DETERMINATION OF A CANNING TECHNIQUE AND ACCEPTABILITY OF A CHICKEN AND RICE DISH USED IN THE PHILIPPINES

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CHAPTER I

INTRODUCTION

Importance of the Problem

In a country like the Philippines, where rice is the staple food, the field for investigation on the processing and utilization of rice seems bright and unlimited.

Rice is one of the oldest food crops and feeds more than half of the population of the world today. It has always been an important crop in Asiatic countries. For the years 1951 to 1955, the average annual world production was 386 billion pounds. Over 92 per cent of this amount was produced in Asia and higher than this percentage was consumed in these same countries. For the years stated, the per capita consumption of milled rice in the Philippines was about 212 pounds. The per capita production was about 303 pounds of rough rice which yields about 65 per cent milled rice.

There are many ways of cooking rice. It blends readily with meat, fish, fruits, vegetables and dairy products because of its bland and pleasing flavor. Combinations of rice and chicken, flavored with seasonings and spices are popular dishes in the Philippines. They are complete meals in themselves with the addition of some fresh fruits or vegetables and milk to balance the food nutrients. At the present time, dishes of these kinds can be obtained only when freshly cooked.

It is believed that rice and chicken dishes in canned form could serve the needs of people who do not have the conveniences of cooking and for those who want the prepared food in the shortest time, and least

effort of preparation. This would be especially true if the canned products could have comparable qualities to that of the freshly cooked dishes.

Purpose of the Study

The purpose of this study is to determine a canning technique for a rice and chicken product, which will have acceptable qualities with respect to flavor, texture, and appearance.

Assumptions

The choice of this problem is based on the following assumptions:

1. Combinations of rice and chicken are well-accepted dishes in the Philippines, hence there should be no problem of introducing this canned product to the people.
2. A canned rice and chicken dish will greatly reduce the time and effort necessary for its preparation.
3. The raw materials for canning this dish are available at all times at reasonable cost in the Philippines.
4. The recipe contains carbohydrates, animal protein, fat, minerals and vitamins, so that with the addition of fresh fruits or vegetables and milk, it will provide a nourishing meal.
5. This canned product, could be made available to Filipinos going to foreign countries, especially to students who do not have the conveniences of cooking.
6. The development of this product will be an addition to the expanding canning industry in the Philippines.
7. The portions of ingredients and the method of pre-cooking the mixture to suit processing conditions, can be established in a

course titled, Investigational Cookery, FNIA 513, taught in the fall of 1963 at Oklahoma State University.

8. A taste panel composed of Asian men and women students can be set up to evaluate the acceptability of the product after processing.

Hypotheses

In this study, the following hypotheses will be considered:

1. The rice-chicken combination dish can be satisfactorily canned when the following desirable conditions are identified:

   temperature of processing

   pressure of processing

   length of processing time

   method of packing

2. The canned rice-chicken combination dish is acceptable to a panel of Asian students with respect to flavor, texture and appearance.

This study requires the knowledge of basic canning procedures and principles, microorganisms associated with food spoilage, and basic bacteriological techniques. Some experiences in taste panel evaluation of food and understanding of statistical methods and procedures are important. A survey of literature concerning the behavioral characteristics of rice during cooking is helpful.

CHAPTER II

REVIEW OF LITERATURE

History of the Canning Industry

Canning is a capital invention which has changed the eating habits of the western world (7). The art of canning was discovered one hundred and fifty years ago, but the theories behind the preservation were not explained until fifty years later. Bacteriology, the special branch of science upon which this type of work depends, was unknown during this time. Nevertheless, the canning process was practiced during the early years with some success but in the darkness of ignorance.

In 1795, France had the problem of insuring adequate and safe food supplies for the army and navy as well as for the civilian population. The French government offered a prize of 12,000 francs to any person who would develop a new successful means for preserving foods. Nicholas Appert, a Parisian confectioner entered the competition and got the prize in 1809 (5).

There were several claims as to who started canning. One previous reference to the preservation of food by the application of heat to the food in sealed containers was made by Spallanzini in 1765 (5). From an article that appeared in Food Technology (17), a claim was made that a famous Russian scientist, Vasili Nazar'evich Karazin, discovered food preservation by canning. A publication by Karazin issued in Moscow in 1829 was entitled, Concerning the most suitable method for preserving and for long distance shipping of nutritious and kitchen-ready products of the animal and plant kingdom. In this article he described the original method

for processing canned meat products. Karazin was quoted to say, "the first presentation of this invention to the government was made by me in 1806. Consequently, it was made much earlier than the similar presentations and descriptions of the method made in foreign countries" (14, p. 410). It was said that his invention was not supported by the Tsarist government thus it was unfortunate that due recognition was not given to him.

The credit for discovering the canning process was awarded to Appert by virtue of his work between 1795 to 1810. Nicholas Appert was born at Chalon-sur-Maine, France in 1750. He experimented with foods all the working years of his life. He conducted and superintended the work in confectionaries, kitchens, distilleries, breweries and storehouses for foods, besides being the provisioner to the ducal house of Chritian IV. It was mentioned that although Appert's training was in the school of experience, he could be classified as a scientist. He had the ability to develop facts through carefully planned experiments and to interpret the results of chance findings. Although he did not know the reasons behind his findings, many of his postulates are still valid in modern cooking practices. Appert died in 1841 at the age of 91 without the high degree of recognition which his discovery deserved (12).

During the 150 years of the growth of the canning process there were some outstanding discoveries that made advances and improvements in the industry. Some dates of importance (5) are as follows:

1810 - Peter Durand, an Englishman, conceived and patented the idea of using "vessels" of glass, pottery, tin or other metals to fit materials. Thus the forerunners of the modern tin can were created.

1819 - Authorities are not in full agreement but it is believed that William Underwood, who had come to America in 1817, started the first American canning operation in Boston in 1819, using Appert's procedure.

1819 to 1820 - the commercial canning operation began in America.

1840 - tin containers came into widespread use.

1853 - Gail Borden perfected the process for manufacture of condensed milk which became widely used for infant feeding.

1861 - calcium chloride was added to the water bath to increase the sterilizing or processing temperatures.

1861 to 1865 - the war between the states brought rapid expansion of the canning industry.

1874 - the closed, steam pressure retort or autoclave was patented and came into use.

1895 to 1900 - the science of bacteriology was first applied to problems of the canning industry.

1900 - the first open-top sanitary style of can was used, both plain and lined with "fruit" enamel.

1901 - the American Can Company was organized.

1906 - the first chemical laboratory in the can manufacturing industry was founded by the American Can Company.

1907 - the National Canners Association was founded.

1918 to 1920 - the use of the sanitary style of can for fruit and vegetables became practically universal.

1921 - commercial production of enameled cans for low-acid food was begun. The American Can Company Research Department was founded.

1923 to 1928 - a method for mathematical calculation of adequate heat processes for canned foods from physical and bacteriological data was perfected.

1930 to 1940 - canned food production reached an all-time record.

1941 - the canning industry increased production to meet the National Defense and Lend-Lease needs.

1942 - the canning industry produced record war-time packs of standard canned commodities.

1950 to the present time - the industry has made steady progress in the area of mechanical efficiency of processing plants. More production is obtained with fewer people. Recent canning developments have been in agitation retorting. This method permits the contents of the cans to be heated at increased rates consequently the quality of the canned foods is improved.

Microorganisms and Food Spoilage

The object in processing canned foods is the attainment of sterility with respect to the most resistant microorganism present which would bring about spoilage. Therefore the problem of determining the time necessary to process canned foods consists of determining the time necessary to produce this sterility within the cans (12).

The heat resistance of bacterial spores varies greatly with the species of bacterium and the conditions during sporulation. Resistance to 100°C (212°F) may vary from less than a minute to over more than 20 hours. In general, spores from bacteria with high optimum and maximum temperatures for growth are more heat-resistant than those from bacteria which grow best at lower temperatures. The following examples of thermal death times (11, p. 96) for some bacterial spores are:

Spores of	Time to kill at 100°C (minutes)
Bacillus anthracis	1.7
Bacillus subtilis	15 - 20
Clostridium botulinum	100 - 330
Clostridium calidotolerans	520
Flat sour bacteria	over 1,030

The heat resistance of microorganisms usually is expressed in terms of their thermal death times, which is defined as the time it takes at a

certain temperature to kill a stated number of organisms (or spores) under specified conditions. This sometimes is referred to as the absolute thermal death time to differentiate it from the majority thermal death time for killing most of the cells or spores present, and the thermal death rate, expressed as the rate of killing (11).

The thermal processes for canned foods can be calculated. In the computation, the following data must be known; (a) the thermal death-time curve for the most heat resistant organism likely to be present in the food, (b) the heat penetration and cooling curves for the food in the size and type of containers to be used. In low-acid foods the spores that would likely be present are the spores of a thermophile, e.g., the flat sour organism.

The heat processes can be determined by either one of the following methods; (a) graphical method, (b) formula method, (c) nomogram method. In the graphical method, the thermal death-time curve for the most resistant spoilage likely to be encountered is determined. The thermal death times this curve are converted to lethal rates for the various heating temperatures. The lethal rates for a temperature is the reciprocal of the thermal death time, thus if it took 400 minutes at 210°F to kill all the spores in a food, the lethal rate would be 1/400, which is equal to 0.0025. Then the heat penetration (and cooling) curve for the food and can size involved is determined. Lethal rates for the different temperatures at the center of the can during the length of the heating and cooling process are plotted on the heat-penetration (and cooling) curve. The area beneath the curve is measured by means of a planimeter. A given area has a corresponding significance in the adequacy of the processing conditions in relation to the destruction of microorganisms.

The formula method applies data from the thermal-death-time and heat penetration curves to an equation, by means of which the thermal process is calculated mathematically.

The nomogram method is the most rapid for the estimation of thermal process time. It involves the application of the data on thermal death times and heat penetration to a graphic representation of these numerical relations and has the advantage over the previously described methods in that the "coming-up-time" of the steam pressure sterilizer is considered.

Regardless of the method used for the calculation of the thermal process time, they are verified by actual tests on canned food. An experimental pack is inoculated with a known concentration of spores of the resistant spoilage organism. These cans and the uninoculated controls are processed for several time intervals near that calculated for the temperature chosen. The samples are incubated to test for spoilage and are subcultured to test for sterility. Usually a margin of safety is allowed beyond the minimum treatment for killing the spores being tested, when recommendations are made concerning a thermal process time. It should be noted that the process recommended will be successful only for the concentration of spores used and might not take care of gross contamination beyond that level (11).

In the cooling of the processed canned foods it is desirable to cool the contents so that the mass average temperature is greater than 90°F but less than 110°F. At temperatures below 110°F, the thermophiles which are not killed during processing will not grow and at temperatures above 90°F, the surface of the can dries rapidly enough to prevent rusting (29).

The following material is a compilation of the processing time and temperature for chicken and meat mixtures, recommended by the American Can Company for home canners using a steam pressure cooker (5).

Processing Time (Minutes) Recommended by the American Can Company

Food	No. 2 can	No. 2½ can	No. 3 can	Pint glass jar	Quart glass jar	pH value average
at 250°F (15 pounds pressure)						
Beef stew	85	110	120	85	120	
Stew with vegetables	85	110	120	85	120	
Chicken w/ bones	55	65	70	65	75	6.2
Boned chicken	85	110	120	85	120	
Soup broth with rice	35	40	40	35	40	6.2
at 240°F (10 pounds pressure)						
Chili con carne	120	135	150	120	150	5.5
Pork & beans	70	80	85	80	90	5.3

At altitudes over 2,000 feet an additional one pound of pressure for each additional 2,000 feet must be added.

Ashbrook (1) gave the processing time and temperature for canning chicken, which is compiled in the following informations:

Processing time (minutes) for chicken processed at 240°F (10 pounds pressure)

	Pint jars	Quart jars	No. 2 cans	No. 2½ and No. 3 cans
Hot pack, with bones	65	75	55	75
Hot pack with bones out	75	90	65	90
Raw pack with bones	65	75	55	75
Raw pack with bones out	75	90	65	90

For hot pack method, the meat is pre-cooked until medium done or when there is no more pink color at the center of the pieces. For raw packing, the

air is exhausted from the can by establishing an internal temperature of 170°F before sealing the cans. Boned poultry requires a longer processing than poultry with bones.

Canning of Rice

Canned rice was formerly made almost exclusively from par-boiled rice. According to Roberts et al (28), this kind of rice does not disintegrate when the cans are sterilized, however, canned par-boiled rice lacks the brilliant white color and typical rice flavor compared to freshly cooked white rice. When fully-cooked rice is packed, sealed and processed the result is undesirable. The high moisture content in the rice or the presence of excess liquid in the can before retorting was found to be primarily responsible for the stickiness and clumping effect.

