggplant, lotus and others)					
0712			**15%**	**12%**			**KG**
0712.20	000	**Dried vegetables:**					
0712.30		Onions	**15%**	**13.9%**			**KG**
	010	Mushrooms and Triffle	**15%**	**12%**	**9 x**		**KG**
	091	Shiitake mushroom	**15%**	**13%**	**9 x**		**KG**
	099	Black Fungus					
		Others	**15%**	**12%**	**7.5 x**		**KG**
0712.90			**15%**	**12%**	**9 x**		**KG**
		Other dried vegetables:	**15%**	**12%**	**9 x**		**KG**
	010	Bamboo shoot	**15%**	**12%**	**9 x**		**KG**
	020	Zenmai					
	040	Daikon					
	090	Others	**FREE**	**FREE**			**KG**
0713							
0713.31	000	**Dried beans (except French beans):** Green bean (mungbean)					
0910							
		Ginger, saffron, turmeric (curcuma), thyme, bay leaves, curry and other spices:	**15%**	**12%**			**KG**
0910.10		Ginger:					
	100	1. Provisionally preserved in brine, in sulphur water or in other preservative solutions;	**10%**	**7.5%**	**FREE**		**KG**
			5%	**3.8%**	**FREE**		**KG**
		2. Other:	**5%**	**3.8%**	**FREE**		**KG**
		i) put up in containers for retail sale.					
	210	Fresh					
	231	Other					
	239						
2001			**15%**	**(20%)**	**12% x**		**KG**
		Vegetables, fruit, nuts and other edible parts of plants, prepared or preserved by vinegar or acetic	**12%**	**(16%)**	**9% x**		**KG**
2001.10		acid:	**15%**	**(20%)**	**12% x**		**KG**
		Cucumbers and gherkins:	**12%**	**(16%)**	**9% x**		**KG**
	100	1. Containing added sugar					
2001.20	200	2. Other					
		Onions:					
	100	1. Containing added sugar					
	200	2. Other					

Notes:

1. *For the purpose of assessment of duty, a Preferential rate is applied before a GATT rate, a GATT rate before a Temporary rate and a Temporary rate before a General rate. However, if a GATT rate is not lower than the other rates, the rate applicable is a Temporary rate, or if no Temporary rate is provided, a General rate.*
2. *The mark "x" put to certain Preferential rates denotes that these rates are applicable only to the goods concerned originating in the Least Less Developed Countries.*
3. *The mark "❑" put to rates in the "Temporary" column denote that these rates are Temporary rates based on Annex I-(B) to the Temporary Tariff Measures Law.*

TARIFF RATES (cont.)

No.	Stat. Code No.	Description	Rate of Duty				Unit
			General	GATT	Preferential	Temporary	
2001.90		**Other vegetables:**					
		1. Added sugar:					
	120	Sweetcorn	**17.5%**	**14%**			**KG**
2005	130	Baby corn	**28%**	**22.4%**			**KG**
	140	Others	**15%**	**(20%)**	**12 x**		**KG**
		2. Others:					
	230	Sweetcorn	**12.5%**	**10%**			**KG**
	240	Baby corn	**25%**	**20%**	**9 x**		**KG**
		Others:					
	250	Ginger	**12%**	**(16%)**	**9 x**		**KG**
	290	Others	**12%**	**(16%)**	**9 x**		**KG**
2003		**Prepared vegetables:**					
2003.10		Mushroom	**22.4%**	**17.9%**	**13.4 x**		**KG**
	100	1. Added sugar					
		2. Others:					
		i) airtight container (less than 10 kg.)	**16%**	**14.8%**			**KG**
	211	English Mushroom	**16%**	**12.8%**			**KG**
	219	Others	**11.2%**	**(14%)**			**KG**
	220	2. Others					
2004		**Prepared vegetables:**					
2004.90		Other vegetables:	**16%**	**14.8%**			**KG**
		Bamboo shoot	**25%**	**20%**	**9 x**		**KG**
		Baby corn - airtight container	**25%**	**20%**			**KG**
		- Others					
2005.90		Other vegetables prepared or preserved otherwise than with vinegar or acetic acid but not frozen:	**16%**	**14%**			**KG**
	210	Other vegetables:					
		Bamboo shoot					
2008							
2008.99		Fruit, nuts and other edible parts of plants, otherwise prepared or preserved, whether or not containing added sugar or other sweetening matter or spirit, not elsewhere specified or included:	**(25%)**			**20%**	KG
	100	Other:					
		1. Ume (fruit of Japanese apricot, *Prunus mume*)					

Notes:

1. *For the purpose of assessment of duty, a Preferential rate is applied before a GATT rate, a GATT rate before a Temporary rate and a Temporary rate before a General rate. However, if a GATT rate is not lower than the other rates, the rate applicable is a Temporary rate, or if no Temporary rate is provided, a General rate.*
2. *The mark "x" put to certain Preferential rates denotes that these rates are applicable only to the goods concerned originating in the Least Less Developed Countries.*
3. *The mark "❑" put to rates in the "Temporary" column denote that these rates are Temporary rates based on Annex I-(B) to the Temporary Tariff Measures Law.*

3.1.4 Suggestions for Access to Japanese Market

Tsukemono imports, semi-processed products in particular, will still continue for some time. Tsukemono makers in Japan are eagerly looking for inexpensive, good quality materials from abroad in order to survive heavy competition in the domestic market. To procure better materials less expensively and with more stability, they are diversifying material suppliers. It is hoped that exporting nations can co-exist with Japan in a well-balanced manner by means of an international division of labour, ie. the best crops from the best farms. In other words, this means that producers who have not had access to foreign markets can now have new opportunities of business, while existing exporters are required to make increased efforts to improve product quality and business practices.

a) Observance of quality standards:

Japan is very keen to have stable quality and quantity. Japanese importers are requiring foreign exporters of tsukemono materials to fine tune responses in terms of size, shape, texture, salting methods, volume of salt and other additives, and product yield etc. For example, in addition to basic standards of quality commonly sought by the trade as previously explained, each manufacturer often has his own specifications of salt and other additives to fill the needs of his prospective consumers. Naturally, as tsukemono is eaten directly from the package, all production processes must be sanitary with the inclusion of foreign substances being avoided by any means and residual agricultural chemicals removed completely. As for the yield rate, this remains very important as it directly affects the production cost. Packages and packaging styles should also be considered, as there are many cases of damages and spills after arrival in Japan.

b) Introduction of proper technical assistance from Japan:

Quality is the life of a product in Japan and continuous efforts are needed to improve product quality. The acquisition and improvement of technologies is required in a variety of fields including knowledge of cultivation, the selection of species, improvement of soil, farm rotation procedures if necessary, methods of raising and fertilising, timing and system of harvesting, and the process of salting. The quality of tsukemono basically depends on the salt content, length of salting and temperature. Manufacturing tsukemono in a foreign country in which weather and climate are different from that of Japan occasionally proves unsatisfactory in terms of quality even with the help of Japanese partners. Therefore, a co-operative stance is needed to take advantage of knowledge and wisdom of both parties.

c) Confirmation of consumer needs:

