TRADITIONAL PROCESSED FOODS AND THEIR PROCESSING TECHNOLOGIES IN THE PHILIPPINES

DAISY E. TANAFRANCA

Food Technology Research Program National Institute of Science and Technology Manila, Philippines

ABSTRACT

This paper presents a review on Philippine traditional processed foods and their processing technologies with particular emphasis on agricultural products. As in other ASEAN countries development and improvement of food processing technologies applying the basic techniques of fermentation, dehydration and canning provide a means of meeting the demands for increased food supply in the country. Traditional fermented food products and their processing requirements are discussed in this review. These include fermented fruits and vegetables, rice and soy products. Improvement studies are being carried out on the production of *burong mangga* (pickled green mangoes) and some alcoholic beverages.

In the area of dehydration, the bulk of researches are on fruits, vegetables and spices because of the demands for these commodities in the local and export markets. The most commercially important fruits for dehydration in terms of marketability are mangoes, papaya and pineapple. Likewise there is a big demand for dehydrated spices such as garlic, ginger and onions. Local food manufacturers recognize the potential of indigenous spices as effective substitutes for imported condiments.

Legumes and oilseeds received considerable attention for the past several years not only because of their abundance but because of the variety of products that can be derived from them. Protein concentrates from legumes are widely used as fortifiers for weaning foods and snack items.

Coconut products include canned *gata,* simulated milk, non-carbonated and carbonated coconut water, vinegar, coconut milk powder and coconut snack items. Their processing technologies are described in this paper.

INTRODUCTION

The Philippines for the past decades has improved and intensified its food production program. The supply of agricultural products for example is more than what the country demands. It is for this reason that developments in food processing and preservation have been accelerated to prevent heavy losses. Increased food production will be of little use if food processing technology fails in its role of converting surplusses into storable and usable foods for the future. Food harvests are by nature highly perishable, hence food conversion technology could be an important tool in transforming surplusses into quality stable food products that could serve as buffer stocks against months and years of low production.

More and more researches are being conducted on different areas of food preservation and technology resulting to a variety of food products high in quality and requiring low production costs.

Traditional fermentation techniques achieved practical results which with the passing of time grew to become one of the most important sectors of the country's local food industry. Food fermentation in the Philippines has been improved and standardized as a result of the application of the basic principles of microbiology and biochemistry to industrial fermentation processes.

Recently, preservation of foods by drying received considerable attention from local food processors. Fruits, vegetables and spices are among those being tapped because of their export potential and local market demands. Intensive studies on the improvement of designs of various driers for specific dried products are being carried out. Problems that usually arise in developing export quality dried products are due to poor drying techniques and in efficient driers. For example, in the dehydration of spices, further studies on pre-treatment and appropriate drying techniques are being recommended to improve the retention of the original note. The latter is the deciding factor whether the dried spice is of high quality and within the standard of the importing countries.

The simple canning technique discovered by Appert turns into a highly mechanized technology through the years. Methods of preparation, like peeling, filling and sealing of containers are now done on high speed machines. The method of establishing minimum processing time for specific canned products takes into account the thermal resistance of the spoilage organism and the heating characteristic. Thermally processed products like fruit preserves, jellies, jams are highly acceptable and favored by Filipinos.

This paper aims to present a general view of the wide variety of traditional processed foods in the Philippines. Discussed by commodities, a brief description of the processing method is given for each product as well as significant highlights of research and development activities relative to the same.

FRUITS AND VEGETABLES

Among the agricultural commodities in the Philippines fruits and vegetables together occupy the lead position exceeded only by cereals and coconuts in terms of value (Mendoza, 1982). Increased production of fruits and vegetables lead to the improvement and development of more processed products to minimize heavy losses during peak seasons. Fermentation, canning and dehydration are some methods of preservation applied to these commodities.

Fermented Fruits and Vegetables

1) *Burong Mangga* and Sweet-Sour *Santol.* - The most common fermented fruit are mangoes (*Mangifera indica* L.) and *santol* (*Sandoricum koetjape* Brim. F). Mangoes for fermentation may be either immature or mature. Fermented immature mango is locally called *burong mangga* while the mature ones come is sweet-sour form. *Santol* is blanched first after peeling and allowed to ferment in brine of about 10° Salometer for about 3 days. The fruits are then washed to remove salty taste and packed in thin or medium syrup. A similar procedure but with slight modification is employed for sweet-sour mango.