Roberts, et al (28), of the Western Regional Research Laboratory, successfully canned white rice by controlling the moisture content of rice to about 55 per cent. Their process was patented. Some of the important steps of their canning process are as follows:

1. Soaking - the rice was washed in cold water to remove free starch, dust and other extraneous materials. Then the rice was soaked for about 30 to 40 minutes depending on the variety used, until it reached an equilibrium moisture level of about 30 per cent. Pearl rice reached the equilibrium level in about 30 minutes, when soaked at about 80°F (27°C) and Texas Patna required 45 minutes at the same conditions. The final moisture content of rice soaked at 131°F (55°C) was no higher than 80°F, although the rate of imbibition in the first 10 to 15 minutes was greater. Furthermore, the time required to reach equilibrium was about the same at both temperatures.

2. Boiling - after soaking, the rice was boiled for one to 5 minutes

in water. This treatment partially cooked the rice and the moisture content was increased to 45 to 60 per cent. The moisture content affected the texture and grain separation but had little influence on the color and flavor of the finished product. The moisture content should not be greater than 60 per cent.

3. Sealing and retorting - the use of C-enamel cans is mandatory because the objectionable odor of free hydrogen sulfide was readily detectable within samples of rice packed and processed in other types of containers. Furthermore if a vacuum of 26 inches of mercury or less was used the rice acquired a light brown color and had an objectionable odor and flavor. Little, if any, improvement was obtained by replacing the air in the can with nitrogen. However, when packed in C-enamel cans and sealed at 28 inches vacuum, the product remained very white after processing and had excellent texture, flavor and grain separation.

In the article mentioned above a heat penetration study was made by the National Canners Association Laboratory, Western Branch. They used long grain rice in 300 x 407 cans, the size which is commonly used for canning rice. They recommended a process of 55 minutes at 240°F (115.6°C) with an initial temperature of 70°F (21°C) for this size of can when sealed at least 23 inches vacuum. However, they recommended a further study along this line of processing.

Most of the rice canned in the laboratory (28) for experimental purposes was in 211 x 300 size cans and processed for 60 minutes at 240°F (115.6°C). This was considered more than adequate. Heating at this temperature for two hours did not adversely affect the texture and grain separation. There was a slight color development observed when the rice was heated for a full two hours.

A comparison of canned samples, freshly cooked rice and a commercially canned product using par-boiled rice is presented below (28, p. 78).

	separation of grain	color	flavor	texture
Canned Patna	6.7	6.6	5.9	6.2
Fresh Patna	5.0	6.8	6.4	5.7
Commercial sample A	6.5	4.2	5.0	5.6
Commercial sample B	6.0	4.5	5.5	5.6
least significant difference at 1% level	0.6	0.4	0.3	not sig.
Canned Pearl	6.2	6.0	5.9	5.9
Fresh Pearl	3.8	6.5	6.4	4.7
least significant difference at 1% level	0.9	0.4	not sig.	1.0

The canned rice was stored at room temperature for 9 months and the qualities were evaluated. The results are presented below (28, p. 79).

	separation of grain	color	flavor	texture
Canned Patna	6.6	6.8	5.7	6.1
Fresh Patna	6.0	5.4	6.1	5.2
least significant difference at 1% level	0.5	0.5	not sig.	0.6
Fresh Pearl	4.2	6.5	6.1	4.4
Canned Pearl	6.0	5.8	5.7	5.8
least significant difference at 1% level	0.6	0.4	not sig.	0.8

The samples were judged for each characteristic on a scale ranging from seven for the highest score to one for the lowest. The data shown were obtained by averaging the scores of at least nine judges from three replications of the test.

From this study it was concluded that canned white rice compared favorably with freshly cooked rice and no deterioration occurred during storage for a nine month period at room temperature. The grain separation in processed rice is better than the freshly cooked rice. It is desirable to limit the moisture absorbed by the rice and to complete the hydration before packing into cans so that the moisture will be evenly distributed.

Behavioral Characteristics of Rice During Cooking

Varieties of rice may be divided into short, medium and long grain groups based on grain size and shape. Most long-grain varieties tend to cook dry and fluffy and the grains do not split or stick together. Medium grain varieties are usually intermediate in these respects. The differences in processing and cooking behaviors reported are due to inherent differences in the chemical make up of the rice grains rather than the grain size and shape (20).

The differences in behavior of long and short grain rice appear to lie in the composition of the starch fraction which constitutes about 90 per cent of milled rice on the dry basis. The starch of long-grain rice may contain as much as 23 to 25 per cent amylose, whereas in short-grain rice the amylose may be 14 per cent or lower. The so-called glutinous rice contains virtually no amylose (22).

Williams, et al (33) supported the previous idea and stated that amylose content may be responsible for the general processing characteristics of rice.

Desikacher (6) reported the differences between the behavioral characteristics of old and fresh rice. Fresh rice upon cooking lost more solids into the cooking water than the stored rice. This condition of

losing more solids into the cooking water yields thick, viscous gruel. Warm water extracts more solids from fresh rice than cold. Solutions of amylose and starch isolated from fresh rice had a slightly higher specific viscosity than the corresponding constituents from old rice. The amylose from the new rice also exhibited a lower iodine combining capacity when titrated potentiometrically with iodine. Fresh rice does not swell to the maximum extent while cooking, compared to stored rice. There is higher diffusible starch and dextrins in fresh rice than in the old.

Pastiness appears to be due to the greater dispersal of starch granules in the cooking medium and the higher specific viscosity of solutions of starch. The lowered amylose content and colloidal changes brought about during storage are considered to be responsible for the better cooking quality of stored grain. The ripening process of the grains may be continued in the storage stage (6).

The study of Greenivasan and Giri (13) supported the ideas given above. They reported that fresh rice contains an active enzyme, amylase which causes it to become pasty on cooking but this enzyme is inactivated upon storage. It has been observed in this study that increased temperature and reduced air supply during the storage quickly improve the cooking quality of rice. Paddy stored at cold temperatures did not improve much after several months storage. The well-stored rice was found to swell on cooking to about four times its original volume, whereas the freshly harvested rice scarcely swelled to double its size with similar treatment.

According to Halik and Keneaster (14) previous studies have employed "swelling number" as an index of the cooking quality in rice. The swelling number was described as the water imbibed by 100 grams of rice when cooked in water at 98°C, under standard conditions.

As reported by Batcher, et al (4) the grain type appeared to be an influencing factor in the water absorption of rice, in that most of the long-grain varieties absorbed more water than either the medium or short-grain types. There are exceptions to this however. There was some overlapping of water uptake ratios among the three grain types. As might be expected, samples that have high water uptake ratios tended to yield larger volumes of cooked rice. The volume ranges from 38 to 50 millileters per 8 grams raw rice.

Batcher, et al (3) made a study on the different ways of cooking rice for school lunches. The study used long-and medium-grain varieties of white and a long-grain variety of parboiled rice. Three methods of cooking were used; (a) covered stock pot on direct heat, (b) covered baking pan at 350°F in over, (c) open pan in steam chest at five pounds pressure. The following results were obtained; of the white rices, the medium-grain rice was more waxy, moist and sticky when cooked than the long-grain rice; with white rice, the use of oil or other bland fat reduced foaming in the direct heat method and reduced the tendency for the rice to be sticky in any of the cooking methods. The formula for the stock pot method produced a firm yet tender, dry, flaky rice with each grain standing out separately. The rice cooked by the oven and steamer method was tender and slightly moist with the grains firm enough to hold their shape. If a softer white rice is desired with the stock pot method, the water can be increased to one cup per pound of rice and the cooking time can be increased to 20 minutes.

Ferrel et al (10) made a study on the treatment of rice with surface-active materials and vegetable oil emulsions to reduce cohesion between kernels without affecting other properties of the canned rice. Oil emulsions were usually prepared by adding one part of emulsifier to ten

parts of vegetable oil and after the mixture was heated to 149 to 158°F. (65 to 70°C.) the water of the same temperature was slowly stirred until the oil concentration of the dispersion was 50 per cent or 25 per cent. This was then passed through a homogenizer three times to obtain emulsions which were diluted with water to the desired strength just before use.

In this particular study the concentration used was 5 per cent cotton seed oil and 0.5 per cent polyoxyethylene sorbitan monooleate. The kind of oil used in the emulsion had only a minor effect on the separation index. The amount of oil taken up by the rice reflected the concentration of oil in the emulsion, but barely exceeded one per cent even at the level of 15 per cent oil in the rinse.

Cohesiveness between kernels in the finished product was markedly reduced by either of two methods: (a) by treatment during processing prior to canning with edible oil-in-water emulsion containing small amounts of surfactant or (b) dilute dispersion of certain amounts of the surfactants themselves. Oil emulsions were applied in each of the three steps of soaking, cooking and rinsing and all combinations of these steps. The use of emulsion in the rinsing stage gave as good results as the combination treatment. Preliminary results suggested that a content of not less than 3 per cent oil in the emulsion was required for significant reduction in cohesiveness. In this study only one surfactant (sorbitan monooleate) approached the oil emulsion in effectiveness when used alone with 0.5 per cent concentration. Simple suspensions of oil in water without a surfactant were ineffective (27).

The adhesion of oil on rice from the emulsion amounts to less than 0.5 per cent of the weight of the rice as it comes from the can. There was no readily detectable effect on flavor or appearance found in freshly canned emulsion-treated rice. A concentration of 5 per cent or more oil

was reliably distinguished from untreated by organoleptic evaluation. The intimate contact in the can between highly hydrated starchy kernels of untreated rice permits bonding between kernels. The placement of a hydrophobic film around the kernels reduces much of this stickiness and yields a less cohesive product. It was mentioned that best texture and least mechanical damage to kernels was obtained if cooking prior to canning was conducted below 100°C. In commercial practice a hot rinse just before can filling would help to obtain the relatively high vacuum of at least 26 inches (27).

The results with the canned samples stored at different temperatures suggest that with-in-kernel changes occur more rapidly than the between-kernel effects. Masking or retardation of these inter-kernal effects reduces the undesirable cohesiveness. The changes during processing and subsequent aging of canned rice which make it superior to freshly prepared short-grain rice, appear to be similar to firming or hardening in bread and other starchy foods often associated with retrogradation or crystallization of gelatinized starch (10).

Matz gave the following accounts on the composition of rice (22, p. 430).

	Brown rice	Milled rice
Carbohydrate per cent[2]	87.2	91.5
Protein per cent[2]	8.3	7.6
Fat per cent[2]	2.0	0.3
Niacin ug/gm	47.2	18.1
Thiamine ug/gm	4.2	0.80
Pyridoxin ug/gm	10.3	4.5
Patothenic acid ug/gm	17.0	6.4
Riboflavin ug/gm	0.53	0.26

[2]on moisture free basis

The starch fraction constitutes about 90 per cent of the milled rice on the dry basis. Protein constitutes about 5 to 10 per cent of the milled grain. It is largely glutelin. Seventeen amino acids have been identified in rice protein, including all the recognized essential amino acids. It has been reported that the glutelin of glutinous (waxy) rice differs from that of ordinary rice glutelin in its higher content of tyrosine, lysine and histidine and lower amounts of other amino acids. It was stated that glutinous rice does not contain combined nucleic acid in its glutelin fraction.

The other constituents of rice of lesser degree are sugar, hemicellulose, mineral matter, fiber, fat, free amino acids, short chain plant acids, compounds of phosphorus, vitamin B complex, enzymes, and pigments. Some of these substances such as fat have important bearing on the keeping quality of the rice and rice products. Phytin is the principal phosphorus compound in rice. It is reported to form more than 8 per cent of the bran fraction. Rice ash contains calcium, iron, potassium, magnesium and sulfur as well as minor amounts of other elements. The hemicellulose may be partly responsible for adhesion of the bran to the endospherm and therefore is a factor in the milling of rice.

Effects of Canning on the Nutritional Values of Food

Since meat is an excellent source of nutritionally complete protein and of many vitamins, it is important to know whether these substances remain unharmed during normal canning procedures. Millares and Fellers (23) made a study of the effects of normal canning procedures on the retention of certain vitamins and essential amino acids in light and dark meat of chicken. The following information gives the thiamine content of chicken meat and its retention during processing (23, p. 135).

Thiamine content of chicken meat and its retention during processing.

Sample	Light Meat		Dark Meat	
	content ug/gm	retention pct	content ug/gm	retention pct
Fresh	0.97	-	1.76	-
Frozen	0.85	87.60	1.02	58.00
Pre-cooked frozen	0.55	56.70	0.56	31.60
Canned (tin can)	0.32	33.00	0.41	23.30
Canned (glass jars)	0.44	45.40	0.41	23.30
Cured, smoked and canned	0.29	30.00	0.29	16.50

The meat in tin cans was processed for 70 minutes under 15 pounds pressure at 121°C. After processing the cans were opened and the contents were ground, mixed thoroughly, transferred to a glass jar and hermetically sealed. They were stored at -18°C until ready for analysis. The meat processed in glass jars was subjected to 15 pounds steam pressure, 121°C for 85 minutes. After processing, the same procedure as in tin cans was followed until the samples were ready for analysis. The cured, smoked and canned samples were processed for 75 minutes at 15 pounds pressure and 121°C, and stored in the same way as the samples above. The fresh and the pre-cooked frozen samples were stored at -18°C. for 8 months.