As tsukemono is a food item peculiar to Japan, tsukemono manufacturers find Australians are reluctant to eat it habitually. Therefore, we are at a disadvantage to judge acceptability of the product and consumer needs. The supply of information from those concerned may be both precise and effective in many cases to ascertain consumer needs and collect market information, but, if possible, Australian tsukemono manufacturers should visit Japan to actually confirm the market. Ideally they should co-operate with Japanese manufacturers or a stay in Japan to experience the consumption of tsukemono in a common Japanese environment. Japanese owned companies in Australia would also be good partners for new products such as tsukemono (Table 56).

d) Stable supply and price:

As tsukemono materials are agricultural products, crop conditions and prices tend to fluctuate. But prices of merchandised tsukemono items change little and demand remains constant. Therefore, an

abrupt price increase after contract conclusion or a change in the volume of shipment should be avoided as it seriously undermines the credit standing of the shipper.

e) Newcomers in the Japanese market:

Inquiries from foreign dealers who have never traded with Japan are increasing but some inquiries lack essential information to convince Japanese importers of success in trading with foreigners. The following information is what Japanese manufacturers require:

i) What is the species? (If product sells in Japan as tsukemono).
ii) The salting method used.
iii) Is product in accordance with Japanese standards?
iv) Is product in accordance with Japanese specifications?
v) What volume of product will be supplied?
vi) Samples must be attached.

If a Japanese importer judges it is possible to begin transactions based on the above mentioned information being satisfactory, then he proceeds to give details of technical guidance and price negotiations. Lastly and most importantly, a good exchange of communication is necessary for both existing exporters and newcomers.

Table 54. List of Japanese food companies in Australia.

Parent company	Share (%)	Registered company name	Major business
Ito-en	100	Ito-en Australia Pty. Ltd.	Green tea
Itoham	100	Itoham Foods (Australia) Pty. Ltd.	Meat, Foods trading
Itoham	100	Renod Holdings Pty. Ltd.	Husbandry
Itoham	75	Rockdale Beef Pty. Ltd.	Animal Feedstuffs
Kikkoman	25	Japan Food (Australia) Pty. Ltd..	Foods Trading
Taiheiyo Boeki	75	Japan Food (Australia) Pty. Ltd..	Foods Trading
Kikkoman	100	Kikkoman Australia Pty. Ltd.	Oil, Teriyaki sauce
Kirin Beer	100	Kirin Australia Pty. Ltd.	Wheat sprout
Kirin Beer	100	Kirin Restaurants of Australia Pty. Ltd.	Beer
Suntory	100	Restaurant Suntory (Sydney)	Restaurant
Suntory	100	Restaurant Suntory (VIC) Pty. Ltd.	Restaurant
Nichirei	100	Nichirei Australia Pty. Ltd.	Processed foods
Nipponnam	100	Nippon Meat Packers Australia Pty. Ltd.	Meats
Nipponnam	100	M.Q.F. Pty. Ltd.	Ham, sausages
Nippon Seito	65	Tibaldi Small Goods (A/asia) Pty. Ltd.	Ham, sausages
Nichimen	32.5	Tibaldi Small Goods (A/asia) Pty. Ltd.	Ham, sausages
Hokuriku Coca-Cola	51.7	Arrowfield Wines Pty. Ltd.	Wines
Meiji	40	Meiji-MGC Dairy Co. Pty. Ltd.	Infant milk
Mitsubishi	20	Meiji-MGC Dairy Co. Pty. Ltd.	Infant milk
Meiji	N/K	Meiji-Dairy A/asia Pty. Ltd.	Dairy products
Yakuruto	100	Yakult Australia Pty. Ltd.	Yakult drink
Yukijirushi	100	Snow Brand Tatura Dairies Pty. Ltd.	Milk powder
Yukijirushi	100	Piam Pty. Ltd.	Cheese
Yukijirushi	100	Snow Brand Trading Australia Pty. Ltd.	Foods and drink
Marubeni	93.3	Rangers Valley Cattle Station Pty. Ltd.	Meats
Marubeni	87.18	Marubeni Rural Investments Pty. Ltd.	Meats
Mitsubishi	65	The Mid Coast Meat Co. Pty. Ltd.	Meats
Mitsubishi	100	Riverina Stock Feeds Pty. Ltd.	Cereals
Mitsubishi	100	MC Meats Holdings Pty. Ltd.	Meats
Mitsubishi	32	Intermix Australia Pty. Ltd.	Processed foods
Zenchiku	100	Zenchiku (Australia) Pty. Ltd.	Meats
Toshoku	100	Toshoku Australia Pty. Ltd.	Foods Trading
N/K	N/K	Jun Pacific Corporation Pty. Ltd.	Foods Trading
Noson Koryu International	100	Noson Koryu Australia Pty. Ltd.	Restaurant and Buck wheat
Shirayuki	N/K	Sun-Masamune (Go-Shu)	Japanese Sake

3.2 China - The Major Supplier of Processed Asian Vegetables

China is the world's oldest existing major civilisation with records dating back approximately 3,500 years. With the nation's population exceeding 1.2 billion (1996) and with a new "open market" policy, China has become the largest market in the world.

Despite China's size of 9.6 million km^2, 90 per cent of its people live on one-sixth of the land. This is primarily because two-thirds of China's area is mountainous or semi-desert and only one-tenth is cultivated.

Agriculture dominates the Chinese economy. Although only 11% of the land is suitable for cultivation, virtually all of it is used for crops. In fact, China has become the world's largest producer of rice, potatoes, millet, peanuts, tobacco, tea and pork. Major industrial crops such as cotton, sugar and various oil seeds as well as vegetables, particularly Asian vegetables, are also produced. China is endeavouring to further improve agricultural production since farm exports are viewed as a primary vehicle for gaining foreign exchange.

China has great potential for penetrating overseas markets due to its climatic conditions, the availability of a wide variety of fruit and vegetables, its location in the midst of the Asian growing economies and, most importantly, the large rural, cheap labour force available for intensive cultivation, harvesting and packaging. Through the Chinese system of forced procurements (farmers had to supply a set amount of a given product to the Ministry of Commerce) and state-determined procurement prices, the state was able to obtain large quantities of fruit and vegetables at low prices for the export market.

One of China's major areas of export growth is processing vegetables, which increased 800% from US$34 million in 1970 to US$271 million in 1980. With the improvement of trade relations with Japan, China increased its vegetable product exports from ¥47 billion (A$600 million) in 1988 to ¥146 billion (A$1,857 million) in 1997. This is an increase of 210% in a period of only 10 years. By 1999 China had captured more than 39% of the Japanese vegetable import market, ranked number one, and outyielded the USA's 31%.

3.2.1 Pickling industry:

Chinese pickles (*Zha cai)* and *Sauerkraut* from Europe are believed to be the world's two oldest types of pickles. Chinese pickled their vegetables thousands of years ago and pickles are becoming a very important part of their lives. Many types of pickles are available in China but they could be divided into three different groups - salted pickled vegetables, vegetables pickled in vinegar, and vegetables pickled with seafoods.