Burong Mangga is either peeled or unpeeled, allowed to ferment in 10% brine for 2 weeks, rinsed and packed in brine.

No scientific investigations have been reported for sweet-sour mango and *santol.* Lately, the demand for *burong mangga* for export has been very encouraging but a major processing problem is the rapid softening of the fruits after a few days of brining. The study of Sevilla (1979) on the effects of maturity, firming agent and chemical preservatives on the softening of fermented mangoes provided baseline data for subsequent studies on the softening problem of fermented mangoes. Microorganisms were ruled out since treatment with benzoic and sorbic acids which inhibited yeasts and molds did not prevent softening during fermentation. The fact that calcium salts were found effective firming agents suggests that pectins particularly the polygalacturonic acids are involved in the softening.

It was observed by Sulit and Raiz (1969) that salt is necessary to reduce the growth of spoilage organisms, and calcium chloride is needed as the firming agent. The maximum shelf-life of the product is one year preserved at 25° Salometer, however the crispiness of the product was retained for only two months. De Lara (1969) attributed pectin breakdown as the immediate cause of softening and the extent depends on the microbial count.

More studies are being carried out to solve the softening of *burong mangga* and retain the crispiness of the product during storage.

2) Fermented Vegetables - To ferment vegetables in the Philippines, the vegetables are either soaked in brine or by simply adding salt to the vegetables.

Examples of vegetables being fermented in the Philippines are cucumber, cauliflower, onion, pepper, turmeric, native onions, green tomatoes, string beans, raddish and ampalaya (bitter gourd). Generally 10% brine is used for fermentation. Mendoza (1961) suggested the preparation of a starter made up of sliced raddish, chopped leaves of green mustard, and cabbage of the violet variety mixed and soaked in brine. It is believed that this mixture provides the *Lactobacilli* naturally present in the vegetables assuring lactic acid production.

Grated *papaya* and mustard leaves are not soaked in brine. Chopped ginger is thoroughly mixed with the grated papaya and allowed to ferment for a

week. This is washed and packed in pickling solution. The finished product is locally called *achara.*

Fermented mustard leaves is called *burong mustasa.* Salt is sprinkled over the leaves to wilt, then boiled rice water washings with salt is added. Acidity is produced after two days of fermentation.

These fermented vegetables are served with broiled or fried fish or meat and are considered very good appetizers.

Orillo (1966) compared several brine concentrations for the fermentation of cucumber and found that acidity was most rapid at 51% salt or 20° Salometer brine. Over mature cucumber did not make good pickles. Cruz and Luis (1968) compared chemical and microbiological changes in the fermentation of papaya and sauerkraut and found them very similar. In the latter studies of King and Gatchalian (1975) the microbiological sequence in the fermentation process was identified. The sequence was *L. mesenteroides,* followed by *L. brevis* and *L. plantarum* with *S. faecales* and *P. cerevisiae* growing in limited number. The desired end point of fermentation was reached at the eighth day when the product attained a total acidity of 1.32% as lactic acid and a pH of 3.50.

Dried Fruits and Vegetables

Dried fruits have gained economic importance in the country today. Increase in the total production of fruits for the past years encouraged fruit processors to produce more products for the export market.

Among the local dried fruits popularly and widely accepted in the local and export markets are dried mangoes, *langka* (jack-fruit), papaya, *santol* and pineapple.

All the above dried fruits follow the same principle; pre-treatments prior to drying, syruping process and final drying of fruit slices.

Processing of dried mangoes is given as an example. Rareripe mangoes, usually 75% yellow and 25% green are ideal for drying. Fruits are washed and sliced into halves. The cheeks are scooped out and each cheek is sliced along its lateral axis into four pieces depending on the size of mangoes. Fruit slices are soaked in 50° Bx syrup overnight and syrup concentration is adjusted the following day by 10° Bx. The slices are again soaked overnight. At the end of the syruping process, the slices are rinsed with tap water and dried. Drying can be done either by solar or cabinet dryers.

Problems usually associated with dried fruits during storage are discoloration, change in texture and development of off-flavor. More studies are being conducted to minimize these problems hence extending the shelf-life of the product.