This study showed that significant losses of thiamine occurred in all methods of processing, the losses being a function of both time and temperature of the process. As much as 50 per cent of the amino acid may be lost in canning. There was no significant loss in riboflavin, niacin, leucine, isoleucine, valine, threonine, phenylalanine, histidine, arginine or lysine.

The presence of water in the heating medium is a very important factor in the thiamine decomposition. Meats cooked in dry heat such as roasting

and broiling have lower thiamine destruction than those cooked with water. The cooking processes that appear to be favorable to the retention of thiamine in the order of retention are as follows: broiling, 60 to 86 per cent; frying, 50 to 89 per cent; roasting, 40 to 70 per cent; boiling and braising, 26 to 50 per cent; and canning, 23 to 44 per cent. The lower thiamine content of canned meats as compared to the fresh meats cooked by standard procedures of roasting or broiling is associated with the more extended heat treatment used to achieve commercial sterility during canning (15).

Farrer (9) discussed the factors that influence the thermal destruction of thiamine. He mentioned them as follows: (a) temperature, (b) time, (c) pH, (d) electrolyte system, (e) heavy metals, (f) concentration of electrolytes, (g) non-electrolytes, (h) form of the vitamin, (i) concentration of the thiamine and cocarboxylase, (j) oxygen and (k) moisture content. Time, temperature and pH are the most important factors to be considered.

Desrosier (7) discussed the influence of canning on the quality of food. Fats may undergo two types of rancidification, hydrolytic, and oxidative. Oxidative rancidity may be accelerated by heat, metallic ions from tin cans, and presence of moisture and light. However, fats are stable to moist heat in the absence of oxygen. This explains why fats and oils in canned food remain relatively unchanged by the canning process.

Sugars and starches are degraded by prolonged heating at high temperatures. Heating under moist conditions may produce a browning-type reaction of organic acids, amino acids and reducing sugars. The caramelization of carbohydrates in sweet corn is an example of heat damage.

Denaturation of proteins may be brought about by heat in the presence of moisture. There is evidence that heat impairs the nutritional value of

proteins without altering the amino acid content as determined chemically. The failure of proteolytic enzymes to digest heated proteins as readily as unheated proteins may be the explanation of the reason why animals thrive less well on highly heated proteins than the slightly heated ones.

Heating pigments in a complex substrate such as a canned food, results in degradation of the natural color characteristics. The action of metal containers may enhance color destruction. Heating may degrade both flavor constituents and the physical character of foods. The degree of change is related to the sensitivity of the food to heat. High temperature and short time of exposure are less destructive on flavor and texture than low temperature and long time processing. However, some products such as pork and beans are improved by heating longer than necessary to sterilize the product (7).

Taste Panel Evaluation

Peryam et al (25) stated that other aspects of a food are important in determining its total worth such as its nutritional value, microbiological purity and chemical stability. However, without satisfactory flavor quality, it may not matter that a food is otherwise good.

According to Harrison et al (16), the use of a group or panel of tasters permits one to estimate in some degree at least, the limits of confidence to be placed in their flavor judgment. Statistical analysis helps to determine the probability that a given judgment could have been reached by chance alone. The confidence limits established in this manner apply only to the particular panel employed and does not mean the panel's ability to reflect public opinion. Little statistical significance can be attached to most results from a panel numbering 10 or fewer. Any method of panel selection should include a preliminary training period,

designed to acquaint the tasters with the quality factors involved in the product to be tested. This is followed by a blind test designed to show the individual's relative perception and discrimination.

As to how many members are needed to compose a panel, Peryam (24) stated that one aspect of this problem is concerned with the reliability of the result. A sufficient number of responses is needed to assure that an important difference will be proved statistically. The number of judgments can be increased either by using more people or by getting more judgments per person. The two approaches are not statistically equivalent. As the number of people on the panel is reduced, the generality of the test result is progressively restricted. However this may not be of great concern since the usual difference test panel could hardly represent any definite population anyway. It may be assumed that the taste panel members are more discriminating than the general consumer, beyond this nothing more is known. Panels of less than 5 persons are seldom used and panels of more than 20 are also rare. Decisions are seldom based on fewer than 16 judgments and it is unusual to obtain more than 30. The less the panel member has to draw on complex skills, the less opportunity there is for error.

According to Mahoney et al (21) the use of appropriate statistical analysis is important in the interpretation of taste panel results. During recent years, there have been developed many short-cut procedures for statistical analysis of data. Most of these are based on the use of the range as a measure of variance in the data. Tukey's "quick and easy" procedure is one that is frequently used because it is simple and accurate. This method of analysis permits the evaluation of results by simply adding the appropriate totals, the ranges (difference between highest and lowest values) and multiplying the sum of the ranges by a factor obtained from

reference tables.

Mahoney et al (21), stated that no one should be asked to serve on a taste panel who is not acquainted with the product through normal use, who has a strong dislike for the product to be tested, or who is not interested in the work and willing to give a conscientious, unbiased judgment of the qualities to be evaluated. The purpose of the test should be fully explained as well as the objectives in order to get the full co-operation of the judges. A judge who has a cold or other indisposition which might affect his ability to taste or smell should not be employed in flavor evaluation tests. Judges should be requested not to eat or smoke within 30 minutes prior to tasting.

The test should be conducted in a quiet, clean, odor-free room at a temperature of approximately 72°F. This room should be equipped with separate booths for each judge. The walls of the booth should be at least 20 inches high and a minimum width of 30 inches. The cross dividers should extend 6 to 8 inches beyond the edge of the table. The use of booths creates the necessary private atmosphere for each judge to evaluate the test sample. Taste panel sessions should be held preferably sometime between 9 and 11 o'clock in the morning and 2 and 4 o'clock in the afternoon.

When evaluating canned foods, all cans or lots within each treatment, or control, should be combined and mixed thoroughly to avoid inter-can variation within given treatment lots. It is important that all samples in the same replicate be exactly the same temperature at the time of their presentation to the judges. The sample size should only be large enough to permit an evaluation of the qualities to be tested (21).

CHAPTER III

METHOD OF PROCEDURE

Design of the Experiment

In the previous study conducted by Roberts et al (28), 240°F. at 10 pounds pressure for 55 minutes was found adequate to process rice in 300 x 407 size cans. The present study employed the conditions cited above, for processing the rice and chicken dish, except for the processing length of time. The varying lengths of processing time were designed as 60, 90, and 120 minutes.

A microbiological treatment was conducted to verify by actual test the adequacy of the length of processing time used in killing the spoilage organisms. The experimental can was inoculated with a known concentration of spores of Bacillus stearothermophilus, a heat-resistant spoilage microorganism responsible for the "flat sour" spoilage in food. This can and the uninoculated control were processed for each given length of time. These cans were incubated and tested for spoilage. The test employed was to determine decrease in pH of the food following incubation, which indicates failure to destroy the organism.

To determine the acceptability of the canned product and to determine whether it would differ in flavor, texture and appearance from the freshly-cooked dish, a taste panel evaluation was conducted. The judges compared the flavor, texture and appearance of the canned product with a reference sample which was not processed. They were instructed to indicate whether in their opinion, the flavor, texture and appearance was

acceptable or not acceptable.

Three canning trials were conducted for each specified length of processing time. Each trial had 4 cans, 2 of which were for microbiological study and 2 for taste panel evaluation. All the cans were processed at 240°F. and 10 pounds pressure. The following is a summary of how the experiment was designed.

Summary of the Experimental Design

Trials	Lengths of Processing Time (Minutes) 60	90	120
1	No. of cans = 4 2 for taste panel 2 for microbiological 1 inoculated 1 not inoculated	No. of cans = 4 2 for taste panel 2 for microbiological 1 inoculated 1 not inoculated	No. of cans = 4 2 for taste panel 2 for microbiological 1 inoculated 1 not inoculated
2	No. of cans = 4 2 for taste panel 2 for microbiological 1 inoculated 1 not inoculated	No. of cans = 4 2 for taste panel 2 for microbiological 1 inoculated 1 not inoculated	No. of cans = 4 2 for taste panel 2 for microbiological 1 inoculated 1 not inoculated
3	No. of cans = 4 2 for taste panel 2 for microbiological 1 inoculated 1 not inoculated	No. of cans = 4 2 for taste panel 2 for microbiological 1 inoculated 1 not inoculated	No. of cans = 4 2 for taste panel 2 for microbiological 1 inoculated 1 not inoculated
Total no. of cans	12	12	12 = 36

Due to some difficulties encountered in culturing the B. stearothermophilus (NCA1518) to be inoculated into the cans, the cans intended for taste panel evaluation were processed separately from the cans intended for microbiological study. However, the design remained the same.

For the taste panel evaluation a recipe sufficient for 6 pint-size cans was prepared per batch. The batch was divided into the 6 cans. Two cans were considered as a unit. Each unit was processed at each of the stated lengths of time. The same procedure was followed for processing

the cans for microbiological study, except that one of the two cans in a unit was inoculated with a known concentration of spores. The one not inoculated was the control.

The same pressure cooker was used for all processing to avoid variation due to the pressure cooker. At the start all the 6 cans were placed inside the pressure cooker. After 60 minutes at 240°F., the pressure was released and 2 cans were taken out. Then the temperature was immediately brought back to 240°F. by increasing the flame. After 30 more minutes, 2 cans were again taken out and the temperature was again immediately brought to 240°F. and continued to process for another 30 minutes to complete the 120 minutes. The cans were immediately cooled in running water after processing and labeled. The cans for the taste panel were kept in the refrigerator until ready for evaluation which was conducted the following day. The cans for microbiological study were put in the incubator at 55°C. for 7 days.

Development of Microbiological Treatment

The objective of the microbiological treatment was to determine by actual test, the length of processing time desirable to render the canned product bacteriologically safe. The Microbiology Department was consulted for some suggestions on the procedure and kind of microorganism to use. Dr. Eric Noller recommended Bacillus stearothermophilus, also known as NCA 1518 which he had in the laboratory at the time. B. stearothermophilus is a heat-resistant microorganism producing "flat sour" spoilage in food. This organism is more heat-resistant than Clostridium botulinum and other thermophilic organisms causing spoilage, thus if B. stearothermophilus could be destroyed during processing, the product would be safe from other thermophilic microorganisms. It grows best at 55°C. and requires a pH of

about 5. The spores are rod shaped.

Equipment and Culture Media Used

Equipment - test tubes, beakers, flasks, cylinders, pipettes, thermometers, petri dishes, wire loop, Bunsen burner, colony counter, incubator set at 55°C., pH paper, glass electrode pH meter, pressure cooker, gram scale, spatula, cotton plugs.

Culture media - Bacto-Thermoacidurans Broth, Bacto-Thermoacidurans Agar, physiological salt solution (Appendix, p. 81). The Bacto-Thermoacidurans Broth is the same as the Basto-Thermoacidurans Agar, but omitting the Agar in the preparation.

Culturing of Microorganism

1. The Thermoacidurans Broth was prepared and the pH was adjusted to approximately 5, using 1 N HCl with Bromcresol purple as indicator. The pH was determined using the glass electrode pH meter.

2. 10.5 ml of broth were placed in the test tubes and sterilized at 15 pounds pressure for 15 minutes.

3. The pH was determined after sterilization and recorded.

4. To each tube of sterile broth, cooled to about 55°C., was added 0.1 ml of pure organism using a sterile pipette.

5. The tubes were incubated at 55°C. for 3 to 4 days.

6. After incubation, the pH was determined to check for growth of microorganisms. A decrease in pH indicates growth.

7. The tubes were heated in a water bath at 80°C. for 10 minutes to kill the vegetative cells.

8. To check for spore growth after heating at 80°C., 0.1 ml of the heated culture was transferred to tubes of 10 ml sterile broth of known

pH. The tubes were incubated at 55°C. for 2 to 4 days. The pH was determined after incubation.

Quantitative Estimation of Spores by Dilution

1. Five tubes of 9 ml sterile physiological salt solution were prepared (Appendix, p. 81). The tubes were numbered 1 to 5 and arranged in sequence in a tube rack.

2. Fifteen petri dishes, each with 15 ml sterile Bacto Agar, were prepared. They were numbered 1 to 5 with 3 petri dishes per number, except for No. 5 which had only two petri dishes. One petri dish served as a control. A modification in the preparation of Bacto Agar (Appendix, p. 81) was made to prevent hydrolysis and softening of the Agar. The agar and dextrose were combined and dissolved in 500 ml of distilled water in a flask. The rest of the ingredients were combined and dissolved in 500 ml of distilled water in another flask and the pH was adjusted to approximately 5 using 1N HCl. They were sterilized at 15 pounds pressure for 15 minutes. After sterilization they were cooled to 55°C. and asceptically combined.

