THE CANNING STYLES, MICROBIAL STABILITY, AND ACCEPTABILITY OF CANNED MUSSEL

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Doctor of Philosophy in Educational Management

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APPROVAL SHEET

In partial fulfillment of the requirements for the degree, Doctor of Philosophy (Ph. D.), this dissertation entitled " THE CANNING STYLES, MICROBIAL STABILITY AND ACCEPTABILITY OF CANNED MUSSEL " was prepared and submitted by Miss LETICIA E. DELOS REYES who having passed the comprehensive examination with a Rating _____, is hereby recommended for oral examination.

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DEDICATION

This humble accomplishment
is dedicated to her sisters, brothers,
and to those who had inspired HER
Most especially dedicated
to her parents wherever they may be,
they being the light, the hope, and the prime
mover in the total development of HER.

Letty

ABSTRACT

The study is envisioned to determine the effects of canning style on the microbial stability and acceptability of the canned mussel. A Quasi Experimental Design was used to determine the degree of acceptability, microbial stability, the most appropriate canning styles and procedure, and to realize a workable manual for Tahong Canning, so that the development of the tahong canning industry can take its course. The results of the study reveals that five styles used to canned tahong were all acceptable and fit for human consumption, since the bacterial count was less than thirty (30). Therefore, the five styles used in canning tahong (Tahong in Chili Sauce, Tahong in Adobo, Tahong in Tomato Sauce, Tahong in Sweet and Sour Sauce, and Tahong in French Styles) are appropriate in canning tahong in commercial scale. The finding provided the necessary insights and information in the formulation of a Manual for Canning Tahong. The Manual can now serve as an entry point in the operation of tahong canning plant/factory leading to the development of tahong canning industry in the province of Samar.Both sensory evaluation and microbial analysis provided very vital and wanting information that is, the five styles were all acceptable and that the four attributes (color, odor, flavor, and texture) did not affect the acceptability of the canned product. The number of microorganisms did not in any way affect the quality of the canned product, making it therefore fit and safe for human consumption. Optimum time and temperature (20 minutes at 10 pound (1bs) pressure at 240F/115.6C) had destroyed and

reduced the number of bacteria, agents of spoilage to less than thirty (30). A Manual for Tahong Canning came to birth after discovering that the five styles of canning had provided favorable results as the canned products were all acceptable or linked.

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CHAPTER I

THE PROBLEM AND ITS BACKGROUND

Introduction

The world's populace lives mainly along the lakes, rivers and coastal water systems of the world. For this reason, fisheries must be that important as a food supply system.

Acosta (1975:5) revealed that in the Philippines, like the rest of the Southeast Asian Countries, Aqua-culture plays a very important role in its economy. As early as the 1970's, mollusk culture has developed into a profitable industry in Bacoor Bay.

Pillay (1977:15) stated that comprehensive statistics of aqua-culture production are not available and the last estimate was made in 1975. According to this estimate, the world production through aquaculture in 43 countries is 6,102 thousand tons, of which 329 thousand tons are mussel production. The data available is as follows:

	Production in Thousands of Tons
Finfish	3,981
Shrimps and Prawns	16
Oyster	591
Mussel	329
Clams	37
Other Mollusk	93
Seaweeds	1,055
Total	6,102

Lawson (1985:94) found out that most aquatic products are of animal origin and are high in protein, are highly digestible, and provide a reasonable balance of amino acids. These characteristics of seafoods are reasons for the strong interest in fisheries by many developing countries and international development agency.

In the Global 200 Report (1980:22) it is assumed that the aquatic catch is about 20% protein and an average person requires about 36 grams of protein per day for an adequate diet, it is possible to calculate the contribution fisheries will make to protein supplies for 1980 and 2000. The 1980 catch of 72.2 mmt. supplies about 14.4 mmt of protein. With a 1980 population of 4.4 billion people, fisheries will supply about 24% of the human protein requirement.

Recent trends in the relative importance of different shellfishes in the whole world are affected by the public desire to obtain fishery products having high keeping qualities and presenting uniform high palatability at all times.

Young (1982:43) reported that there are numerous commercially important species of bivalve in the Philippines but only green mussel (Perna viridis) and slipper-shaped oyster (Crassostrea iredalei) are found extensively in traditional ways. Mussel culture occurs

mainly in Bacoor Bay (Cavite), Sapias Bay (Capiz) and Maqueda Bay (Jiabong, Samar). Usually the farm ranges from 20-60 tons/hectare (using stake method) to 300 tons/hectare (using hanging method). The Philippine Green Mussel have grown an average of 10mm/month and marketed after 4-6 months (about 40-60mm long). The location of the Tahong farms in different parts of the country can be seen in Figure 1. Figure 1 - Philippine Map showing the location of tahong/mussel farms.