Other studies being conducted at NIST are the effect of different varieties on the quality and acceptability of dried fruits, like mangoes, jackfruit and

papaya. Likewise, different driers are being tested in drying of fruits to determine the efficiency, economics and limitations of each drier.

The Philippines can be considered self-sufficient in vegetables but is faced with the problems of seasonality. Over production of vegetables, for example, tomatoes, carrots, onions, eggplants, lettuce, cabbage during its peak season usually results into wastage if not properly stored. Because of its perishability, more processing techniques are being developed to minimize these wastage. Carrots dried into cubes or slices up to 4% moisture are used in baby foods and in some meal preparations.

Other Fruit and Vegetable Products

Other fruits and vegetables are canned or bottled either using syrup or brine as the packing media. Examples are mango, santol, papaya, jackfruit and pineapple in syrup. Vegetables like whole tomatoes, onions, shredded unripe papaya and shredded bamboo shoots are usually canned in brine. These products are highly acceptable in many Asian countries.

Traditionally, fruit rejects are usually allowed to rot or spoil, but due to the high cost of living, more and more studies are being carried out to utilize these wastes or rejects. One good example is banana (cavendish variety) in which case rejects constitute about a 10% of the total produced for export. A proportion of these rejects are made into flour and are intended for use as high-protein mixtures for nutrition feeding programs. Researches are likewise being undertaken in coverting the banana rejects into processed foods such as banana chips, sauce, hydrolyzed syrups, purees (as base for baby foods, nectars, drinks, etc.). Banana sauce is very popular in the country as a condiment for fried chicken, meat and fish. It is artificially colored with a read colorant to simulate tomato catsup, and is quite spicy.

Mango rejects produced for export are processed into jams, jellies, spread and purees.

COCONUT

Coconut together with sugar and canned pineapple occupy the most important positions in the country's total food exports. For many years, the potential of coconut has been extensively investigated in various laboratories, working almost independently of each other to improve the efficiency of the utilization of the product as human food. It is now well recognized that coconut is a cheap source of protein. To date, a number of products have been developed from coconut meat, milk and meal (Bautista *et al.* 1984).

1) Canned *Gata* (cream). The process (Phil. Patent No. 5632) is as follows: Sound mature coconuts are selected and de-shelled. The meat with

paring is collected and passed through a grinder. The ground meat is mixed with water and passed through a screw press or expeller to extract the coconut milk. The cream (*gata*) is separated from the watery and solid portions of the extract using a centrifuge. The cream is again mixed with water and pasteurized for about 15 to 30 minutes. The pasteurized cream is mixed with stabilizer, passed through a homogenizer, heated to boiling and filled in cans or bottles, sealed immediately and processed at 6 to 10 psig for 45 to 70 minutes.

2) Non-Carbonated and Carbonated Coconut Water. Carbonated/Non-carbonated coconut water beverage is a useful by-product prepared from the water of mature/immature (*buko*) coconut. It is higher in nutrients compared to softdrinks or artificial fruit-based drink. Both products possess the characteristic coconut flavor, and are stable at room temperature storage.

3) Modified Coconut Water: A suitable fluid for oral rehydration. Modification is done by reducing the potassium concentration of coconut water to 50% and addition of sodium chloride, sodium carbonate and glucose.

4) Simulated Dairy Milk. The development of a simulated dairy milk from an indigenously available protein source particularly coconut may provide a cheaper alternative to imported dairy milk and eventually improve the nation's economy. Coconut milk was centrifuged to separate coconut skim milk from the cream (CSM). CSM was heated immediately to coagulate the proteins and then allowed to settle. A portion of the whey was removed by simply decanting. pH was adjusted to about 7, then blended. CSM was modified to simulate the composition of dairy milk by adding the required amount of pre-mixed ingredients (sucrose, stabilizer, coconut fat, vitamin-mineral blends). SDM was then heated, homogenized, pasteurized or sterilized and cooled.

5) Coconut chips. Coconut chips are consumed either as salted or sweetened. Thinly sliced coconut meat are dried by conventional methods, then coated with sugar or salt and finally cooked in the oven until crispy. Coconut chips is a popular snack item in the country and has been exported to several countries for the past years.