Due to difficulty in collection of data on processed vegetables production in China, this report discusses data only based on figures from the Japanese Agriculture and Forestry Statistic Organisation (1999). In 1997, Japan imported 227,992 t of salted vegetables which were valued at approximately ¥24,399 million (A$310 million) and 24,627 t of vegetables pickled in vinegar valued at approximately ¥4,518 million (A$57 million). Of these, China had 84% of markets for salted vegetables and 41.5% for vegetables in vinegar, thus dominating the import market for processing vegetables. It should be noted that in the salted

vegetables industry, China has many advantages over other countries. Firstly, China's pickles are similar to those of Japan with regard to scallion, ginger, lotus etc and Japanese manufacturers need only to make up final products for the Japanese taste and flavour. Secondly, the CIF prices for export of China's pickles to Japan are low due to China's cheap labour in their rural communities. Table 55 shows that there is a close relationship between China's pickle domination and its cheap prices.

Table 55. The CIF prices in 1997 of some salted vegetables in the Japanese import market (Unit=¥/kg.).

Salted vegetables	Avge	China		Vietnam		Thailand		USA		Indonesia	
		CIF	%[2)]	CIF	%	CIF	%	CIF	%	CIF	%
Cucumber and Gherkin	55	54	87.8	59	9.7	92	0.7	76	0.3	78	0.03
Ginger	105	104	26.6	128	1.9	103	65.7	N/A	-	117	4.6
Lotus	99	99	99.7	?	0.3	N/A	-	N/A	-	N/A	-
Scallion	164	164	99.7	110	0.2[1)]	N/A	-	N/A	-	N/A	-

Note 1) In 1997, Vietnam supplied 28 t of salted scallion for the first time with CIF price of ¥110/kg as a sample. If Vietnam can maintain this price, which is approximately 33% lower than those of China, they may penetrate the Japanese scallion market which has been dominated by China for the last 10 years.

2) Percentage of market share

Table 56. Export volume of pickles from China to Japanese markets from 1988-1997 (10 years) (Unit - ton)

Commodity	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Salted vegetables:	**127,584**	**145,851**	**129,016**	**151,515**	**166,305**	**180.986**	**189,579**	**218,599**	**221,014**	**191,605**
Cucumber & gherkin	43,188	57,404	46,188	51,158	54,799	55,675	59,796	65,352	46,348	53,122
Small eggplant	-	-	-	-	-	-	-	5,152	6,727	5,996
Scallion	-	-	-	-	-	-	-	22,656	25,145	14,340
Small eggplant & scallion	11,992	12,216	12,350	15,103	17,095	21,635	20,768	-	-	-
Eggplant	-	-	-	-	-	-	-	8,319	8,472	7,228
Lotus	-	-	-	-	-	-	-	14,887	16,480	15,282
Warabi (Bracken)	12,723	10,276	11,418	8,335	10,066	10,379	8,573	9,550	11,094	5,398
Ginger	3,662	2,770	2,552	3,376	4,491	5,278	7,562	14,604	7,748	8,022
Others	56,018	63,184	56,508	73,544	79,855	88,019	92,879	77,719	98,998	82,216
Vegetables in vinegar:	**5,007**	**5,407**	**4,217**	**4,364**	**7,383**	**18,403**	**13,664**	**12,860**	**11,171**	**10,207**
Cucumber & gherkin	-	-	-	-	78	224	731	705	453	318
Ginger	-	-	-	-	-	-	-	5,269	4,300	3,727
Others	5,007	5,407	4,217	4,364	7,305	18,179	12,932	6,886	6,418	6,162

Table 57. Export values of pickles from China to Japanese markets from 1988-1997 (10 years) (Unit-¥1,000).

Commodity	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Salted vegetables:	**14,599,868**	**15,940,526**	**14,569,038**	**15,854,648**	**16,747,283**	**15,801,336**	**14,852,739**	**16,578,298**	**23,729,768**	**20,559,615**
Cucumber & gherkin	2,179,152	3,049,141	2,540,717	2,859,755	3,181,203	2,924,803	2,775,215	3,226,016	2,782,078	2,885,368
Small eggplant	-	-	-	-	-	-	-	357,762	559,386	505,353
Scallion	-	-	-	-	-	-	-	1,830,094	3,649,776	2,348,620
Small eggplant & scallion	1,334,148	1,267,168	1,248,454	1,542,777	1,876,670	2,118,510	1,766,316	-	-	-
Eggplant	-	-	-	-	-	-	-	484,871	580,837	517,970
Lotus	-	-	-	-	-	-	-	878,387	1,390,494	1,506,359
Warabi (Bracken)	891,455	998,933	1,420,140	1,052,995	1,180,988	1,113,821	957,125	901,761	1,434,670	813,173
Ginger	382,316	448,078	297,616	367,445	468,176	453,385	475,565	969,941	801,969	838,010
Others	9,812,797	10,177,206	9,062,111	10,031,676	10,040,246	9,190,817	8,878,518	7,929,466	12,530,558	11,144,762
Vegetables in vinegar:	**591,928**	**711,097**	**596,319**	**613,302**	**985,315**	**1,628,572**	**1,103,923**	**1,481,145**	**2,048,731**	**1,874,706**
Cucumber & gherkin	-	-	-	-	7,187	18,865	57,075	60,891	49,029	30,719
Ginger	-	-	-	-	-	-	-	465,716	926,633	693,546

Others	591,928	711,097	596,319	613,302	978,128	1,609,707	1,046,848	954,538	1,073,069	1,150,441

Table 58. Country's shares of cucumber and gherkin pickles into Japanese import market from 1988-1997.

Year	Import (t)	China	Vietnam	Sri Lanka	Thailand	Myamar	USA	India	Switzerland	Indonesia
1988	54,561	43,188	233	-	4,869	-	2,025	-	-	103
1989	71,251	57,404	700	26	9,701	36	1,063	-	-	214
1990	57,557	46,188	778	241	8,833	-	869	-	-	208
1991	60,180	51,158	796	681	6,256	-	762	-	-	94
1992	61,719	54,799	677	274	4,547	70	792	-	-	152
1993	60,840	55,675	922	405	2,909	45	488	-	-	249
1994	64,457	59,796	896	767	2,014	132	641	-	-	122
1995	72,227	65,352	2,603	733	2,604	89	385	-	-	230
1996	58,476	46,348	9,222	712	1,392	95	221	-	-	474
1997	60,476	53,122	5,839	555	435	245	193	29	17	17
Market shares (percentage):										
1988	92.41	79.16	0.43	-	8.92	-	3.71	-	-	0.19
1989	97.04	80.57	0.98	0.04	13.62	0.05	1.49	-	-	0.30
1990	99.24	80.25	1.35	0.42	15.35	-	1.51	-	-	0.36
1991	99.28	85.01	1.32	1.13	10.40	-	1.27	-	-	0.16
1992	99.34	88.79	1.10	0.44	7.37	0.11	1.28	-	-	0.25
1993	99.76	91.51	1.52	0.67	4.78	0.07	0.80	-	-	0.41
1994	99.86	92.77	1.39	1.19	3.12	0.20	0.99	-	-	0.19
1995	99.68	90.48	3.60	1.01	3.61	0.12	0.53	-	-	0.32
1996	99.98	79.26	15.77	1.22	2.38	0.16	0.38	-	-	0.81
1997	99.96	87.84	9.66	0.92	0.72	0.41	0.32	0.04	0.03	0.03

Table 59. Country's shares of small eggplant and scallion pickles in Japanese import market - 1988-1997.