3. Tube No. 1 of physiological saline was inoculated with 1 ml of culture from the tube heated to 80°C. (step 7 on culturing microorganism). For convenience let this be called original culture. Tube No. 1 was rolled and agitated between the palms to distribute the organisms throughout the solution. It was assumed that each ml of this tube now contained 1/10 the number of spores that were present in 1 ml of original culture.

4. With a sterile pipette, tube No. 2 of the saline was inoculated with 1 ml of the material from tube No. 1. Each ml of saline solution in tube No. 2 now contained 1/100 as many spores as were present in 1 ml of the original culture. With the same pipette, the petri dishes marked No.

1 were inoculated with 0.2 ml each of the culture from saline tube No. 1. The culture was spread on the agar using a sterile spatula and allowed to solidify.

5. Tube No. 3 of saline was inoculated with 1 ml of material from tube No. 2. Each ml of saline in tube No. 3 now contained 1/1000, the number of spores present in 1 ml of the original culture. With the same pipette, petri dishes marked No. 2 were inoculated with 0.2 ml of culture from Saline tube No. 2. The culture was spread on the agar and allowed to solidify.

6. The process of inoculating the saline tubes and agar petri dishes was continued until all the agar petri dishes had been inoculated, except the control. Tube No. 5, the last in the series of saline tubes, contained per ml 1/10,000 the number of spores present in 1 ml of the original culture.

A separate sterile pipette must be used for each series of dilution. The temperature of the agar must be controlled to about 45°C. during inoculation.

7. The edges of the petri dishes were sealed with tapes, then incubated at 55°C. for 24 to 48 hours. The petri dishes were inverted during incubation to prevent condensation.

8. After incubation the number of colonies were counted in each petri dish. The product of the number of colonies and the reciprocal of the dilution is the number of spores per ml of the original culture.

9. As a result of this experiment, petri dishes No. 1, contained an average of 3 colonies, petri dishes No. 2 contained 1 colony and the rest did not have any colonies. Since the culture in petri dishes No. 1 came from saline tube No. 1 in which the dilution was 1/10 and 0.2 ml or 1/5 of the total culture of this tube was transferred to petri dishes No. 1

the final dilution in petri dish No. 1 was 1/5 x 1/10 = 1/50. The number of colonies multiplied by the reciprocal of dilution would then be 3 x 50 = 150. This was the estimated number of spores per ml in the original culture. Since there were 10 ml in each tube of the original culture, it was assumed that there were about 1500 spores in the original culture per test tube.

In this study it was desirable to add approximately 10,000 spores per can, but due to lack of time for detailed experimentation and difficulty encountered in culturing the microorganisms, the study was conducted using the estimated 1,500 spores per can.

Inoculation of Food With the Microorganism

1. The cans were filled with the rice and chicken mixture. From each can, about 10 gram samples were taken and placed in 50 ml beakers. To the sample was added 10 ml of distilled water and stirred with glass stirring rod. The pH was determined using the glass electrode pH meter and recorded.

2. The growth of B. stearothermophilus in each test tube was allowed to settle at the bottom of the tubes. The rest of the broth was decanted using sterile pipettes. The sediment from each tube was poured and stirred throughout the contents of the cans to be inoculated. The inoculated cans were labeled distinctly to avoid interchanges with the control.

3. The rest of the procedures in canning and the procedures discussed in the design of the experiment were followed.

Incubation of the canned products after processing was conducted at 55°C. - 60°C. for 7 days. The cans were rearranged in the incubator everyday to have uniform heating. They were examined for occurrence

of abnormalities such as "swell."

Test for Spoilage by pH Determination

1. The cans were opened and the contents were stirred with a glass stirring rod. The conditions of the contents were observed.

2. About a 10 gram sample was taken from each can and placed in a 50 ml beaker. Ten ml of distilled water was added and stirred.

3. The pH for each sample was determined by the glass electrode pH meter and was recorded.

4. The original pH was compared with the final pH. A decrease in the final pH would indicate failure to kill the acid forming microorganisms.

Development of Canning Procedure

Recipe development

The development of the rice and chicken recipe intended for canning was started in a special problem course titled, Investigational Cookery, FNIA 513, taught in the Fall of 1963 at the Oklahoma State University. In this special problem, the proportions of ingredients and the method of pre-cooking the mixture to suit the processing conditions were partially identified.

The original recipe was taken from the Kitchen Tested Recipes (18, p. 79) under the name "Arroz a la Valenciana" which is as follows:

4 tablespoons lard
1 clove garlic, bruised
1 onion, chopped
1 young chicken cut into pieces
2 chorizos (Spanish sausage, sliced)
1 bay leaf
2 tablespoons paminton (paprika)
2 stalks green onion (leeks)
2 hard-cooked eggs
1 can tomato sauce or paste
2 fresh green and red pepper (cut into strips)
2 cups cooked enriched rice
1 small can peas
a pinch of salt
dash of pepper

Saute garlic and onions. Add chicken, cover and cook for 20 minutes. Add chorizo, paminton, tomato sauce, green and red pepper. Add cooked rice and peas. Cover and cook on a very low fire for 10 minutes. Add 2 extra tablespoons lard to keep rice from sticking to the pan. Arrange in mound on a platter. Garnish with finely sliced green onions (leeks), eggs, peas, red and green pepper rings. 6 servings.

It will be noted that the amounts of ingredients are not specific. For example, 1 can tomato sauce does not specify the size of the can. Some steps in the procedure are not needed for canning purposes. Hence modifications were made. A taste panel composed of four class members was employed to evaluate the qualities of the finished product.

From this special problem the following points were identified:

1. The method of pre-cooking the rice suggested by Roberts et al (28) was found acceptable with respect to the texture and grain separation of rice kernels. The method also controlled the moisture content of the grains. Such procedure is as follows: Soak the rice in water for 45 minutes at 27°C.; boil the rice in water for 1 to 5 minutes.

2. The rice-water ratio that will allow just the right amount of water that will be absorbed during 45 minutes soaking and 5 minutes boiling was found to be approximately 1:7/6, that is one part rice to 7/6 parts water.

3. The addition of tomato sauce significantly affected the flavor and appearance of the product.

4. The peas, either canned or frozen and the green pepper were overcooked, tasted bitter and appeared undesirable when the mixture was processed at 250°F. (15 pounds pressure) for one hour.

5. From the preliminary trial on the processing conditions, the

240°F at 10 pounds pressure for either 60 or 90 minutes, gave the desirable qualities of the product.

6. The proportions of ingredients, sufficient for 6 pint-size tin cans (12 cups) are as follows:

Rice - 4 cups raw (10 cups cooked)

Water - 4 2/3 cups

Chicken - partially cooked, boned and shredded - 300 grams

Tomato sauce - 300 grams

Shortening - 200 grams

Garlic, crushed - 1 tablespoon

Onion, chopped - 100 grams

Salt - 2 tablespoon

Pepper - 1 teaspoon

The peas were omitted. The mixture was heated at moderate flame for 10 minutes.

The development of the recipe was continued and some modifications were made from the findings in FNIA 513. It was suggested that raw chicken cut into pieces with bones and skin might appear better than partially cooked shredded chicken meat. The suggestion was tried and the result was desirable. Whole pieces of chicken, with bones and skin were then used.

Varying amounts of tomato sauce were tried. The range from 50 to 150 grams per can was tested. The 100 gram per can was considered desirable. Lard was used instead of vegetable shortening and the amount was decreased. Peas were incorporated to add color to the mixture. The pepper was omitted since it could be added just before serving. The rice-water ratio was reduced to 1:1 ratio to compensate for the additional tomato sauce.

Thus the final recipe sufficient for 6 pint-size tin cans (12 cups) was as follows:

Ingredients:

Rice, partially cooked - 1610 grams (approximately 9 cups)

Chicken, raw with bones and skin, cut into pieces - 660 grams

Peas, frozen - 300 grams

Shortening, lard - 150 grams

Tomato sauce, canned - 600 grams

Onion, diced - 150 grams

Salt, refined - 2 tablespoons

Directions:

a) Pre-cooking of rice

1. Wash the rice to remove dust and extraneous materials.
2. Drain the water through a wire strainer.
3. Soak the rice in equal amounts of water. (1 part water for every 1 part rice), at 27°C. for 45 minutes.
4. Boil the rice and water for 3-5 minutes. Count the time as soon as the water boils.

b) Preparation of chicken

1. Clean the chicken and cut into pieces, such that two pieces (1 drumstick and $\frac{1}{2}$ wing or $\frac{1}{4}$ breast and $\frac{1}{2}$ wing) will approximately weigh 110 grams. Cut through the joints to divide the legs and wings.

c) Pre-cooking of the mixture

1. Saute onion in one-half of the shortening.
2. Add the following in the order given with constant stirring to prevent scorching in the pan: chicken, rice, one-half of the shortening, peas, tomato sauce and salt. The heating

time should be between 7 to 10 minutes over moderate heat.

Steps in canning:

1. Fill the cans with the pre-cooked mixture. Put 2 pieces of chicken per can. Leave about one centimeter head space.
2. Weigh each can to have uniform contents. The gross weight should be 525 grams.
3. Exhaust the air by heating the cans inside the pressure cooker with open petcock for 5 to 10 minutes or until the temperature inside the can is 170°F.
4. Seal the cans.
5. Process at 240°F. and 10 pounds pressure at varying lengths of time as indicated in the design of the experiment.
6. Cool the cans in running water until the temperature of the cans is approximately 90°F.

Materials used:

Ingredients for the dish

Rice - Texas Patna # 1, a long-grain variety, recommended for canning.

Chicken - raw, cut into pieces with bone and skin.

Tomato sauce - canned, Hunt's brand

Peas - frozen, Bel-Air brand

Shortening - pure lard, Armour brand

Salt - refined, iodized, Morton's brand

Onion - fresh

Equipment used:

Tin cans, C-enameled, pint-size (303 x 407)

Can sealer - hand operated, Burpee Simplex

Pressure cooker - 15 quart capacity, calibrated from 5 to 20 psig,

Burpee Can Sealer Co.

Cooking utensils - large frying pan, sauce pans, chopping board, knives, basting spoons, measuring cups and spoons.

Gram scale - dietetic

Timer

Thermometers

Electric range.

Taste Panel Evaluation

The primary objective of the taste panel evaluation was to determine and quantify the degree of flavor, texture and appearance difference between any of the samples that were processed and the reference sample which was unprocessed and freshly cooked dish. The method followed was patterned after Evaluating Flavor Differences in Canned Food by Mahoney et al (21). This method had been suggested for the following reasons:

1. It is simple to use for both researcher and judges.
2. It provides an effective method of screening and selecting judges.
3. It provides an accurate measurement of the degree of differences between samples.
4. It provides an indication of the acceptability or non-acceptability of the treatment in the test.
5. It provides a quick and easy yet accurate method of statistical analysis of data.

Panel selection

Asian male and female students were selected to serve in the panel because of their familiarity with rice dishes. Letters asking for their willingness to serve in the panel and their most convenient times were sent to them. From the responses received, 4 boys and 9 girls were willing

to serve in the panel. Tuesday afternoon between 2:00 P.M. to 5:00 P.M. was set for the testing.

Judging environment

The tasting was conducted at the Food Research Laboratory of the West Home Economics Building. The room was quiet, with comfortable room temperature, clean and was equipped with separate booths for each judge. Each booth was provided with a chair, a glass of water, napkin, fork, scorecard and pencil. The booths provided privacy for each judge.

Sample preparation and serving

The treatments were coded as follows:

A = 60 minutes processing

B = 90 minutes processing

C = 120 minutes processing

D = blind sample which was identical to the reference sample.

The reference sample was prepared by following the recipe for canning, except for the following modifications: (1) the rice was not soaked for 45 minutes; (2) the chicken was cooked with the shortening and onion in a covered pan over a low flame for 20 minutes before adding the rest of the ingredients; (3) the whole mixture was cooked further for 10 minutes.

A tablespoon-full of sample from each treatment (a total of 4 samples) was arranged on a paper plate and labeled accordingly. The plate was covered with aluminum foil and stacked in the refrigerator. The reference sample was placed on a small paper plate and labeled as reference. It was covered with aluminum foil and stacked also in the refrigerator. All samples were fixed on paper plates in the morning of the tasting session. In the afternoon, as soon as the judges arrived, the plates were heated in

an oven at 350°F for 5 minutes. Then the foil cover was removed and the food was served to the judges.

Tasting procedure

The taste panel was conducted at three different times. Each judge was presented samples A, B, C, D and the identified reference sample per sitting. Judges were instructed to compare each sample with the reference. He was requested to indicate by a check (√) in the appropriate box the degree of the difference in flavor, texture and appearance between the sample being judged and the reference. Adjectives at the top line of the score card described the difference as none, slight, moderate, large and extreme. Boxes were provided between two descriptive adjectives so that the judge may indicate an intermediate description between the two terms. Judges were instructed to state whether this particular sample was acceptable or not acceptable to them by checking the boxes provided. This information provided additional data on the practical significance of the evaluation. Judges were allowed to re-taste the reference sample as often as necessary to determine the degree of difference. No time limit was set on the judges.