6) Coconut pretzel. A fortified snack item, making use of coconut *sapal* and dessicated coconut fines as the fortifying agents is a nutritious and palatable food item for school children. The formulation for the preparation of a regular biscuit was adopted in the development of coconut pretzel. The proportion of wheat flour to coconut *sapal* is one is to one. Addition of flavoring agents like chocolate, cheese and cinnamon were highly acceptable. The composition of coco-sapal pretzel is as follows: protein - 7.00%; moisture - 1.77%; ash - 1.9%; carbohydrates - 72.09%; and calories - 487. Like coconut chips, coconut pretzel also gained acceptance both in the local and export market.

7) Coconut milk powder. This is also known as instant coconut *gata*, one of the most popular export items in the country today. The development of instant *gata* opened new trends in the food processing industries. The procedure for the preparation of canned coconut *gata* was modified and dehydration was done using a spray drier or a drum drier.

8) Coconut vinegar. Coconut water, considered as a waste product of copra manufacturers and dessicated coconut factories, is a good material for vinegar manufacture. The improved technology of vinegar production makes use of two microorganisms, namely, *Acetobacter rancens* var. *turbidan,* and *Saccharomyces cereviseae,* products of Industrial Fermentation Laboratory Culture Collection, NIST, which hasten and complete the fermentation in 7 days. Either surface fermentation process or submerged process may be followed without any different in fermentation time.

SOYBEANS AND LEGUMES

The popularity of soybean and legume products in the Philippines may be attributed to its high nutrient content. Extracted protein from soybeans and legumes are being utilized in applied nutrition programs. Food products range from low cost high protein food formulations, baby foods and snack items.

Products from Soybeans and Legumes

1) Instant baby food. FNRI has developed a soy-based extruded infant supplement prepared from a blend of rice-flour, soy flour and non-fat dry milk, and instant mongo soup of about 20% protein. The Philippine Women's University, on the other hand, has prepared by extrusion process low cost high protein blends from legumes, cereals and nuts which contain 15—17% protein and 382—398 calories per 100 grams. The recipes developed from the blends were found to be highly acceptable and well tolerated by infants and pre-schoolers. Flours from legumes like mung beans, *mongo,* cowpea, mecan pea and *tapilan* have been successfully used in the formulation of high protein foods (e.g. instant soups, weaning food and snack items).

2) Snack items. Formulated at the University of the Philippines, College of Home Economics were low cost nutritious lunch and snack items from blends of *mongo,* peanuts, mecan pea flour and mongo flour. At the UP at Los Baños, the Department of Food Science and Human Ecology studied the feasibility of utilizing eight varieties of *paayap* (cow pea) as main ingredient of bean cookies, pastillas and espasol.

3) Soy milk. Soy milk which is now being produced at UPLB adopts the hot water grind technique developed at Cornell University. Spray dried soy milk powder is now commercially available.

4) Textured vegetable protein. Studies on TVP using mungbean were successfully made producing a caramel-colored product with good acceptability.

5) Fermented Soy Products. There are four fermented soybean products commonly used in cooking Philippine dishes, namely: *toyo* (soy sauce), *tao-si, tahuri* and *miso.*

Tao-si is produced by fermenting whole soy beans with strains of *A. oryzae.* Soybeans are soaked and steamed until soft, drained, cooled, mixed with roasted wheat flour and inoculated with *A. oryzae.* After incubation the beans are packed with the desired amount of salt, spices, wine and water and aged for several weeks or months.

Tahuri is a soft cheese-type product made from cubes of soy bean curd that has been fermented and aged in brine. *Angkak,* a red rice condiment is often used to impart a red color and distinctive flavor to certain fish recipes. The fungi needed in the fermentation process is *Actinomucor elegans.*

Miso is essentially fermented soy beans and salt, with or without cereal with a paste-like consistency and smooth texture. Its color ranges from a light, to a bright yellow. The product is typically salty and has a distinctive pleasant aroma. *A. oryzae* and *A. sojae* are molds in the fermentation process.

Unlike the first 3 fermented soybean products, much attention has been given to the production of soy sauce. Recently, Pardo *et al.* (1979) reported on the changes in the free amino acid content of an experimental soy sauce. The work presently being done at the NIST is on the substitution of soy beans with the local beans like mongo, mecan pea, and cow pea, and wheat with rice, cassava or banana flour for the production of soy sauce.