Year	Import (t)	China	Taiwan	Hong Kong	Vietnam	Thailand	Indonesia
1988	15,115	11,992	2,511	43	9	543	-
1989	14,793	12,217	2,071	-	-	506	-
1990	14,272	12,350	1,286	24	-	612	-
1991	16,642	15,103	689	45	-	745	61
1992	19,047	17,095	814	-	-	1,137	-
1993	22,651	21,635	269	84	15	637	11
1994	22,614	20,768	262	-	3	1,576	5
Market shares (percentage):							
1988	99.89	79.34	16.61	0.28	0.06	3.59	-
1989	100.01	82.59	14.00	-	-	3.42	-
1990	100.00	86.53	9.01	0.17	-	4.29	-
1991	100.01	90.75	4.14	0.27	-	4.48	0.37
1992	99.99	89.75	4.27	-	-	5.97	-
1993	100.00	95.51	1.19	0.37	0.07	2.81	0.05
1994	100.00	91.84	1.16	-	0.01	6.97	0.02

Table 60. Country's shares of salted ginger into Japanese import market from 1988-1997.

Year	Import (t)	Thailand	China	Indonesia	Vietnam	Taiwan	Laos	Myamar	Hong Kong	Malaysia
1988	50,020	37,841	3,662	23	583	7,912	-	-	-	-
1989	47,875	38,444	2,770	333	1,030	5,247	-	-	-	4
1990	41,404	31,423	2,552	2,772	1,468	2,530	-	-	-	-
1991	47,392	38,293	3,376	2,312	1,630	1,274	-	-	-	-
1992	41,974	32,284	4,491	1,487	1,258	2,283	-	-	27	-
1993	19,822	8,915	5,278	3,162	1,427	905	-	-	24	6
1994	24,598	14,481	7,562	1,326	1,092	122	-	-	-	15
1995	35,396	19,307	14,604	853	611	9	-	-	12	-
1996	29,387	18,394	7,748	1,333	1,231	657	-	24	-	-
1997	30,219	19,866	8,022	1,380	572	313	34	30	-	-
Market shares (percentage):										
1988	100.00	75.65	7.32	0.05	1.17	15.82	-	-	-	-
1989	99.90	80.30	5.79	0.70	2.15	10.96	-	-	-	0.01
1990	98.41	75.89	6.16	6.70	3.55	6.11	-	-	-	-
1991	98.93	80.80	7.12	4.88	3.44	2.69	-	-	-	-
1992	99.66	76.91	10.70	3.54	3.00	5.44	-	-	0.06	-
1993	99.47	44.98	26.63	15.95	7.20	4.57	-	-	0.12	0.03
1994	100.00	58.87	30.74	5.39	4.44	0.50	-	-	-	0.06
1995	100.00	54.55	41,.26	2.41	1.73	0.03	-	-	0.03	-
1996	100.00	62.59	26.37	4.54	4.19	2.24	-	0.08	-	-
1997	99.99	65.74	26.55	4.57	1.89	1.04	0.11	0.10	-	-

Table 61. Country's shares of ginger in vinegar into Japanese import market from 1995-1997.

Year	Import (t)	Thailand	China	Indonesia	Vietnam	Fiji	Taiwan	Cameroon	Laos	Malaysia
1995	14,288	8,319	5,269	79	620	-	-	-	-	-
1996	13,999	9,077	4,300	101	248	-	-	-	-	-
1997	11,824	7,556	3,727	339	101	41	38	10	10	1
Market shares (percentage):										
1995	99.99	58.22	36.88	0.55	4.34	-	-	-	-	-

1996	98.05	64.84	30.72	0.72	1.77	-	-	-	-	-
1997	99.98	63.90	31.52	2.87	0.85	0.35	0.32	0.08	0.08	0.01

Table 62. Country's share of salted lotus rhizomes into Japanese import markets, 1995-1997.

Year	Import (t)	China	Vietnam
1995	14,887	14,887	-
1996	16,484	16,481	3
1997	15,332	15,282	50
Market share (percentage):			
1995	100.00	100.00	-
1996	100.00	99.98	0.02
1997	100.00	99.67	0.33

Table 63. Country's share of salted scallion into Japanese import markets,1995-1997.

Year	Import (t)	China	Vietnam	Switzerland
1995	22,656	22.656	-	-
1996	24,145	25,145	-	-
1997	14,380	14,340	28	1
Market share (percentage):				
1995	100.00	100.00	-	-
1996	100.00	100.00	-	-
1997	100.01	99.72	0.19	0.09

Table 64. Country's share of salted small eggplant into Japanese import markets, 1995-1997.

Year	Import (t)	China	Thailand	Vietnam	Taiwan	Czechoslovakia	Indonesia
1995	5,982	5,512	387	18	47	-	18
1996	7,788	6,727	922	18	76	45	-
1997	6,714	5,996	651	36	32	-	-
Market share (percentage):							
1995	100.00	92.14	6.47	0.30	0.79	-	0.30
1996	100.00	86.38	11.84	0.23	0.98	0.58	-
1997	100.00	89.31	9.70	0.54	0.48	-	-

China dominates Japanese import markets for processing vegetables as the Chinese are familiar with Japanese pickles and produce them at very low prices.

3.3. Vietnam - A Rising Exporter for Japanese Markets

In 1988, Vietnam exported 828 t of processed vegetables to Japan and these were valued at approximately ¥46 million. In 1996, Vietnam increased its exportation of processed vegetables such as salted and pickled vegetables to 11,341 t, valued at ¥757 million. This is an incredible increase of 1270% and 1547% in terms of volumes and values respectively.

Investigation of development of the pickling industry in Vietnam would help the developing Australian processed vegetable industry.

3.3.1. General :

Vietnam is an agriculturally-developing country which is still heavily reliant on production of agriculture for its post-war economic recovery. To achieve a high level of agricultural production, Vietnam needs physical reform in agriculture in the sense of hardware, supply of sufficient fertiliser, chemicals, agri-mechanical equipment, certified seed for national production of foods, cereals, vegetables and fruits either by self-production or importation. The country also requires intellectual agricultural software including freedom in farming development policies, medium and high levels of agri-eduction, training, high technologies, farm systems, rural communication and transportation systems.

In response to the above, the implementing of the renovations of the Vietnamese Communist Party in 1989 on agricultural development in which almost all of the policies that hindered development were removed, Vietnam agriculture has achieved significantly good results.

Agricultural production has grown steadily by an average of 4.3% per annum. Since 1987, production of foodstuff each year has increased by 1.8%, coffee by 20%, rubber by 3.5%, tea by 1.8%, poultry by 1.8%, pigs by 1.67% and cattle by 1.2% per annum. In the 10 years from 1987-1997, 1.67 million hectares were reafforested involving hundreds of millions of trees.

Exportation of agriculture, forestry and fisheries products have increased by an average of 20% per annum.

Rural economic structure has been transformed and where once industrial and services accounted for 30%, there now exists an agriculture-dominated society.

Rural infrastructure has been upgraded and in 1997 the road system was extended to 93% of villages. Electricity has reached 70% of villages and fresh water is being supplied to 40% of the rural population.