Statistical evaluation of the data

At the completion of the test, numerical scores were assigned to the descriptive terms in sequence from 1 = none to 9 = extreme. The numerical difference ratings for flavor, texture, and appearance were then transferred to the form for summary tabulation for flavor, texture and appearance respectively. Scores were entered opposite the proper treatment, by judge and replicate or trial. If the sample was marked not acceptable, numerical "2" was written next to the score on the summary tabulation form.

When all the data for all judges, treatments and replicates had been entered in the respective summary forms, the data were analyzed by the Tukey method of analysis discussed by Mahoney et al (21), (Appendix, p. 73).

CHAPTER IV

RESULTS AND DISCUSSIONS

Taste Panel Evaluation

The data obtained from the taste panel evaluation was treated statistically by Tukey's procedure (Appendix, p. 73), discussed by Mahoney et al (21) to evaluate the degree of acceptability of the canned product and to determine whether the flavor, texture and appearance of the canned product differ significantly from the unprocessed dish.

The descriptive terms checked by the judges in the score card, to indicate the degree of difference between each sample and the reference sample, were given their equivalent numerical scores. The scores were 1 = none, 3 = slight, 5 = moderate, 7 = large, 9 = extreme. Between two descriptive terms was one numerical value, thus between "none" and "slight" would be a score of 2, between "slight" and "moderate" a score of 4, between "moderate" and "large" a score of 6 and between "large" and "extreme" a score of 8.

The numerical scores for flavor, texture and appearance are summarized and are presented in Tables 1, 2, and 3. The scores were entered in the column of the appropriate judge, opposite the treatment and replicate concerned. For example, the score for judge No. 1, for treatment A, replicate 2, for flavor evaluation, was 5; for judge No. 10, treatment C, replicate 3, for flavor evaluation was 9.

The samples indicated by the table footnote 2 were samples rated "not

Table 1

Summary of Flavor Difference Scores of Taste Panel Members

Treatment	Replicate	Flavor difference scores for indicated judge													Total Scores	Range of judge sums	No. not Acceptable
		1	2	3	4	5[1]	6[1]	7	8	9	10	11	12	13			
A 60 minutes	1	5	3[2]	5	3	3	3	3	3	5	3	7[2]	7[2]	2			
	2	5[2]	3	5	5	5	1	5	3	1	7	5	5[2]	3			
	3	3	2	2	5	5	3	1	3	3	5	3	7[2]	3			
	Sum	13	8	12	13	13	7	9	9	9	15	15	19	8	130	11	6
	Range	2	1	3	2	2	2	4	0	4	4	4	2	1	Percent not acceptable = 18.2		
B 90 minutes	1	7[2]	3[2]	5[2]	7	3	1	5	5	5	1	9[2]	7[2]	3			
	2	5	3	5	5	5	3	7	5	3	5	7[2]	5[2]	5			
	3	3	3	5	5	1	3	7[2]	7[2]	5[2]	7	5	5[2]	3			
	Sum	15	9	15	17	9	7	19	17	13	13	21	17	11	167	12	11
	Range	4	0	0	2	4	2	2	2	2	6	4	2	2	Percent not acceptable = 33.3		
C 120 minutes	1	7[2]	3[2]	7	7	5	1	7[2]	1	7[2]	7[2]	5	7[2]	5[2]			
	2	5	2	7	7[2]	3	3	7[2]	5	5[2]	9[2]	7[2]	9[2]	5[2]			
	3	3	2	5	4	3	3	7[2]	3	9[2]	9[2]	3	3	3			
	Sum	15	7	19	18	11	7	21	9	21	25	15	19	13	182	18	17
	Range	4	1	2	3	2	2	0	4	4	2	4	6	2	Percent not acceptable = 51.5		

Table 1 (Continued)

Treatment	Replicate	Flavor difference scores for indicated judge													Total Scores	Range of judge sums	No. not Acceptable
		1	2	3	4	5	6	7	8	9	10	11	12	13			
D control (unprocessed)	1	1	1	1	1	5	1	3	1	1	3	3	1	1			
	2	1	1	1	2	3	1	1	1	1	1	1	1	1			
	3	1	1	1	1	3	1	3	1	1	3	1	1	1			
	Sum	3	3	3	4	11	3	7	3	3	7	5	3	3	44	4	0
	Range	0	0	0	1	2	0	2	0	0	0	2	0	0	Percent not acceptable = 0		
Grand sum of ranges		10	2	5	8	10	6	8	6	10	14	14	10	5		45	Judge Range Totals
Grand range of sums		12	6	16	14	4	4	14	14	18	18	16	16	10	138	Grand range of totals	
O.S.D. (1.13)		11.3	226	565	9.04	11.3	6.78	9.04	6.76	11.3	15.82	15.82	11.3	5.65			

[1]These judges (5,6) were unable to distinguish flavor difference and their data were eliminated from consideration.

[2]These scores indicate a judgment of an unacceptable product by the panel members.

Table 2

Summary of Texture Difference Scores of Taste Panel Member

Treatment	Replicate	Texture difference scores for indicated judge													Total	Range of judges sums	No. not Acceptable
		1	2	3	4	5^1	6^1	7^1	8	9	10	11	12	13			
A 60 minutes	1	5	2	3	3	3	1	3	3	3	3	7^2	7	3			
	2	5	3	5	3	3	3	1	5	1	7^2	7	7^2	3			
	3	5	2	2	5	5	3	3	5	3	5	5	6	5			
	Sum	15	7	10	11	11	7	7	13	7	15	19	20	11	128	13	3
	Range	0	1	3	2	2	2	2	2	2	2	2	1	2	Percent not acceptable = 10		
B 90 minutes	1	7^2	2	3	3	1	3	3	1	1	5^2	7^2	7^2	5^2			
	2	7^2	3^2	5	3	3	3	1	5	3	5^2	9^2	5	5^2			
	3	7	2	7^2	5	1	3	3	7^2	5^2	7	5	6	7^2			
	Sum	21	7	15	11	5	9	7	13	9	17	21	18	17	149	14	14
	Range	0	1	4	2	2	0	2	6	4	2	4	2	2	Percent not acceptable = 46.6		
C 120 minutes	1	7^2	2	3	3	5	5	3	5	7	9^2	3	5	7^2			
	2	7^2	3^2	7	7^2	3	3	1	7^2	5^2	9^2	9^2	5	7^2			
	3	5	3	5	5	3^2	3	3	5	9^2	9^2	5	9^2	9^2			
	Sum	19	8	15	15	11	11	7	17	21	27	17	19	23	181	19	15
	Range	2	1	4	4	2	2	2	2	4	0	6	4	2	Percent not acceptable = 50		

Table 2 (Continued)

Treatment	Replicate	Texture difference scores for indicated judge													Total	Range of judge sums	No. not Acceptable
		1	2	3	4	5	6	7	8	9	10	11	12	13			
D control (unprocessed)	1	1	1	1	1	5	5	1	1	1	1	1	1	1			
	2	1	1	1	1	2	1	1	1	1	1	1	1	1			
	3	1	1	1	1	4	1	2	1	1	3	1	1	1			
	Sum	3	3	3	3	10	7	4	3	3	5	3	3	3	32	2	0
	Range	0	0	0	0	3	4	1	0	0	2	0	0	0	Percent not acceptable = 0		
Grand sum of ranges		2	3	11	8	9	8	7	10	10	6	12	7	6		48	Judge range scores
Grand range of sums		18	5	12	12	6	4	3	14	18	22	18	17	20	149	Grand range of totals	
O.S.D. (1.13)		2.26	3.39	12.42	9.04	10.17	9.04	7.91	11.3	11.3	6.78	13.56	7.91	6.78			

[1]These judges (5, 6, 7) were unable to distinguish texture differences and their data were eliminated from consideration.

[2]These scores indicate a judgment of an unacceptable product by the panel members.

Table 3

Summary of Appearance Difference Scores of Taste Panel Members

Treatment	Replicate	Appearance difference scores for indicated judge													Total	Range of judge sums	No. not Acceptable
		1	2[1]	3	4[1]	5[1]	6	7	8	9	10	11	12	13			
A 60 minutes	1	5	3	5	1	3	1	3	3	3	7	5	5	3			
	2	5	2[2]	5	7	1[2]	3	5	7[2]	3	7[2]	5	5	3			
	3	5	3[2]	5	7	5	3	3	7[2]	3	5	5	5	4			
	Sum	15	8	15	15	9	7	11	17	9	19	15	15	10	133	12	3
	Range	0	1	0	6	4	2	2	4	0	2	0	0	1	Percent not acceptable = 10		
B 90 minutes	1	7[2]	1	5[2]	3	3	1	3	5	1	5	7	5	5			
	2	7[2]	3[2]	7	7	5	3	5	7[2]	3	5[2]	7[2]	5	3			
	3	5	3[2]	7[2]	7	1[2]	5	3	7[2]	5[2]	7	5	5	5			
	Sum	19	7	19	17	9	9	11	19	9	17	19	15	13	150	10	9
	Range	2	2	2	4	4	4	2	2	4	2	2	0	2	Percent not acceptable = 30		
C 120 minutes	1	7[2]	1	3	3	1	3	3	7[2]	7[2]	5[2]	7	5	7[2]			
	2	7[2]	2[2]	7	7[2]	5	5	3	7[2]	5[2]	9[2]	7[2]	5	7[2]			
	3	5	3[2]	5	7[2]	3	7	3	6[2]	9[2]	9[2]	7	1	7[2]			
	Sum	19	6	15	17	9	15	9	20	21	23	21	11	21	175	14	15
	Range	2	2	4	4	4	4	0	1	4	4	0	4	0	Percent not acceptable = 46.6		

Table 3 (Continued)

Treatment	Replicate	Appearance difference scores for indicated judge													Total	Range of judge sums	No. not Acceptable
		1	2	3	4	5	6	7	8	9	10	11	12	13			
D control (unprocessed)	1	1	1	1	1	1	1	1	3	1	1	1	1	1			
	2	1	1	1	1	1	1	1	1	1	1	1	1	1			
	3	1	1	1	1	3	1	2	1	1	3	1	1	1			
	Sum	3	3	3	3	5	3	4	5	3	5	3	3	3	35	2	0
	Range	0	0	0	0	2	0	1	2	0	2	0	0	0	Percent not acceptable = 0		
Grand sum of ranges		4	5	6	14	14	10	5	9	8	10	2	4	3		38	Judge range total
Grand range of sums		16	5	16	14	4	12	7	15	18	18	18	12	18	140	Grand range of totals	
O.S.D. (1.13)		4.52	5.65	6.78	15.82	15.82	11.3	5.65	10.17	9.04	11.3	2.26	4.52	3.39			

[1] These judges (2, 4, 5) were unable to distinguish appearance difference and their data were eliminated from consideration.

[2] These scores indicate a judgment of an unacceptable product by the panel members.

acceptable" by the judges. The judges indicated by the table footnote 1 were those who were unable to distinguish quality differences among the samples. Their data was eliminated from consideration. As shown in Table 1, two judges were eliminated from flavor evaluation. For texture evaluation (Table 2) judges 5, 6, and 7 were eliminated and in appearance evaluation (Table 3) judges 2, 4 and 5 were eliminated.

The sum for each judge was obtained by adding the scores for the 3 replicates. For example, for flavor evaluation, treatment A, for judge No. 1, the sum would be 13. The range was determined by substracting the lowest score from the highest score. Hence for the example given, the range would be 2. The grand sum of the ranges was found by adding the range for each treatment, for each judge. For the example cited, the grand sum of the ranges was 10. The grand range of sums was computed by subtracting the lowest sum from the highest sum. In the example cited, the highest sum was either in treatment B or C which was 15 and the lowest was in treatment D which was 3, hence the grand range of sums was 12.

The overall significant difference (OSD) was determined by locating in Table B (Appendix, p. 77) the appropriate factor in the 5 per cent column for the number of treatments and on the line for the number of replicates used. For the data in this study, the number of replicates was 3 and the number of treatments was 4, thus the factor at the 5 per cent level of significance was 1.13. This factor was written in the summary form opposite to OSD. The grand sum of range for each judge was multiplied by this factor to find the OSD for that judge. For the example cited, the OSD of judge No. 1 would be 1.13 x 10 = 11.3. The OSD for each judge was compared with their respective grand range of sums. When the grand range of sums was equal or less than the OSD value,

it indicated the lack of ability of the judge to distinguish between any of the treatments, hence his data could not be included for consideration. For example, for judge no. 5 in flavor evaluation, her grand range of sums was 4 which was less than her OSD which was 11.3, therefore her data was eliminated.

The sums of the replicate score for each of the judges not eliminated were added, to find the total sum. For example, the total of the sums for treatment A for flavor evaluation, for the remaining judges was 130. The range of the sums for the remaining judges in each treatment was determined by substracting the lowest sum from the highest sum. In the flavor evaluation, treatment A, the highest sum was given by judge 12 which was 19 and the lowest sum was given by judge 13 which was 8. The range was therefore 19 - 8 = 11.