6) Instant Soybean Curd. One product derived from soybeans is instant soybean curd (tokwa). In the traditional production of soybean curd in fresh form, this product has a short shelf life. An improved production technology is introduced in the production of instant-dry soybean curd, using magnesium sulfate as coagulant which increases the yield of fresh soybean curd. The final product has a good texture upon rehydration. The storage life of instant soybean curd is six months, compared to the fresh "tokwa" which would easily get spoiled after three days at room temperature.

STAPLE FOOD

The main staple food of the population is rice which is grown extensively in several parts of the Islands (that is about 2.7 million hectares or 27% of total cropped area). The second most important staple food in the country is white corn planted on 1.6 million hectares (16% of total cropped area).

Rice and corn are processed into a number of products, including a variety of noodle-type foodstuffs, puffed snack foods, rice cakes and native traditional fermented delicacies.

The production of root crops in the Philippines is estimated to be about 3,406,619 metric tons/year. In rural areas, root crops are usually eaten as normal parts of the meal where other type of food are not readily available. Root crops like potato, sweet potato, cassava, *gabi*, arrow root, *ube,* water chestnuts and singkamas are being utilized in the country as fresh food for home consumption, processed food products, animal feeds and as starch for the food industries.

Fermented Rice Products

1) *Puto* and *Bibingka* - Two popular rice cake products in the Philippines are *puto* and *bibingka.* They are usually made from a year-old milled rice, ground with enough water and allowed to ferment before steaming as in *puto* and baked over and below live charcoal in a makeshift oven (dry cooking) in the case of *bibingka.*

Togamanta and Orillo (1971) developed a standard method of preparation of rice cake (*puto*). In the process of fermentation, they noted that the important changes in acidity and leavening of the fermented batter were brought about mainly by *L. mesenteroides* and strains of *S. cereviseae. S. faecales* was significant only in the production of acid. According to Juliano (1974) as cited by Arroyo (1974), the cohesiveness of the raw rice starch could be the main factor affecting gas-retention during fermentation. Gas retention during steaming is probably a function of the viscosity of gelatinized starch, i.e. amylose.

Sanchez (1975) tested 12 rice varieties for suitability in the preparation of rice cake using a standard method. She reported a very high degree of correlation between amylose content and acceptability (texture and flavor) and between high amylose content and satisfactory volume expansion of fermented rice cake.

2) *Angkak* - *Angkak* is used in the Philippines for coloring *bagoong* and *atsibe* (salted roe) and for imparting flavor and attractive color to *burong isda.* It is known in the literature as red rice, *angkak,* chinese red rice, *ankak, anka, ang quac, ben* koji (1960). *Angkak* is prepared by soaking rice in water for 24 hours, followed by steaming, cooking, inoculating with *monascus purpureus* and allowing to ferment for 20 days. Palo *et al.* (1960) stated that all the commercially available rice in the Philippines except the glutinous species were found suitable for *angkak* production. The red color production is best at pH 3.5 to 7.5 with an optimum temperature of 27°C.

3) *Binuburan* or *binubudan* - This is prepared cooked rice or cassava, inoculated with *bubud* and allowed to ferment for about 24 to 48 hours

depending on the desire of the consumer. *Binuburan* is slightly sweet, acidic and alcoholic. It is served with or without the addition of thin syrup during breakfast or is taken as a snack in the afternoon.

Bubud which is the starter is prepared from finely pounded non-glutinous rice that has been soaked overnight. The resulting mash is mixed with pureed ginger, shaped into balls and flattened into 6 cm. disks, aranged in a rectangular basket lined with rice straw covered with banana leaves, and stored in a dark room for 2 days. They are then transferred to shallow bamboo trays and dried under the sun until hard. *Bubud* can be kept for 6 months. These are sold in the markets as starter for the preparation of *binuburan* and *tapoi.*

4) *Tapoi* - *Tapoi* is the brew that is collected when *binuburan* is allowed to ferment from 3 to 10 days. During fermentation, sugar and water are added to hasten the production of alcohol. Its high alcohol content and aroma contribute to its popularity. *Tapoi* is popular in Northern Luzon and is a traditional drink of a large segment of the population.