PCARRD Report (1983:2-3) mentioned that there are two species of mussel used as food in the Philippines, namely: the green mussel, Perna viridis, and the brown mussel, Modiulis metcalfie and Moduilis philippinarum.

The green bay mussel formerly known in science as Mytilus smaragdinus, and now as Perna viridis, locally known as "Tahong", is the most common bay mussel in the Philippines. It is popular among the Filipinos as the sea delicacy and an important source of shellfish protein. The mussel is characterized by untorted bilaterally symmetrical mollusca with a laterally compressed, dorsally hinged two-valved shell that enclosed the body. Head, radula and cephalic eyes lacking and a muscular foot. Its intestine passes through the heart. Bivalve ranged in size from a few mm. to over 6 inches in length. The body is soft and shiny, the shell is usually hard. All the

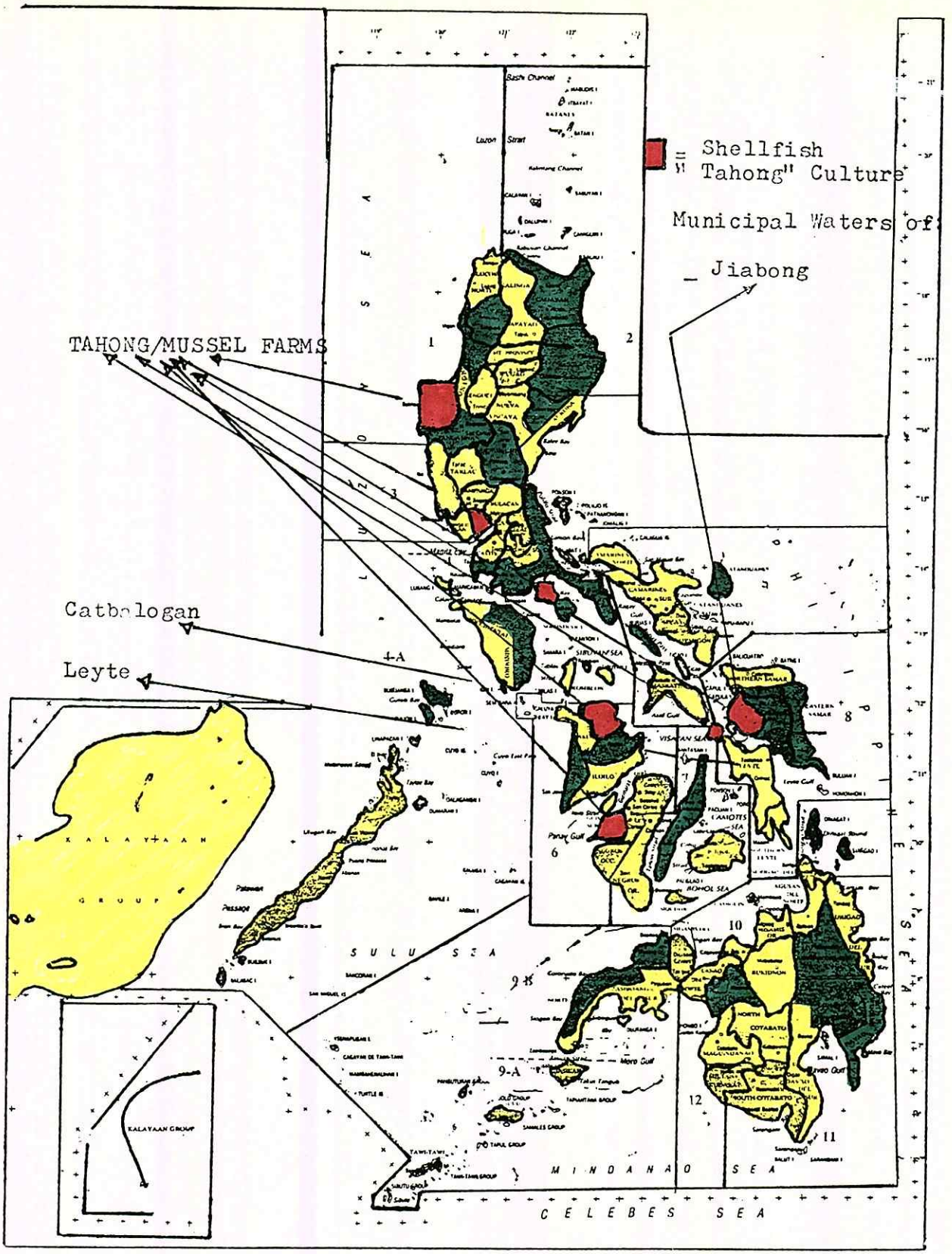

Figure 1: Philippine Map showing the location of the Tahong/Mussel Farms

species are sedentary but ranging from fairly mobile, burrowing forms to bysally attached or cemented. Some are capable of swimming short distances by clapping their valve. The parts of the mussel are properly labelled. Figure 2 a-b- Parts of a Tahong/Mussel Shell.