3.2.2 Vietnam vegetable industry

i) Vegetable production:

In 1995 Vietnam grew 4,145,600 t of vegetables on 328,000 ha. Northern Vietnam produced more vegetables than the southern part, namely 2,171,400 t on 175,800ha. However, the Mekong Delta in the south produced the largest quantities of vegetables on 66,400 ha followed by the South Central Coast on 35,300 ha, the North East on 32,900 ha and the Central Highland on 17,800 ha.

The yield of vegetables in Vietnam in 1995 was still low and only averaged 12.1 t/ha. The Vietnamese per capita consumption of vegetables (in 1995) was also low, at 58.5kg/person/year (Table 65)

Table 65. Per Capita of Vegetables in Asia

Country	Per Capita, (kg/person/year)
The Philippines	14.4
Indonesia	18.6
Malaysia	29.9
Thailand	45.0
Vietnam	58.5
Taiwan	156.9
South Korea	161.3
Japan	194.0

Source: Vietnam Statistics Yearbook

There are approximately 40 major vegetables grown in Vietnam (Table 66). Included are temperate crops such as potato, carrot, cauliflower and peas, which are grown in the north and central highlands. Domestic markets mainly focus on big cities and industrial areas with products being mostly fresh and processed vegetables and canned vegetables making up a low proportion.

Ho Chi Minh City is a potential market for legumes as well as vegetables and has nine municipal districts, local districts, Dalat, Dong nai, Ninh thuan and Long an which produce and provide 245,000 t of vegetables annually.

Hanoi, the capital, is provided with more than 80,000 t of vegetables and legumes annually from neighbouring districts and provinces. However, one of the basic features of the fruit and vegetables markets is fluctuation in price. Prices for the winter to spring crop from December to March are very cheap and so the vegetable grower is discouraged. However, during the between crop period, vegetables are very expensive and are adversely affected by weather conditions, making production costs very high and providing little benefit to the farmers.

Table 66. Major Vegetables Grown in Vietnam.

Leafy Vegetables	Fruit Vegetables	Root Vegetables
1. Cabbage	1. Tomato	1. Radish
2. Chinese cabbage	2. Brinjal (small egg plant)	2. Carrot
3. Cauliflower	3. Sweet pepper	3. Potato
4. Green mustard	4. Hot pepper	4. Kohlrabi
5. Pak-choi	5. Bitter gourd	5. Onion
6. Petsai	6. Loofah	6. Garlic
7. Kangkong	7. Bottle gourd	7. Shallot
8. Edible amaranth	8. Pumpkin	8. Jam
9. White jute	9. Chayote	9. Asparagus
10. Water cress	10. Common beans	10. Sweet potato
11. Celery	11. Yard long bean	
12. Lettuce	12. Cucumber	
	13. Okra	
	14. Egg plant	
	15. Jointed gourd	
	16. Peas	
	17. Water melon	
	18. Mung beans	

ii) Pickling industry:

Pickles are a very important part of Vietnamese meals, particularly in rural areas where people are still living in poor conditions. There are many types of pickles available in Vietnam but they could be divided into three difference groups - salted pickling vegetables, vinegar pickling vegetables and pickling vegetables - with seafoods such as prawns or fish.

i) Salted pickling vegetables including gherkin, green mustart (Takana), Chinese cabbages and brinjal (small white eggplant). Dua mon is a pickle that is combined with carrots, white radish and scallion in a solution of salt and sugar with fish sauce and is a very popular salted pickle in Vietnam.
ii) Vegetables pickled in vinegar include gherkin, celery, scallion, garlic, onion, carrot, hot chilli, peppercorn, lotus rhizome and young lotus flower stalks.
iii) Seafoods and pickled vegetables including tom chua (prawn and young paw paw fruit pickles) and Mam ca phao (small fish and brinjal pickles) are the most popular pickles of this type. Kimchi, which is made with Chinese cabbage, hot chilli and fish sauce, is also available but in different flavours to those of Japan and Korea.

In the 1980s there were 18 vegetable and fruit processing manufacturers in Vietnam with seven in the north, one in the centre and 10 in the south regions. Vegetexco, a government-run vegetable producer, had 12 factories all over the country and the remaining six manufacturers belonged to provincial management. There are some small-scale, family-run pickle companies which serve local areas but it is impossible to establish how many. Capacities of vegetable and fruit processing manufacturers were low due to outdated equipment. However, it should be noted that a large number of pickle factories have been built since 1975.

Also in the 1980s, Vietnam produced approximately 50,000 t of canned tropical fruits and vegetables, 25,000 t of frozen fruits and vegetables, 10,000 t of spices including garlic, hot chilli, turmeric and 7,000 t of pickles and sprouts (mungbean).

ii) Exports of vegetables :

Since 1957 Vietnam has exported fruits and vegetables to Communist block countries including the USSR, Eastern Europe and China. Exports peakedfrom 1986 to 1990 when approximately 500,000 t of fresh and processed vegetables and fruits were exported to the USSR and Eastern Europe, earning US$191 million.
At present the export market for vegetables and products varies with annual production of the above commodities is:

Fresh vegetables	over 30,000 t/annum
Canned vegetables	over 10,000 t/annum
Frozen vegetables	8,000 t/annum
Spices	6,000 t/annum
Pickled vegetables	2,000 t/annum

According to market forecasts, in the next few years the fruit and vegetable processing industry will focus on mainly producing for export and the processing industry: tomato, cucumber, cabbage, carrot, legumes, mushroom, asparagus, maize, chilli, white potato and black pepper.

Of these vegetables, cucumber and tomato seem to be the most promising because they have possible and stable markets. The country's natural conditions are quite suitable for growing these vegetables and technical progress of varieties and intensification are also available. For instance, in 1995 there were 50 units comprising state businesses, limited or private companies and joint ventures with foreigners, dealing in processing vegetables and fruits. There were 16 units with foreign capital. Fourteen projects with a total capital amounting to more than US$54 million, the majority of which is 100% foreign-invested capital have already been ratified. The new situation involves increasing competition in the vegetable and fruit markets of the country, especially with the price of raw materials increasing twofold since the Tien Giang condensed pineapple juice factory came into operation in mid-1998. This has reflected a common trend among many businesses where there is more investment in processing and trading than in production of new materials.

It is difficult to collect data on the horticultural industry exports in Vietnam. However, based on figures from the Japanese Agriculture and Forestry Statistic Organisation, within the nine-year period to 1997, Vietnam sharply increased its exports of vegetables, and processed vegetables in particular, from ¥57 million to ¥1,284 million which represented an increase of 2157% - a very successful exporting story.

iv) Vietnamese vegetables and products in Japanese markets:

Fresh vegetables :

Vietnam exported 523 t of fresh vegetables to Japan in 1997. This was a less important role in the Japanese market, representing approximately 0.05~0.1% in value, which when taken into account as a supply country, made it No. 24 out of 30. Major fresh vegetables sent to Japan were onions (160 t), yam (106 t), carrot (84 t) and ginger (53 t).

Processed vegetables :

Salted vegetables, which are the main ingredient for pickles, were the most important commodity exported to Japan from Vietnam. (Tables 67 and 68).

Table 67. Importation of Salted Vegetables into Japan from Vietnam in a period of 10 years, 1988-97 (unit = tonne).