Coronel *et al.* (1980) selected *Aspergillus oryzae* (Ahlburg) Cohn for the production of *tapoi.* Optimum conditions for the growth of the selected mold isolate are pH of 3.0, temperature of 30°C, carbon source of 8.5% sucrose, and nitrogen source of 0.7% sodium nitrate. Optimum factors for the production of rice wine are temperature, 25°C; steeping time of rice, 1—12 hours; age of mold starter, 3—6 days; duration of incubation period, 2 weeks.

Utilization of root crops into different products

The utilization of root crops is based primarily on their use as food and as a source of starch for the industry. There appears to be a relatively limited conversion of root crops into processed foods, very likely because of their limited home scale utilization and their unavailability in sufficient quantities and quality for processing.

Listed down are several products produced from root crops.

1) Potato chips - It is a popular snack item produced by the rapid dehydration of thinly sliced potatoes when fried in deep fat at temperatures ranging from 325—375°F. The product is crisp and dry and absorbs approximately 35—50% of fat in the frying process.

2) *Ube* powder - produced by steaming the washed tuber, peeling, grinding and drying. It is a convenience-type food which is used mainly in urban homes for making a slightly gelatinous dessert simply called *ube.* The fresh tuber is also used locally as a coloring and flavoring material for ice cream, rice cake (*puto*) and confectionary.

3) Root crop flours - The processing of root crops into flour provide a simple way for converting them into a product with a long storage life. At present only *ube* and cassava are processed into food grade flours in this country. Cassava flour can probably substitute in specific cases for some of the food uses of the starch. It can also be used as a substitute for wheat starch

in breakmaking because of their similar functional properties. Cassava flour in combination with soy protein and a suitable surfactant such as glycerylmonostearate has been shown to produce breads of good loaf volume.

4) Root crops as a source of industrial starch.

The production of industrial starch is probably the most promising outlet for root crops utilization in the Philippines. At present, only cassava and corn starch are locally produced to supply part of the domestic consumption for this commodity.

In salad dressings, it acts as an excellent, inert, natural filler. In canned meat preparations, it is used both as a filler and a binder and in sauces, gravies, canned soups, instant puddings and pie fillings, it serves as a thickening and stabilizing agent. The bakery, canning and confectionery industries are the major users of food grade starch.

Starch from root crops are also being used in the manufacture of glucose. It is produced commercially by the acid and enzymatic hydrolysis of starch. High grade glucose syrup used primarily in the food industry is produced locally from corn. When supply of corn is low, however the plant substitutes cassava for corn as the starting raw material in production.

The hydrolysis of cassava starch is also used locally as a source of glucose for the production of monosodium glutamate. This industry is probably one of the biggest local outlets for this root crop, having replaced molasses and other starches as the starting material for MSG production.

SPICES

Spices are used in several Filipino dishes to impart a desirable flavor or aroma to food and to stimulate appetite. Although spices have no calorific and have little or no nutritional values, they play an important role in the diet when used as seasoning.

1) Ginger - Ginger is the most important of the spices obtained from roots. The aromatic odor of ginger is due to its essential oil, while the pungent taste is due to the presence of the non-volatile oleoresin, gingerin. Several studies on the development of ginger into powder proved to have potential in the local market especially during its off season. The availability of ginger powder will save users the trouble of tedious preparation of the rhizome during cooking. Ginger as a spice is utilized in many local dishes and in flavoring beverages and wine for its characteristic pungent flavor. Usually Hawaiian ginger is used in the dehydration process. Ginger is washed, peeled (others unpeeled), sliced to about 1 mm thickness and dried, either using a solar, vacuum or cabinet drier. The dried ginger is powdered to mesh no. 20. Subjective tests, indicated that the powder of the unpeeled ginger gave a more desirable flavor and aroma.

2) Onions - Onions are dried, either in ring form or as powdered. The problems encountered in drying of onions are caking and lost of distinctive onion flavor and aroma. More studies are being encouraged to solve these problems. Several research studies showed that variety plays an important role in flavor retention.

3) Garlic - Because of market saturation during its peak, heavy losses occur on the harvested garlic due to spoilage. This encouraged producers and manufacturers to process the surplus crops. Garlic can be dried into flakes, tablets and powder. Drying is done either under vacuum or cabinet drier. The finished product is yellowish-white in color with characteristic garlic odor and flavor. However, caking occurs on the finished product because of its hygroscopic nature.