The grand range of totals was computed by subtracting the lowest total sum from the highest total sum. In flavor evaluation, the highest total sum was from treatment C which was 182 and the lowest was from treatment D which was 44, therefore the grand range of totals was 138. The judge range total was found by adding the range of judge sums from each treatment. For flavor evaluation, the total of range of judge sums was 45.

To determine the percentage not acceptable, the scores designated by footnotes 2 were counted for a single treatment for the remaining judges. The number not acceptable divided by the total number of evaluations of the remaining judges for that treatment, multiplied by 100 gave the percentage not acceptable. For example, for flavor evaluation, treatment A; 6 divided by 33 multiplied by 100 = 18.2 per cent.

To determine whether a significant difference exists among the four treatments, the overall significance difference (OSD) value was

determined. The overall significant difference was computed by obtaining the appropriate factor from Table B (Appendix, p. 77) in the column for the number of treatments and on the line for the number of judges. For flavor evaluation, the number of treatments was 4 and the number of remaining judges was 11, hence this factor was 0.99 at the 5 per cent level of significance and 1.24 for the 1 percent significance level. This factor was multiplied by the judge range total. For flavor evaluation, the overall significant difference at the 5 per cent level was 0.99 and the judge range total was 45, then the computed overall significant difference would be 0.99 x 45 = 44.55. This was compared with the grand range of totals. If the grand range of totals exceeds the OSD value, a significant difference exists among the treatments. Table 4 shows a comparison of the computed OSD at the 5 per cent and 1 per cent levels and the grand range of totals for flavor, texture and appearance.

Table 4. A comparison of the computed OSD with the grand range of totals for flavor, texture and appearance.

	Computed overall significant difference (OSD)		Grand Range of Totals
	5% level	1% level	
Flavor	44.55	55.8	138**
Texture	47.04	59.64	149**
Appearance	37.24	46.74	140**

**Highly significant difference

Since the grand range of totals for flavor, texture and appearance greatly exceeds their respective computed overall significant difference, there is evidence to show that a highly significant difference exists among the treatments, at both 5 per cent and 1 per cent levels of significance, with respect to flavor, texture and appearance.

To evaluate the difference between any two treatments, the least significant difference (LSD) values were computed. To compute the LSD, the judge range total was multiplied by the LSD factor found in Table C (Appendix, p. 78) in the column for the number of treatments and the number of judges. For flavor evaluation, the number of treatments was 4 and the number of remaining judges was 11, the LSD factor at the 5 per cent level of significance was 0.74. Then this factor 0.74 x 45 which was the judge range total, gave 33.3, which was the computed LSD. The difference between any two treatment totals was compared with the computed LSD. If the difference exceeds the computed LSD, the difference is significant at the specified level.

Tables 5, 6, and 7 show the differences between any two treatment totals compared with the LSD at 5 per cent and 1 per cent levels of significance.

Table 5. A comparison of flavor differences between any two treatment totals with the computed LSD at 5 per cent and 1 per cent levels of significance.

Treatment Totals	Difference	L.S.D. 5%	L.S.D. 1%
A vs. D 130 - 44	86**	33.3	44.55
B vs. D 167 - 44	123**	33.3	44.55
C vs. D 182 - 44	138**	33.3	44.55
A vs. B 130 - 167	37*	33.3	44.55
A vs. C 130 - 182	52**	33.3	44.55
B vs. C 167 - 182	15	33.3	44.55

* significant difference
** highly significant difference

Since the differences in flavor between treatments A (60 minutes), B (90 minutes), C (120 minutes) and D (unprocessed) are significant, there is evidence to show that the flavor of canned samples, processed at any given length of time, differs significantly from the flavor of unprocessed samples, at both levels of significance. The difference between 60 minutes and 90 minutes is not significant at the 1 per cent level but is significant at 5 per cent level. There is no significant difference in flavor between samples processed at 90 minutes and 120 minutes at both levels of significance.

Table 6. A comparison of texture differences between any two treatment totals with computed LSD at 5 per cent and 1 per cent levels of significance.

Treatment Totals	Difference	L.S.D. 5%	L.S.D. 1%
A vs. D 128 - 32	96**	35.52	48.52
B vs. D 149 - 32	117**	35.52	48.52
C vs. D 181 - 32	149**	35.52	48.52
A vs. B 128 - 149	21	35.52	48.52
A vs. C 128 - 181	53**	35.52	48.52
B vs. C 149 - 181	32	35.52	48.52

*significant difference
**highly significant difference

From the data in Table 6 it is evident that the texture of the canned samples processed at 60, 90 and 120 minutes respectively differ significantly from the texture of samples unprocessed. The difference increases as the length of time increases. The difference between 60 minutes and

90 minutes is not sigificant but the difference between 60 and 120 minutes is significant. There is no significant difference between 90 and 120 minutes. This indicates that a range of 30 minutes processing does not have significant effect on the texture of the product.

Table 7. A comparison of the appearance differences between any two treatment totals with computed LSD at 5 per cent and 1 per cent levels of significance.

Treatment Totals	Difference	L.S.D.	
		5%	1%
A vs. D 133 - 35	98**	28.12	37.62
B vs. D 150 - 35	115**	28.12	37.62
C vs. D 175 - 35	140**	28.12	37.62
A vs. B 133 - 150	17	28.12	37.62
A vs. C 133 - 175	42**	28.12	37.62
B vs. C 150 - 175	25	28.12	37.62

*significant difference
**highly significant difference

In Table 7 there is evidence that the appearance of the canned samples processed at 60, 90 and 120 minutes differ significantly from the appearance ofthe unprocessed samples. The difference increases as the length of processing increases. The difference between 60 and 90 minutes and between 90 and 120 minutes are not significant, whereas the difference between 60 and 120 minutes is significant. Again this indicates that an interval of 30 minutes of processing does not have significant effect on the appearance of the product.

To determine the significance of the percentage not acceptable Table

D (Appendix, p. 79) was consulted. This table contained the minimum percentage not acceptable that is necessary for significance at the 1 per cent level, for the indicated number of difference evaluations. For example, for flavor evaluation, there were 33 difference evaluations made by 11 judges, hence the minimum percentage not acceptable to be considered for significance at the 1 per cent level was 21.5. If the computed percentage exceeds the minimum percentage given, the percentage not acceptable is significant. In Table 8 is presented the summary of the significance of percentage not acceptable for flavor, texture and appearance.

Table 8. A comparison of the computed percentage not acceptable with the minimum percentage "not acceptable" at the 1 per cent level of significance, of flavor, texture, and appearance.

	Computed percentage not acceptable			Minimum percentage "not acceptable" at 1% level
	A (60 min)	B (90 min)	C (120 min)	
Flavor	18.2	33.3*	51.5*	21.5
Texture	10	46.6*	50 *	23.5
Appearance	10	30 *	46.6*	23.5

* significant difference at the 1 per cent level

From the data in Table 8, the product processed for 60 minutes is acceptable with respect to flavor, texture and appearance. The data indicates that the longer the processing time, the less acceptable the product in all the three qualities evaluated.

Microbiological Treatment

Food spoilage by thermophilic "flat sour" organisms is indicated by acid production, thus a decrease in pH in the processed product indicates inadequate processing to kill the microorganism.

In Table 9 is presented the result of the pH determination on the original product (freshly prepared) before processing and pH after incubation at 55°C. for 7 days for both inoculated and uninoculated processed cans. The samples were coded as A for 60 minutes, B for 90 minutes and C for 120 minutes. The subscripts 1, 2, and 3 indicate the number of trials and the subscript C means control.

Table 9. A comparison of the original pH[1] and after 55°C. incubation of both inoculated and uninoculated canned samples.

Inoculated samples	Original pH	pH after 55°C incubation	Uninoculated samples	Original pH	pH after 55°C incubation
A_1	5.2	5.3	A_{1C}	5.25	5.3
A_2	5.3	5.3	A_{2C}	5.25	5.25
A_3	5.3	5.35	A_{3C}	5.3	5.3
B_1	5.3	5.4	B_{1C}	5.3	5.35
B_2	5.2	5.2	B_{2C}	5.2	5.5
B_3	5.3	5.4	B_{3C}	5.3	5.25
C_1	5.3	5.2	C_{1C}	5.2	5.2
C_2	5.3	5.2	C_{2C}	5.3	5.3
C_3	5.3	5.35	C_{3C}	5.3	5.3

[1]These determinations were obtained by using a glass electrode pH meter.

As shown in Table 9, there were no distinct changes in the original and final pH for both inoculated and uninoculated processed product. There was evidence that the microorganisms in the inoculated cans were killed during processing which otherwise would have caused a decrease in pH. These results indicate that all the three lengths of processing time were adequate to kill the heat resistant microorganism, as far as the conditions met in this study were concerned.

CHAPTER V

SUMMARY AND CONCLUSION

In this study the author was able to develop a canning technique for a rice and chicken dish being used in the Philippines, with acceptable qualities. The acceptability of the canned product was determined through a taste panel evaluation and by subjecting the data to statistical analysis. The length of processing time desirable to render the product bacteriologically safe was determined by a microbiological treatment, employing determination of change in pH as a test for spoilage.

It was indicated by the statistical analysis that there was a significant difference in flavor, texture, and appearance between the processed and unprocessed product. The samples processed for 60 minutes were found acceptable with respect to flavor, texture, and appearance. There was indication that an interval of 30 minutes in the processing time did not produce any significant differences in flavor, texture, and appearance, yet the difference in percentage of acceptability was significant.

A test for spoilage through determination of pH change indicated that all the three lengths of processing time (60, 90, and 120 minutes) used in this study were adequate to kill the heat resistant, "flat sour" microorganism.

From these findings, 60 minutes processing length of time, at 240°F. and 10 pounds pressure was identified as desirable to process the rice and chicken dish in 303 x 407 size C-enameled tin cans.

The canning technique for the rice-chicken combination dish found acceptable to the taste panel is as follows:

Recipe - this recipe is for 6 pint-size tin cans (12 cups)

1. Ingredients:

   Rice - Texas Patna No. 1, a long grain variety recommended for canning, partially cooked - 1610 grams or 9 cups

   Chicken, with bones, cut into pieces - 660 grams

   Peas, frozen - 300 grams

   Shortening, lard - 150 grams

   Tomato sauce, canned - 600 grams

   Onions, diced - 150 grams

   Salt, refined - 2 tablespoons

2. Procedure:

   a) Pre-cooking of rice

      1. Wash the rice to remove dust and extraneous materials.
      2. Drain the water thoroughly through a wire strainer.
      3. Soak the rice in equal amounts of water, (1 part water for every part of rice) at 27°C. for 45 minutes.
      4. Boil for 3-5 minutes. Count the time as soon as the water boils. (Steps 3 and 4 control the moisture content of the rice grains)

   b) Preparation of the chicken

      1. Clean the chicken and cut into sizes, such that two pieces (1 drumstick plus $\frac{1}{2}$ wing or $\frac{1}{4}$ breast plus $\frac{1}{2}$ wing) will approximately weigh 110-120 grams. Cut through the joints to divide the legs and wings

   c) Pre-cooking of the mixture

      1. Saute onions in one-half of the shortening.
      2. Add the following in the order given, with constant stirring to prevent scorching in the pan. Chicken, rice,

one-half of the shortening, peas, tomato sauce, and salt.

3. The heating time should be approximately from 7 to 10 minutes at moderate heat.

Steps in Canning

1. Fill the cans with the pre-cooked mixture. Put 2 pieces of chicken per can. Leave one centimeter head space.
2. Weigh each can to about 525 grams gross weight to have uniform contents.
3. Exhaust the air by heating the cans inside the pressure cooker or retort with open petcock for 5 to 10 minutes or until the temperature inside the can is 170°F.
4. Seal the cans.
5. Process at 240°F. and 10 pounds pressure for 60 minutes.
6. Cool the cans in running water until their temperature is approximately 90°F.
7. Label and store.

The author believes that many things remain that could be done to improve the quality of the product. This study has helped to identify some phases of the problem but others need further investigation.

Since the acceptability of the product largely depends upon the texture, flavor and appearance, which in turn are largely influenced by the moisture content of the mixture, a further study is suggested for identifying and controlling the desirable moisture content of the product. As mentioned by Roberts et al (28) it is desirable to limit the moisture content absorbed by the rice and to complete hydration before packing into the cans so that the moisture will be evenly distributed. Different rice varieties may give different results.

The processing length of time found adequate in this study holds true,

as far as the conditions met in this study are concerned. Beyond this point, no further recommendations can be made, since the adequacy of the processing conditions such as time and temperature largely depend upon the bacterial load of the materials to be processed. Thus a further study is suggested for more conclusive results in regard to the desirable processing conditions to render the product bacteriologically safe.

From previous studies conducted on canned pure rice, Roberts et al (28) reported that grain separation in canned rice is better than freshly cooked rice. Ferrel et al (10) explained that the superior quality of canned rice compared to freshly prepared short-grain rice, appeared to be due to the changes that occurred during processing and subsequent aging of canned rice. These changes appeared to be similar to firming or hardening in bread or starchy foods, often associated with retrogradation or crystalization of gelatinized starch.