Commodity	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Total Salted	828	1,765	2,320	2,449	1,971	2,509	2,103	3,425	11,093	6,920
Vegetables	233	700	778	796	677	922	896	2,603	9,222	5,839
Cucumber & Gherkin								18	18	36
Small Eggplant										28
Scallion	9					15	3			
Eggplant & Scallion								7		13
Egg plant									3	
Lotus rhizome	583	1,030	1,468	1,630	1,258	1,427	1,092	611	1,231	572
Ginger	4	35	74	23	36	145	112	187	618	433
Others										
Japanese market share, %	0.4	0.78	1.18	1.13	0.88	1.19	0.95	1.34	4.22	3.04

Table 68. The Value of Imported Salted Vegetables into Japan from Vietnam in a period of 10 years, 1988-1997 (Unit = ¥1,000).

Commodity	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Total Salted	46,008	111,054	151,921	141,514	105,109	152,236	119,962	231,360	726,785	472,547
Vegetables	11,295	34,166	38,697	37,580	27,878	47,643	49,105	169,577	541,687	344,439
Cucumber & Gherkin								1,080	1,268	2,907
Small Eggplant										3,045
Scallion	721					1,043	202			
Eggplant & Scallion										
Egg plant								325	1,181	881
Lotus rhizome	33,454	68,686	97,201	98,633	70,098	76,900	54,776	41,111	112,350	73,513
Ginger	538	8,202	16,023	5,301	7,133	26,650	15,879	19,267	70,299	47,762
Others										
Japanese market share, %	0.20	0.44	0.69	0.64	0.45	0.80	0.68	0.16	2.54	1.94

Although China has dominated the Japanese market for imports of processed vegetables, it seems that Vietnam still has room to penetrate that market due to lower costs of some commodities (Table 69). However, following investigation of the pickling industry in Vietnam and in discussions with several Vietnamese state and provincial agents, as well as private companies, it is surprising that:

i) the Vietnamese authorities have not yet recognised that pickle is a potentially large industry both in domestic and export markets;
ii) there are no policies or strategies regarding research and development into pickles on a national scale;
iii) pickles are manufactured on a small-scale, lacking appropriate equipment and expertise;
iv) pickled vegetables for export are based on spot markets, not on long-term commitments;
v) good results with the export of salted vegetables that Vietnam has achieved penetration of Japanese markets for imported processed vegetables (emanating from the hard work of Japanese trade houses rather than Vietnam promoting itself);
vi) Japanese pickle market low priced products which are not of high quality are still acceptable because these products will be used as a semi-processing material, not the final product; and
vii) there is no way that Australia can produce low priced, semi-processed vegetables like Vietnam. However, we can produce our own trade-marked products, such as Australian Kimchi or White Radish pickles and promote them into international markets.

Table 69. Competitiveness in CIF Prices of Salted Vegetables between China and Vietnam in Japanese Imported market.

Commodity	Total Japanese imported market		Imported from China		Imported from Vietnam	
	Volume (ton)	CIF Price (¥/kg)	Volume (ton)	CIF Price (¥/kg)	Volume (ton)	CIF Price (¥/kg)
Cucumber & Gherkin	60,476	55	53,122	54	5,839	59
Small Eggplant	6,714	91	5,996	84	36	82
Scallion	14,380	164	14,340	164	28	110
Egg plant	7,677	74	7,228	72	13	69
Ginger	30,219	105	8,022	104	572	128
Others	84,404	137	82,216	136	433	110

Total Salted Vegetables	227,992	107	191,605	107	6,920	68

4. Australian Asian Vegetable Market - A Big Challenge Ahead

The Asian vegetable market in Australia is reflected in the waves of immigration since the early 1800s (Lee, 1995). It began with the early Chinese immigrant workers in the goldrush days, paused temporarily when the focus was on the southern European migrants after World War II and regained its momentum with more recent migration of Indo-Chinese in the 1980s. In 1993/94, Australia produced approximately A$50.5 million of Asian vegetables. Of these, approximately A$40 million (80%) were for the Australian domestic market and the other A$10 million (20%) were exported. NSW was the largest producer state, achieving A$28.9 million of Asian vegetables, followed by Queensland (A$5.7 million) and Western Australia (A$5.6 million).

However, in terms of export, Western Australia is the largest, exporting A$4.5 million followed by Tasmania and Queensland. Most Australian Asian vegetables exported overseas were in fresh form.

The Australian Asian vegetable share is still growing and was estimated at A$60 million in 1998. In 1997/98 total export of Australian horticulture accounted for A$1.6 billion which represented approximately 25% of its production (ABARE, 1999). Of these, exports of processing vegetables totalled A$40.5 million. This included potatoes, tomatoes, pickles, sweetcorn, cauliflower, carrot and celery. No processed Asian vegetables were exported (Table 72).

However, in the same year Australia imported A$131.8 million in processed vegetables. The majority of imported commodities were potatoes, tomatoes, asparagus and vegetables (Table 72), but it is unclear regarding the proportion of Asian vegetables contained in the imported processed vegetables. The presence of a large number of takana pickles, canned bamboo shoot, dried hot chilli and/or dried daikon into Australian supermarkets and Asian groceries has shown that importation of processed Asian vegetables would account for millions of dollars.

Japan also imported a large number of processed Asian vegetables in 1997, ie. 462,957 t valued at ¥87.9 billion (A$1.1 billion). The most important processed Asian vegetables for the Japanese market are ginger, scallion, lotus, bamboo shoot, shiitake mushroom, edamame and taros.

Clearly, potential markets for traditional Asian vegetables in Asia, particularly in Japan, are still high. Australia has had a western image and very few Asian, as well as Japanese trading companies and supermarket chains, are aware of the efforts of the Australian government and industry to establish a competitive and export-oriented Asian vegetable industry. The market share of an Australian Asian vegetable industry in Asia is, therefore, still very small.

4.1 Australian processed Asian vegetables industry:

In recent years the Australian processing industry has rapidly and significantly changed in an attempt to fit into the competitive “global market”. Back in 1946, Spring Gully Pickles was founded in the foothills of Mt.

Lofty, South Australia, to manufacture pickled onions, mustard and gherkin for domestic market. Now this company has become the major producer of pickles in Australia and exports it products to New Zealand, the United Kingdom, Italy and Spain.

Parle Foods, another pickle company was founded in the 1980s in Griffith, NSW. It is another example of import replacement. Until early in the 1990s Macdonald's imported almost all of its gherkins for their hamburgers, but now all that company's requirements of gherkins are supplied by Parle Foods. In just a decade, pickled gherkins have become a A$5 million industry. In 1998, Australia exported A$40.5 million in processed vegetables, an increase of 434% in comparison to those in 1990 with only A$7.5 million.

A wide range of climatic conditions enabling production of many types of crops, has helped develop a perception of Australia as a reliable supplier of "clean" produce. Advances in processing technology, ready availability of transport between Australia and Asia, and most importantly, with almost 70% of the industry owned and managed by foreign companies, Australian processing vegetable industries have been able to penetrate into global markets. They are selling "new" products and have the opportunity to be internationally competitive. The Australian processing vegetables industry, in short, has potential to grow further into export markets in Asia, particularly Japan.

To do this, the Australian processing vegetables industry needs to accept changes to be more competitive on a global scale, with new products emphasised as value-added. Some of the approaches that need to be taken include the focus on higher product technology and lower costs, which are described below.