ALCOHOLIC BEVERAGES

Production of alcoholic beverages in the Philippines is concentrated in small factories and home industries which are largely family operated or owned (Tanimura *et al.,* 1977). The method of preparation and popularity of each alcoholic drink varies from one locality to another.

1) Rice wine (Tapuy). Rice wine commonly called "tapuy" is a popular alcoholic drink of the Ifugao race. It is only in the northern part of Luzon where rice wine is commonly prepared and consumed.

The schematic diagram for the preparation of rice wine is shown in Fig. 1.

2) *Basi* (sugarcane wine). *Basi* is prepared by the alcoholic fermentation of sugar cane juice. The industry is concentrated in the Ilocos region. It was observed that the methods of preparation of basi differ by localities. One method of preparation consists of concentrating the extracted sugar cane juice by boiling followed by the addition of Duhat bark for color and flavor and *bubod* to ferment. After one year of aging, the *basi* is harvested and sold in the market. In other regions, basically the same steps are followed except that no starter or *bubod* is added to the boiled sugar cane juice. Instead one year old Samac bark, fruits and leaves are added.

3) *Tuba. Tuba* is usually produced by cutting the top of the inflorescence of the coconut, nipa and buri palms and the sap collected in one-node bamboo tubes. There are two types of *tuba,* namely fresh *tuba* and *tuba* with added *tangal* (mangrove) bark. After 12 to 15 hours the sap are collected, bottled and sold in the market. Sanchez and Kozaki (1974), found that there are differences in the chemical and microbiological analyses of the two types of *tuba.* The fresh *tuba* became acidic after 24 hours and had an alcohol content of about 10% by volume. On the other hand, *tuba* with *tangal* bark did not become acidic even after 72 hours of fermentation. Alcohol content is about 13% by volume.

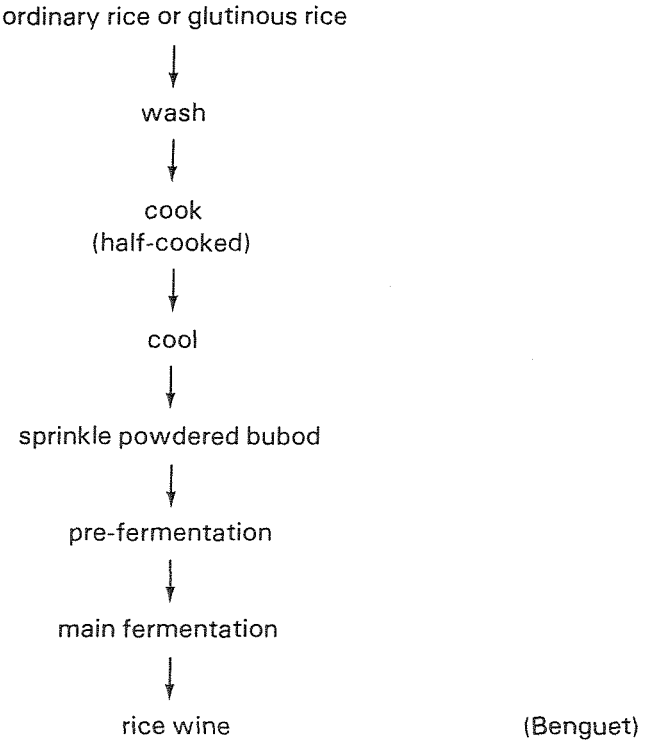

Fig. 1. Schematic Diagram for the Preparation of Rice Wine.

4) *Lambanog. Lambanog* is a distilled spirit made from fermented coconut sap (*tuba*). Usually coconut sap is allowed to undergo alcoholic fermentation for 24 hours and then distilled with the use of copper or stainless steel distilling tanks. Some operators use galvanized drums as distillation tanks.

In retrospect, it may be concluded that the Philippines is a veritable source of traditional food products utilizing indigenous technologies. It now faces the challenge of translating these technologies into profitable ventures to meet the demands of a developing economy. The prospects are bright, the potential is great. A scientific base is directly needed but with the accelerated pace of technological development in the country, particularly in the field of Food Science and Technology, wider avenues are about to be opened.