It is of interest to know whether the conditions mentioned in previous studies are true in regard to the product under consideration. A further study is desirable to evaluate the qualities of the product after months of storage.

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A P P E N D I X

October 4, 1963

Mr. Roy Lee, Jr.
Vice President
Research and Engineering
Uncle Ben's Incorporated
P. O. Box 1752
Houston 1, Texas

Dear Mr. Lee:

This fall there is a young woman from the Philippines with us who is working on her Master's degree in Food Science. She has chosen to develop a chicken-rice combination dish that is popular in her country and to process it by canning. She hopes to come out with a product for which there will be demand in the Philippines and by Philippine students and others in the United States.

Probably she will use Texas Patna or a closely related variety of rice and will need 25 or 30 pounds to complete her research problem. In our previous conversations you indicated an interest in any research involving rice which we might undertake in the future.

Are you interested in donating enough converted rice, or polished white rice of the Texas Patna variety to be used in this study? If so, I would be pleased to hear from you in the near future.

Sincerely yours,

Helen F. Barbour
Head, FNIA Department

HFB:bdw

cc: Dean O'Toole
Miss Manalo

COPY

UNCLE BEN'S Inc.
A Subsidiary of FOOD MANUFACTURERS, INC.

Post Office Bos 1752 - Houston, Texas 77001, USA
Phone Walnut 3-6641

October 11, 1963

Dr. Helen F. Barbour
Head, FNIA Department
Oklahoma State University
Stillwater, Oklahoma

Dear Dr. Barbour:

With reference to your letter of October 4 to Mr. Lee, under separate cover we are sending you a 50 lb. bag of Canners Quality Texas Patna.

In canning chicken and rice combinations, it may be desirable to preblanch the rice in excess boiling water before mixing with the other ingredients. This does two things--tends to reduce the bacteria load entering the can, and it also minimizes the tendency for the rice to settle out in the bottom of the can and cause matting. You will, of course, want to experiment and determine the optimum blanching time for your particular conditions.

If we can be of any further service to you in this project, please let us know.

Sincerely yours,

UNCLE BEN'S, INC.

K.K. Keneaster
Product Services Director

KKK:mm

cc: Mr. Roy Lee, Jr.

October 24, 1963

Mr. K.K. Keneaster
Product Services Director
Uncle Ben's, Inc.
P. O. Box 1752
Houston, Texas 77001

Dear Mr. Keneaster:

Thank you for your prompt reply to my inquiry about Texas Patna rice for experimental use at Oklahoma State University.

The 50 pound bag of Canners Quality Texas Patna has arrived. Miss Manalo and I are grateful to you for the rice and for your suggestions concerning its processing in combination with chicken.

In order to keep records of the cost of her products Miss Manalo needs the commercial cost of Canners Quality Texas Patna such as that with which you have supplied us. Enclosed is a self-addressed envelope in which to mail this information to us.

There is much information in the literature concerning canned rice and meat products. However, we hope to add some new findings to these if possible. Right now I am trying to find an electrically controlled pressure cooker to use during processing of our products.

Thank you very much for the supply of rice and your suggestions for processing it.

Sincerely yours,

Helen F. Barbour
Head, FNIA Department

HFB:bw

Enc.
cc: Miss Baker
Miss Manalo

FNIA Department
Oklahoma State University
Stillwater, Oklahoma
February 19, 1964

Dear _____:

A study is being conducted to determine the effects of different lengths of processing time on the eating quality of canned rice and chicken product.

Your cooperation as a taste panel member is very much needed since you are familiar with rice cookery and dishes made from rice. Panel members will be requested to taste and score a series of samples of the processed rice and chicken product under consideration.

Taste panel evaluation will be held in room 403, Home Economics West Building. If you are willing to serve as a member of these taste panels please check one or more of the hours indicated below which will be convenient for you. If no suggested time is convenient will you please add a time on Tuesday that will be convenient for you.

Tuesday: 10:30 - 11:00 _____ 2:00 - 3:00 _____

11:00 - 12:00 _____ 3:00 - 4:00 _____

Other times _____

Your participation in this study will be greatly appreciated.

Very sincerely yours,

(Miss) Romualda Manalo

Dr. Helen Barbour
Thesis Adviser

FNIA Department
Oklahoma State University
Stillwater, Oklahoma
February 25, 1964

Dear _____:

Thank you for your prompt reply and interest to serve in the taste panel to evaluate the qualities of canned rice and chicken. The time for the taste panel evaluation has been set up on Tuesdays between 2:00 p.m. to 5:00 p.m. You will be notified as to the exact dates later on.

Your cooperation is very much appreciated.

Very sincerely yours,

(Miss) Romualda Manalo

Dr. Helen Barbour
Thesis Adviser

Flavor, texture and appearance difference evaluation

for Rice and Chicken dish

JUDGE SCORE SHEET

REPLICATE:___

NAME: _____

DATE: _____

1. Compare the degree of flavor, texture and appearance differences between each of the labeled samples and the reference sample.

(a) If you do not detect any difference exists, place a check (✓) in the box below the word NONE.

(b) If you think any difference exists, place a check (✓) in one of the other eight boxes below or between the term(s) which best describes the degree of difference.

2. After rating the difference, place a check (✓) in one of the boxes of the column indicating whether the qualities of the samples are acceptable or not acceptable.

3. Rinse your mouth after every sample if so desired. Retaste the reference sample as often as necessary to detect differences.

The Judge Score Sheet is continued on p. 70.

SAMPLE		NONE		SLIGHT		MODERATE		LARGE		EXTREME	ACCEPTABLE	NOT ACCEPTABLE
A	FLAVOR											
	TEXTURE											
	APPEARANCE											
B	FLAVOR											
	TEXTURE											
	APPEARANCE											
C	FLAVOR											
	TEXTURE											
	APPEARANCE											
D	FLAVOR											
	TEXTURE											
	APPEARANCE											

Example of summary of difference scores for quality evaluation designed specifically for use with Tukey's "quick and easy" analysis.

Treatment	Replicate	Quality difference score for indicated judges														Total	Range of judge sums	No. not Acceptable
		1	2	3	4	5	6	7	8	9	10	11	12	13	14			
A	1																	
	2																	
	3																	
	Sum																	
	Range															Percent not acceptable:		
B	1																	
	2																	
	3																	
	Sum																	
	Range															Percent not acceptable:		
C	1																	
	2																	
	3																	
	Sum																	
	Range															Percent not acceptable:		

(Continued)

Treatment	Replicate	Quality difference score for indicated judges														Total	Range of judge sums	No. not Acceptable
		1	2	3	4	5	6	7	8	9	10	11	12	13	14			
D	1																	
	2																	
	3																	
	Sum																	
	Range															Percent not acceptable:		
Grand sum of ranges																		Judge Range Total
Grand range of Sums																	Grand range of Totals	
O.S.D. ( )																		

Step by Step Illustration of the Analysis by the Tukey Method (21, p. 37).

A. For each judge:

1. The sum of the scores in all of the replicates for each treatment. For example, for Judge 1, the sum of the scores for Treatment A is 12, for Treatment B, 18, etc.

2. The range (difference between the highest and lowest score) within each treatment (i.e., Judge 1, Treatment A, the range is 2, and for Treatment B, 4, etc.),

3. The grand sum of the ranges computed in 2 above, i.e., for Judge 1 it is 2 + 4 + 1 = 7.

4. The grand range of the treatment sums computed in 1 above, i.e., the highest treatment sum for Judge 1 occurred in Treatment B (18), the lowest sum in treatment C (6). The difference between these two is the grand range or 12 for Judge 1.

5. Calculate the overall significant difference (O.S.D.) between treatment sums as follows: Enter Table 3 and obtain the appropriate factor in the 5% column for the number of replicates and treatments used. For example, in the illustration (Table 1) the number of replicates being 4 and the number of treatments, 3, the factor at the 5% level of significance is 1.25. Enter this factor on the summary form and multiply the grand sum of the treatment ranges for each judge by this factor. The product which is the O.S.D. is then entered at the bottom of the column for each judge, i.e., for Judge 1 it is 1.25 X 7 = 8.8. A comparison of this product with the grand range of the treatment sums will indicate whether or not the judge rated the various treatments significantly different. The range between the highest and lowest treatment score should be greater than the O.S.D. value, i.e., for Judge 1 the grand range of treatments sums is 12, which is higher than the O.S.D. value of 8.8. Whenever the range between the highest and lowest treatment sum for a given judge is equal to or less than the O.S.D. value, it indicates lack of ability to distinguish between any of the treatments.

6. Evaluation of judge performance: It will be noted in Table 1, after completing the calculations for O.S.D. values for the 15 judges, that judges 3, 6, 8, 12, 14 and 15 had grand range of treatment sums which were equal to or lower than their individual O.S.D. values at the 5% level. These judges, therefore, were unable to distinguish flavor differences, and in the illustration (Table 1) their data were eliminated from further consideration.

B. For each treatment:

1. Add the sums of replicate scores for each of the judges not climated. For example, the total of the sums for Treatment A for the nine remaining judges is 136, for B, 191, and for C, 49. These figures should be entered in the total column to the right side of the summary tabulation form.

2. Compute the range of the sums for the remaining judges in each treatment and enter this value in the column on the right side of the summary tabulation form headed Range of Judge Sums. In this example, for Treatment A the highest sum, 23, was given by Judge 13 and the lowest sum of 8 by Judge 9. The range is, therefore, 15 and is entered on the next column on the same line as the 136.

3. Count the number of asterisks in all of the replicates for a single treatment for the 9 remaining judges and record the number in the column at the extreme right of the sheet headed Number Not Acceptable. In the example given in Table 1, the number of asterisks for Treatment A for 9 judges is 13. For later evaluation of the significances, this number should be converted to a percentage. In the example cited, 13 is 36.1% of the total 36 evaluations made for Treatment A.

C. All treatments, all judges:

1. Determine the range of the total scores for each treatment that was computed for B-1 above. In Table 1 this value is 142 which is obtained by substracting 49 (sum for Treatment C) from 191, the sum for Treatment B. Enter this fugure on the summary tabulation form on the lower right hand at the base of the Total Column.

2. Obtain the judge total by adding the range of judge sums for each treatment. In the example cited, the 3 ranges are 15 for A, 14 for B, and 8 for C, making a total of 37. This figure should be entered at the base of the column headed Range of Judge Sums.

3. The next step is to determine the overall significant difference (O.S.D.) values to determine whether any significant differences exist among treatments. To do this, obtain the appropriate factors from Table 3. These factors are found in Table 3 in the column for the number of treatments that were used and on the line for the number of judges. In the example used, the appropriate factors are found in column 3, "for number of treatments" and on line 9, "for number of judges." For significance at the 5% level, the figure is 1.18, and at the 1% level, 1.53. Multiply this factor by the judge range total, 37. This will give 43.7 at the 5% level and 56.6 at the 1% level. In the example, Table 1, the grand range of totals is 142 which greatly exceeds the O.S.D. value of 56.6, and, therefore, a highly significant difference among treatment exists.

4. The next step is to determine the least significant difference (L.S.D.) values which will permit an evaluation of differences between any two treatments. It is necessary, however, that the O.S.D. value be significant before L.S.D. values are calculated and specific comparisons between treatments are made. (To be significant the O.S.D. value at the 5% level of significance must be less than the grand range of totals.) The procedure for calculating L.S.D. values is essentially identical to that used for O.S.D. In the example, the judge range total, 37, is multiplied by the L.S.D. factor found in Table 4 in the column headed 3 (number of treatments) and on line 9 (number of judges). The L.S.D. value at the 5% level is .98 X 37 = 36.3; at the 1% level it is 1.34 X 37 = 49.6. Therefore, the differences between any two treatment totals (A - C = 87, B - C = 142, and B - A = 55) are significant at the 1% level in this illustration.

D. Determining the significance of the percentage not acceptable:

Table 5 contains the minimum percentage not acceptable that is necessary for significance at the 1% level for the indicated number of flavor difference evaluations. For example, with the 36 flavor difference evaluations used in this illustration, a minimum percentage of 20.5 is needed for significance. Hence, the percentages rated not acceptable in both Treatments A and B (36.1 and 77.8) are highly significant.

LITERATURE CITED

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4. TUKEY, JOHN W. Quick and easy comparisons. (1953 Version) Multilith -- 10 pages.

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Table A. Statistical analysis of taste panel data (21, p. 42).

Table 1

Example (Laboratory 4): Summary of flavor difference scores

NOTE: Place an asterisk next to sample score when sample flavor was judged not acceptable.