Table 70. Australian exports and imports of processed vegetables during a period of nine years from 1990-1998 (ABS, 1999).

Activity	1990	1991	1992	1993	1994	1995	1996	1997	1998	Total
Export (A$)	7,596,506	8,843,160	12,886,532	17,646,631	27,376,884	31,262,724	30,549,772	32,379,159	40,550,772	224,412,022
Import (A$)	99,796,172	96,082,672	101,984,445	138,798,321	121,421,708	133,104,763	119,542,088	116,723,375	131,833,849	1,131,059,243

Table 71. Australia's exports of major processed vegetables (ABS, 1999).

Commodity	1995	1996	1997	1998	Total (1990-1998)
Vegetables in vinegar:					
Cucumber & gherkin	221,206	63,423	91,614	364,519	1,420,146
Pickles and chutney	79,521	416,733	1,556,783	2,020,139	5,351,900
Vegetables	1,256,148	1,345,768	1,447,731	1,822,425	11,824,786
Prepared or preserved:					
Tomatoes (whole)	645,822	766,084	1,293,817	719,615	5,699,896
Tomatoes (pulp)	1,316,200	1,494,764	2,101,218	9,292,625	22,522,805
Potatoes	11,107,030	9,962,624	8,572,709	7,328,365	50,991,064
Vegetables	-	3,790,859	3,873,603	2,450,715	11,044,323
Sweetcorn	-	671,833	1,811,776	1,692,854	5,061,968
Vegetables (mixture)	-	1,359,107	3,359,398	3,043,760	8,557,779
Total:	31,262,724	30,544,772	32,379,159	40,550,772	224,412,022

Table 72. Australia's imports of major processed vegetables (ABS, 1999).

Commodity	1995	1996	1997	1998	Total (1990-1998)
Vegetables in vinegar:					
Cucumber & gherkin	3,978,960	3,207,821	3,248,327	4,604,66681	30,590,552
Pickles	2,009,276	1,137,281	834,105	5,567	11,376,195
Vegetables	5,917,300	6,039,649	6,724,347	7,728,100	50,312,038
Prepared or preserved:					
Tomatoes (whole)	14,317,845	11,762,234	13,053,115	16,147,325	112,432,396
Tomatoes (whole)	8,047,724	8,068,460	7,490,350	8,451,582	59,591,523
Tomatoes (pack)	1,556,242	2,278,860	3,557,150	2,962,654	25,297,091
Tomatoes (pack)	6,807,803	9,388,591	3,777,654	2,633,675	71,789,584
Mushroom	8,636,461	8,846,026	6,575,798	6,386,714	76,661,768
Mushroom	2,501,708	1,828,374	1,041,601	942,282	16,059,564
Potatoes	15,959,196	14,661,830	18,223,640	14,207,961	116,071,722
Asparagus	N/A	5,268,457	6,320,249	8,863,095	24,606,022
Vegetables (in liquid)	9,081,037	4,278,030	N/A	N/A	53,179,589
Vegetables (in liquid)	N/A	4,958,579	9,600,718	11,688,251	33,628,917
Vegetables (mixtures)	N/A	1,811,253	4,338,019	6,202,840	16,701,327
Total:	133,104,763	119,542,088	116,723,375	131,833,849	1,131,059,243

4.1.1 Higher product technology:

i) High yielding cultivars:

Japanese processed vegetable importers are, in general, very keen about cultivars and processing technologies of the processed vegetables they import. This is due to the high degree of sophistication in the marketing and/or production of final products for consumers in Japan. It would, therefore, be easy for Australian producers to focus on Japanese cultivars rather than Australian super cultivars. These Australian ones are not considered as "super" at all in the Japanese market. Salted eggplants for instance, made in Australia with Australian cultivars, are considered unsuitable due to a hard skin. In selecting cultivars for planting in Australia, the Japanese importers and/or Japanese seed companies are probably the best advisers. Most Japanese vegetables are hybrids, multiple disease resistant and of high yielding cultivars.

ii) Modern processing technology:

Australia has the advantage of processing technology over countries such as Taiwan, Thailand, China and Vietnam - the major suppliers for the Japanese market. The application of modified atmosphere (AM) packaging techniques to extend the shelflife of processed vegetables is enabling sea freight to distant markets. Australia is also believed to lead the world in the development of vegetable drying equipment which combines a heat pump dehumidification system with a microwave heating system (Pan, 1995). This equipment is capable of producing dried products with a high degree of colour and flavour retention and in a fraction of the usual drying time of conventional hot air drying systems. Adoption of this technology in the processing of dried Asian vegetables would enable exporters to compete well in the Asian markets (Pan, 1995).

iii) Power of Asian-born Australians:

A population of more than 1.2 million (1997) Asian-born Australians is also an advantage for Australia in the development of a processing Asian vegetables industry. At present, NSW Agriculture is facing some difficulties in making contact with companies who manufacture Asian pickles such as Kimchi, takana pickle and/or dua mon in NSW. The reasons for reluctance on the part of these manufacturers is mostly due to their small-scale, backyard manufacturing system and their limited knowledge of Australian food safety policies.

However, to the companies who are re-packers or importers, requirements of domestic products is given top priority. For instance, Jun Pacific Pty Ltd, which is a A$20 million importer/exporter of Asian food in Sydney, has expressed its interest in takuan (radish pickles) and other Japanese foods such as umeboshi (Japanese apricot pickles), ginger pickles, dried daikon and all types of Ichiyazuke (light pickles).

It is understood that the domestic demand for takuan within the Japanese community is approximately 25 t per annum. CIF prices of imported takuan vary depending on country of production. Japanese takuan is priced at A$5-$6/kg, Korean A$3-$4/kg and China or Thailand approximately A$2-$3/kg. It is envisaged that Australian made takuan would be in the range of A$3-$4/kg. Japanese-born Australians are very good in manufacturing takuan. Similarly, so are Korean-born Australians with kimchi, Chinese-born Australians with takana pickles and Vietnamese-born Australians with dua mon.

4.1.2 Lowering production costs:

Australia has tried very hard to increase exports of vegetable products to Japan since the 1980s. In the late 1980s, Australia exported to Japan approximately 6,000 t of fresh and processed vegetables, valued at approximately ¥2 billion (A$27 million). In 1995, Australia's exports of vegetable products increased to 38,711 t, which was valued at approximately ¥7.8 billion (A$100 million). However, from 1996 there were signs to indicate that Australia had sent less vegetable products to Japan (Table 73). Australian vegetable product exports decreased for the third year inb a row in 1997 in both volume and value, even though the domestic supply by Japan had decreased (Table 74).

It is believed one of the reasons for Australia's loss of Japanese market share is prices, as our CIF prices in Japan are always very expensive (Table 75). For example, in 1995, Australia sent 12,614 t of onions to Japan at a price of ¥45/kg. This was cheaper than the then average import price of ¥52/kg. In 1996, Australia sent 10,146 t to Japan at ¥56/kg, which was higher than the then average price of ¥44/kg.

Table 73. Exportation of Australian vegetables and other products to Japan during 10-year period from 1988-1998 (Source: Vina Booklet 14, 1998).