REFERENCES

ARROYO, P.T. (1974). Rice Cookery. The Science of Philippine Foods. 1st edition. Abaniko Enterprises, Philippines.

BAUTISTA, J.G. III AND F.E. PARIAN (1984). Contributions of R & D to the Growth of Food Processing Industry. NIST, Manila.

CORONEL, L.M., VELASQUEZ, A.O. AND CASTILLO, M.C. (1980). Some factors affecting the production of rice wine using selected species of *Aspergillus oryzae.* For Publication National Institute of Science and Technology, Manila, Philippines.

DE LARA, L. (1969). Factors affecting the texture of mango pickles (*burong mangga*). B.S. Food Technol. Thesis, University of the Philippines, Diliman, Q.C.

GENATO, R.T. AND L. SOLIDUM (1984). Simulated Dairy Milk. Unpublished paper. National Institute of Science and Technology Manila, Philippines.

GONZALEZ, O.N. *ET AL.* (1978). Development and Utilization of protein-rich foods from indigenous sources. Annual Progress Report of the ASEAN Sub-Committee on Protein.

GONZALEZ, O.N. (1979). The Philippine Food Processing Industry, Its role in Community Development. Read during the Second ASEAN Workshop on Food Habits.

GONZALEZ, O.N. AND J.V. ALEJO (1983). Process for Preparing Non-Carbonated and Carbonated Coconut Water. Unpublished work. NIST, Manila, Philippines.

HOLAZO, M.A.F., O.N. GONZALEZ AND E.J. PUNZALAN (1981). Nutrisyon Vol. 6 (1).

KING, R.L. AND GATCHALIAN, M.M. (1975). Determination of chemical changes and sequence of microbiological flora in pickled *papaya* (*Carica papaya* L.). B.S.F.T. Thesis. UPCHE.

MENDOZA, D.B. JR. AND ER. B. PANTASTICO (1982). Food Industry Magazine Vol. 6 (2).

MENDOZA, J.M. (1961). Fermented Vegetables. Phil. Foods, Their Processing and Manufacture. Phil. Education Co., Philippines.

ORILLO, C.A. (1966). Philippine Agriculturist. Vol. 50 (1): 56-61.

PALO, M.A., ADEVA, L.V. AND MACEDA, L.M. (1960). Phil. Journal of Sci. Vol. 89 (1).

PARDO, L.V. ET AL. (1979). Phil. Journal of Food Sci. and Technol. Vol. 3 (1): 31-45.

RAMOS, M.A. (1980). Phil. J. of Food Sci. and Technol. Vol. 4 (2).

SANCHEZ, P.C. (1977). Philippine Agriculturist Journal.

SEVILLA, E.J. (1979). Phil. Journal of Food Sci. and Technol. Vol. 3 (1): 46-60.

SORIANO, M.R. (1975). Soy Sauce manufacture in the Philippines Paper read at the 3rd ASEAN Sub-Committee on Protein. 29 July – 2 August, Manila, Philippines.

SORIANO, M.R., N. NAVARRO AND S. PAUL (—). Solid Substrate Food Fermentation Technology in the Philippines. NIST, Manila, Philippines.

SULIT, J.T. AND RAIZ, C.A. (1969). Araneta J. of Agric. Vol. 16 (2): 139-146.

TAÑAFRANCA, D.E. AND M.R. SORIANO (1980). The Processing of Dried Mangoes. Unpublished Work. NIST, Manila, Philippines.

TAÑAFRANCA, D.E., M.R. SORIANO AND M.P. FAJARDO (1982). Phil. J. of Food Sci. and Technol. Vol. 6 (1 & 2).

TANGANATA, Q. AND ORILLO, C.A. (1971). Studies on the Philippine fermented rice cake (*puto*). M.S. Food Science Thesis. University of the Philippines, Los Baños.

TANIMURA, WAHACHIRO, P.C. SANCHEZ, AND M. KOZAKI (1977). Journal of Agricultural Science of the Tokyo University of Agriculture Vol. 22 (1).

TANIMURA, WAHACHIRO AND P.C. SANCHEZ (1978). Journal of Agricultural Science of the Tokyo University of Agriculture Vol. 22 (3, 4).