Test code, Tomato juice
Dates of test, 1955

Treatment	Replicate	Flavor difference scores for indicated judge																				Total	Range of judge sums	No. not acceptable
		1	2	3[1]	4	5	6[1]	7	8[1]	9	10	11	12[1]	13	14[1]	15[1]	16	17	18	19	20			
A Code 19225	I	2	5*	2	3	7*	7*	3	1	1	4	5*	3	6*	5*	3								
	II	3	1	2	2	6*	3	3	3	3	3	3	1	9*	3	1								
	III	4	7	2	3	4*	5	7*	1	2	3	3*	2	7*	2	1								
	IV	3	6*	2	3	4*	7*	5*	1	2	2	1	1	1	2	3								
	Sum	12	19	8	11	21	22	18	6	8	12	12	7	23	12	8						136	15	13
	Range	2	6	0	1	3	4	4	2	2	2	4	2	8	3	2						Per cent not acceptable = 36.1		
B Code 29225	I	2	5*	4	3	5*	5*	7*	1	6*	3	7*	3	6*	7*	1								
	II	5*	5*	5*	3	5*	3	7*	1	6*	7*	5*	3	6*	5*	3								
	III	6*	9*	1	5	6*	5*	5*	3	5*	5*	3*	1	7*	1	1								
	IV	5	9*	4*	3	6*	5*	7*	1	5*	2	3*	2	7*	2	5*								
	Sum	18	28	14	14	22	18	26	6	22	17	18	9	26	15	10						191	14	28
	Range	4	4	4	2	1	2	2	2	1	5	4	2	1	6	4						Per cent not acceptable = 77.8		
C Control 09225	I	2	1	3	3	1	3	1	1	5	1	1	1	1	3	1								
	II	1	1	1	2	1	6*	1	1	3	1	1	1	1	3	1								
	III	2	1	2	1	1	3	1	3	2	1	1	1	1	3	1								
	IV	1	1	4*	1	1	5*	1	4	2	1	1	1	1	1	1								
	Sum	6	4	10	7	4	17	4	9	12	4	4	4	4	10	4						49	8	0
	Range	1	0	3	2	0	3	0	3	3	0	0	0	0	2	0						Per cent not acceptable = 0		
Grand sum of ranges		7	10	7	5	4	9	6	7	6	7	8	4	9	11	6							37	← Judge range Total
Grand range of sums		12	24	6	1	18	5	22	3	14	13	14	5	22	5	6						142		
O.S.D. (1.25)		8.8	12.5	8.8	6.3	5.0	11.3	7.5	8.8	7.5	8.8	10.0	5.0	11.3	13.8	7.5						↑ Grand range of totals		

[1] These judges (3, 6, 8, 12, 14, 15) were unable to distinguish flavor differences and their data (in italics) were eliminated from consideration.

Table B. Statistical analysis of taste panel data (21, p. 42).

Table 3

Multipliers of the range for computing over-all significant difference (O. S. D.) in evaluating judge performance and treatment differences when using the simplified flavor difference procedure

Number of judges or replicates	Number of treatments and Significance Level															
	2		3		4		5		6		7		8		9	
	5%	1%	5%	1%	5%	1%	5%	1%	5%	1%	5%	1%	5%	1%	5%	1%
	Multipliers															
2	3.43	7.92	2.37	4.42	1.78	2.96	1.40	2.06	1.16	1.69	1.00	1.39	.87	1.20	.78	1.03
3	1.91	3.14	1.44	2.14	1.13	1.57	.94	1.25	.80	1.04	.70	.89	.62	.78	.56	.69
4	1.63	2.47	1.25	1.74	1.01	1.33	.84	1.08	.72	.91	.63	.78	.57	.69	.51	.62
5	1.53	2.24	1.19	1.60	.96	1.24	.81	1.02	.70	.86	.61	.75	.55	.66	.50	.59
6	1.50	2.14	1.18	1.55	.95	1.21	.80	.99	.69	.85	.61	.74	.55	.65	.49	.59
7	1.49	2.10	1.17	1.53	.95	1.21	.80	.99	.69	.84	.61	.74	.55	.65	.50	.59
8	1.49	2.08	1.17	1.52	.96	1.21	.81	.99	.70	.85	.62	.74	.55	.66	.50	.59
9	1.50	2.09	1.18	1.53	.97	1.22	.82	1.00	.71	.85	.62	.75	.56	.66	.51	.60
10	1.52	2.10	1.20	1.55	.98	1.23	.83	1.01	.72	.86	.63	.75	.57	.67	.52	.61
11	1.54	2.11	1.21	1.56	.99	1.24	.84	1.02	.73	.88	.64	.77	.58	.68	.52	.61
12	1.56	2.13	1.23	1.58	1.00	1.25	.85	1.03	.74	.89	.65	.78	.59	.69	.53	.62
13	1.58	2.15	1.25	1.60	1.02	1.27	.86	1.05	.75	.90	.66	.79	.59	.70	.54	.63
14	1.60	2.18	1.26	1.62	1.03	1.28	.87	1.06	.76	.91	.67	.80	.60	.71	.55	.64
15	1.62	2.20	1.28	1.64	1.05	1.30	.89	1.08	.77	.92	.68	.81	.61	.72	.56	.65
16	1.64	2.22	1.30	1.65	1.06	1.31	.90	1.09	.78	.93	.69	.82	.62	.73	.56	.66
17	1.66	2.24	1.31	1.67	1.08	1.33	.91	1.11	.79	.95	.70	.83	.63	.74	.57	.67
18	1.68	2.27	1.33	1.69	1.09	1.34	.92	1.12	.80	.96	.71	.84	.64	.75	.58	.68
19	1.70	2.30	1.34	1.71	1.10	1.36	.93	1.14	.81	.97	.72	.85	.65	.76	.59	.68
20	1.72	2.32	1.36	1.73	1.11	1.38	.93	1.15	.82	.98	.73	.86	.65	.77	.59	.69

This table, shortened from tables prepared by Thomas E. Kurtz, Richard F. Link, John W. Tukey, and David L. Wallace. (2)

Table C. Statistical Analysis of taste panel data (21, p. 42).

Table 4

Multipliers of the range for computing the least significant difference (L. S. D.) in evaluating judge performance and treatment differences when using the simplified flavor difference procedure

Number of judges or replicates	Number of treatments and Significance Level															
	2		3		4		5		6		7		8		9	
	5%	1%	5%	1%	5%	1%	5%	1%	5%	1%	5%	1%	5%	1%	5%	1%
	Multipliers															
2	3.43	7.92	1.76	3.25	1.18	1.96	.88	.39	.70	1.07	.58	.87	.50	.74	.44	.63
3	1.63	3.14	1.14	1.73	.81	1.19	.63	.91	.52	.73	.44	.61	.38	.53	.33	.46
4	1.91	2.47	1.02	1.47	.74	1.04	.58	.80	.48	.68	.40	.55	.35	.48	.31	.44
5	1.53	2.24	.98	1.37	.72	.98	.56	.77	.47	.63	.40	.54	.34	.47	.30	.43
6	1.50	2.14	.96	1.32	.71	.96	.56	.76	.46	.62	.40	.53	.34	.46	.30	.42
7	1.49	2.10	.96	1.33	.71	.96	.56	.76	.47	.63	.40	.53	.35	.46	.31	.42
8	1.49	2.08	.97	1.33	.72	.97	.57	.77	.47	.63	.41	.54	.35	.47	.31	.42
9	1.50	2.09	.98	1.34	.73	.98	.58	.77	.48	.64	.41	.55	.36	.48	.31	.43
10	1.52	2.10	.99	1.35	.74	.99	.59	.78	.49	.65	.42	.55	.37	.48	.32	.43
11	1.54	2.11	1.00	1.35	.74	.99	.59	.79	.49	.65	.42	.56	.37	.49	.32	.43
12	1.56	2.13	1.01	1.36	.75	1.00	.60	.80	.50	.67	.43	.57	.38	.50	.33	.44
13	1.58	2.15	1.03	1.38	.76	1.01	.61	.81	.51	.68	.43	.57	.38	.50	.34	.45
14	1.60	2.18	1.04	1.39	.77	1.03	.62	.82	.52	.69	.44	.58	.38	.50	.34	.45
15	1.62	2.20	1.06	1.42	.79	1.05	.63	.84	.52	.69	.45	.60	.39	.52	.35	.46
16	1.64	2.22	1.07	1.43	.80	1.07	.64	.85	.53	.70	.45	.60	.40	.53	.35	.46
17	1.66	2.24	1.08	1.44	.81	1.08	.65	.86	.54	.72	.46	.61	.40	.53	.36	.48
18	1.68	2.27	1.10	1.46	.82	1.09	.65	.86	.54	.72	.47	.62	.41	.54	.36	.48
19	1.70	2.30	1.11	1.48	.83	1.10	.66	.88	.55	.73	.47	.62	.42	.56	.37	.49
20	1.72	2.32	1.13	1.51	.83	1.10	.67	.89	.56	.74	.48	.64	.42	.56	.37	.49

Extension of table prepared by J. W. Tukey. (3)
Factors for 11 to 20 replicates calculated by H. L. Stier.

Table D. Statistical Analysis of Test Panel Data (21, p. 42).

Table 5.

Minimum percentage of "not acceptable" required for significance at the 1% level

Number judgments	20	25	30	31	32	33	34	35	40
Minimum per cent	31.8	26.5	23.5	23.0	22.0	21.5	21.0	20.5	18.5

Number judgments	45	50	55	60	65	70	75	80
Minimum per cent	17.0	15.5	14.5	13.5	12.5	11.5	11.0	10.5

Procedure for the preparation of Bacto Thermoacidurans Agar, taken from the Difco Manual (8, p. 70).

Bacto Thermoacidurans Agar

Dehydrated

Bacto-yeast Extract	5 grams
Proteose Peptone, Difco	5 grams
Bacto-Dextrose	5 grams
Dipotassium Phosphate	5 grams
Bacto-Agar	20 grams

Bacto-Thermoacidurans Agar is recommended for the cultivation of Bacillus thermoacidurans (Bacillus Coagulans) the organism causing "flat sour" spoilage of tomato juice. It is prepared according to the formula described by Stern, Hegarty and Williams for the isolation of this organism, and for its cultivation in pure culture.

For the detection of B. thermoacidurans Stern, Hegarty and Williams recommended the plating of 1 ml of tomato juice per 20 ml of agar medium. They observed that larger quantities of tomato juice exhibited an inhibitory effect on the growth of the microorganism. Plates are poured with the sterile melted agar at 45-55°C. and following solidification, incubated at 55°C. for 48 hours.

To rehydrate the medium, suspend 39 grams of Bacto-Thermoacidurans Agar in 1000 ml of cold distilled water. Heat to boiling to dissolve the medium completely. Distribute in tubes or flask and sterilize in the autoclave for 15 minutes at 15 pounds pressure (121°C). Since this is an acid medium, overheating during sterilization period or holding in the melted state should be avoided or a soft medium will result. The final reaction of the medium will be pH 5.0.

Procedure for the preparation of Physiological Salt (water blanks) solution taken from: An Introduction to Laboratory Technique in Bacteriology (19, p. 376).

Physiological Salt Solution

(Water Blanks)

Water blanks are tubes or flasks or bottles containing definite quantities of physiological salt solution.

1. Prepare physiological salt solution by adding 8.5 grams of NaCl to 1000 ml of distilled water.
2. Place in each of ten test tubes 9.5 ml of the salt solution. On sterilization about 0.5 ml will evaporate thus leaving 9 ml which on addition of 1 ml of the substance to be diluted will yield a dilution of 1 to 10.
3. To flasks or bottles add 103 ml of physiological salt solution. This will lose about 4 ml upon sterilization and will yield an addition of 1 ml of the material to be diluted, a dilution of 1 to 100.
4. Sterilize in the autoclave at 15 pounds for 20 minutes.

VITA

Romualda S. Manalo

Candidate for the Degree of

Master of Science

Thesis: DETERMINATION OF A CANNING TECHNIQUE AND ACCEPTABILITY OF A CHICKEN AND RICE DISH USED IN THE PHILIPPINES

Major Field: Food, Nutrition, and Institution Administration

Biographical:

Personal Data: Born February 7, 1935 in Pasig, Rizal, Philippines, the daughter of Ceferino Manalo and Cayetana Santos.

Education: Graduated from Rizal Provincial High School in 1953; received the Bachelor of Science degree from the University of the Philippines in 1957.

Professional Experience: Served Dietetic Internship at the Philippine General Hospital, Manila, Philippines 1957; worked as Dietary Interviewer at the Food and Nutrition Research Center of the Philippines 1958; passed the civil service examination for dietitians, given by the Philippine government, 1959; Faculty member of the Araneta University, Philippines, 1959-1962; food researcher, Araneta University and Republic Flour Mills, Philippines, 1960-1962; completed Administrative Dietetic Internship, Oklahoma State University 1962-1963; worked as Assistant Dietitian, Murray Dining Hall, Oklahoma State University, fall 1963.

Professional Activities: Secretary - Philippine Association of University Women, Araneta University chapter; member - Philippine Association of Nutrition; Dietetic Association of the Philippines; American Dietetic Association; Recipient of the Presidential Fellowship Award, Oklahoma State University (1963-1964); Grant-in-Aid, Altrusa International Foundation, 1964.