Year	Fresh vegetables		Processed vegetables		Total	
	Volume (t)	Value (¥ thousand)	Volume	Value (¥ thousand)	Volume	Value (¥ thousand)
1988	6,664	1,754,862	734	95,820	7,398	1,850,682
1989	4,355	1,853,638	877	144,764	5,232	1,998,402
1990	4,502	2,094,369	282	79,192	4,784	2,173,561
1991	7,862	2,729,286	617	109,590	8,479	2,838,876
1992	8,273	2,669,245	1,077	150,999	9,350	2,820,244
1993	10,845	3,199,075	3,639	721,147	14,484	3,920,222
1994	18,139	3,428,022	9,497	2,664,628	27,636	6,092,650
1995	25,290	4,005,228	13,421	3,870,446	38,711	7,875,674
1996	21,731	4,562,781	9,838	2,411,697	31,569	6,974,478
1997	14,190	3,967,497	7,201	1,785,673	21,391	5,753,170

Table 74. Consumption of domestic Japanese vegetables and fruits.

Year	Vegetables			Fruits		
	Domestic production	Import	Domestic supply	Domestic production	Import	Domestic supply
1990	15,740	1,551	91.0%	4,895	2,978	63.1%
1991	15,269	1,724	89.9%	4,366	3,033	59.1%
1992	15,612	1,731	90.0%	4,858	3,449	59.3%
1993	14,773	1,921	88.5%	4,411	3,776	53.2%
1994	14,546	2,331	86.2%	4,267	4,792	46.5%
1995	14,608	2,628	84.8%	4,242	4,547	49.0%
1996	14,615	2,464	85.6%	3,892	4,386	46.9%

Then in 1997, due to Australia's price of ¥50/kg being higher than the then average price of ¥39/kg, only 3,799 t was sent to Japan. But in the same year the USA exported to Japan 120,053 t of onions at a price of ¥36/kg which was ¥3/kg cheaper than the then average price. This was an increase of 23,230 t in comparison with the previous year for USA exporters (Table 75).

Australian producers have for a long time been disenchanted with the suggestion that they receive special advantages compared with competitors due to off-season fresh vegetable production. It may have been true in previous days when Japan enjoyed the heyday of its economic development era. But with the economic crisis in Asia, which Japan was one of the first countries to suffer early in the 1990s, Japanese customers have different viewpoints and now accept the philosophy of "lesser quality but lower prices". During the late 1990,s vegetable products originating from China, Thailand, Vietnam, Indonesia and The Philippines have been overwhelmingly accepted into the Japanese market (Table 76).

With regard to processed vegetables, Australian CIF prices were not high but close to the average prices, except for prepared ginger (Table 78). However, due to Australia's major competitors being China, Vietnam, Thailand and Indonesia where farm labour is still very cheap, lower production costs for Australian horticultural products, is becoming a challenge for the industry. USA producers lower their on-farm costs by adopting broadacre farming systems, with extensive mechanisation of cultivation, irrigation, pest and disease control, application of fertilisers, harvesting and postharvest handling (Pan, 1995). Australian farmers and Asian-born Australian farmers in particular, should adopt some of the high-tech methods used by producers in the USA and Japan in order to be competitive.

China and Vietnam dramatically increased their exports of processed vegetables to Japan through their knowledge of products and low prices. Development of processed Asian vegetables in Australia for domestic and export markets should be in the hands of Australians who already know the products and are professional producers. Asian-born Australian producers are particularly advanced in this type of business. There is no way that Australia can produce low-priced, semi-processed vegetables like China and Vietnam. But Australia can produce its own trademarked products, such as Australian Gobu-Gobu pickles, Kimchi and/or beni-shoga (red diced ginger). It is therefore believed that the federal and state governments should develop a strategy to help these Australian producers to make their trademark and promote them into international markets directly.

Table 75. Importation of vegetables and other products into Japan by country.

(Source Vegetables & Fruit Databook, 1998).

Commodity	1995			1996			1997			Reason for market loss
	Volume (t)	CIF (¥/kg)	Avge	Volume (t)	CIF (¥/kg)	Avge	Volume (t)	CIF (¥/kg)	Avge	
Onion	12,614	45	52	10,146	56	44	3,799	50	39	USA= ¥36/kg)
Carrot [1)]	5,099	63	57	2,635	92	68	1,717	89	79	Decrease in juice Philippines
Asparagus	4,536	576	506	4,435	632	556	4,522	587	572	=¥449 year round.
Kabocha	1,355	75	82	1,446	109	80	1,305	114	90	
Broccoli	1,004	192	170	1,300	227	190	888	222	199	Good production in Japan.
Sweetcorn	248	230	196	985	259	254	1,349	272	264	
Leek etc.	220	450	158	321	550	166	338	553	166	
Cabbage stc.	108	75	54	284	58	58	32	153	56	

1) Carrot imports dropped from 55,573 t in 1995 to 30,200 t in 1996 and 13,305 t in 1997, mainly caused by a decrease in demand for carrot juice.

Table 76. Market shares for frozen and salted vegetables in 1997 into Japan by countries.

i) Frozen vegetables:

1. Potatoes (241,120 t):

USA	86.88%
Canada	9.99%
China	1.66%
The Netherlands	0.5%
Australia	0.49%

2. Edamame (60,314 t):

China	45.42%
Taiwan	42.42%
Thailand	11.52%
Vietnam	0.34%
Indonesia	0.19%

3. Taros (54,435 t):

China	99.72%
The Philippines	0.27%

ii) Salted vegetables:

4. Gherkins and cucumber (60,476 t):

China	87.84%
Vietnam	9.66%
Sri Lanka	0.92%
Thailand	0.72%
Myamar	0.41%

5. Ginger (30,219 t):

Thailand	65.74%
China	26.55%
Indonesia	4.57%
Vietnam	1.89%
Taiwan	1.04%

6. Lotus (15,332 t):

China	99.67%
Vietnam	0.33%

7. Scallion (14,380 t):

China	99.72%
Vietnam	0.19%

Table 77: CIF prices of Australia's major horticultural commodities in Japanese import markets in 1997. Unit = ¥/kg.

Commodity	From Australia	Average import prices
1. Fresh vegetables:	**280**	**178**
Potato	122	122
Onion	50	39
Broccoli	222	199
Garlic	609	120
Leek	553	166
Lettuce	153	140
Endive	839	636
Carrot	89	79
Asparagus	587	572
Sweetcorn	272	264
Kabocha	114	90
Ginger	192	157
2. Frozen vegetables:	**148**	**154**
Potato	124	124
Peas	110	140
Sweetcorn	148	149
3. Tomato products:	**249**	**108**
Tomato ketchup	217	102
Tomato juice	95	139

Table 78. Competitiveness in CIF prices in 1997 of processed vegetables between Australia and other major supply countries into Japanese markets.

Commodity	Total import		USA		China		Thailand		Australia	
	Volume (t)	CIF	Volume (t)	CIF	Volume (t)	CIF	Volume (t)	CIF	Volume (t)	CIF
Dried onion[1)]	4,773	290	3,285	334	726	164	NIL	-	5	290
Sweetcorn -Canned	61,058	145	54,639	140	229	114	1,487	101	1,305	118
Prepared ginger	27,302	192	NIL	-	7,154	227	14,047	124	1	452

Note: 1) CIF price = ¥/kg.
2) Figure in 993. In 1997 Australia sent NIL to Japan.

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6. Appendices

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