The Philippine Fisheries Commission (1967:4) reported that mussel usually found along shallow coves, bays and mouth of estuaries clinging to stones, bamboo files or any object. Spawning season is not definite, however findings reveal that mussel lay eggs from April to May and October to November. A male mussel is characterized by a white mantle while a female mussel has orange to red-orange.

Teng (1977:69) found out that mussel matures when about 2.5-3.0 cms. in length and spawns throughout the year. Fertilization is external. The length of a mussel at settlement is about 0.3-0.4 mm. and eventually reaches 13-15 cms. It was found out that during periods of over 3-6 months, the modal length increases from 0.89-1.29 cm/month.

When the bay mussel becomes sexually mature, the female lays egg in water while male secret milt to fertilize the eggs. Fertilization takes place, then the eggs are hatched into free-swimming larvae. As the free-swimming larvae develops, the shell and the byssus gland become denser. Later, the larvae attaches to any

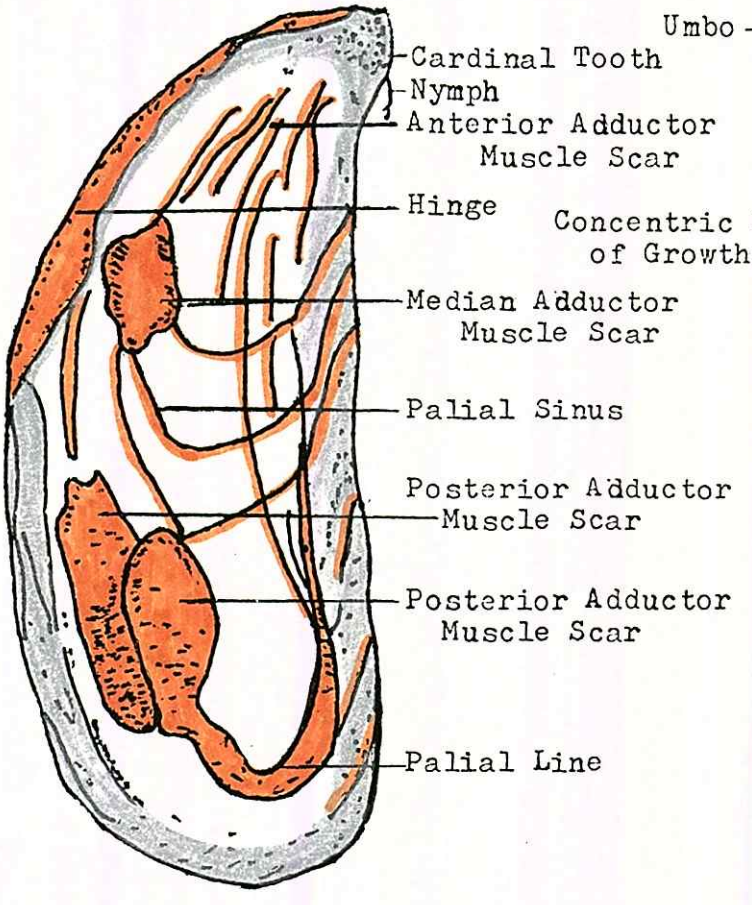

Figure 2-a - Shell Interior

Figure 2-b - Shell Exterior

Figure 2a-b: Parts of a Tahong/Mussel Shell

available hard object, serving as mode of attachment. The stage is known as "spat". When the mussel had permanently attached itself to the object of attachment, it becomes immobile or is considered as sessile organism. The mussel is a filter feeder and therefore would take any kind of food that settles, to include microscopic organisms.

Anon(1979:29) stated that a good indicator for a farm site is intensity of mussels and oysters found clinging to structure. Favorable salinity for mussel is from 27-35 part per thousand (ppt). The site should have a somewhat hard and sticky bottom and could assure that mussel remains under water at all times. Methods employed in the Philippines are the stake, rope, and wigwam.

Based on 1992 price, a one hectare mussel farm using the stake method can yield a net profit of P3.50 per peso investment.

The Bureau of Fisheries and Aquatic Resources, Catbalogan (1988) reported that there are 115 Mussel Farm Operator in Samar. This resulted to the development of 6.376 hectares mussel farms with a total annual production of 1,551,600 kilos or 1,551.6 tons. The mussel farm is from 0.003 to .35 hectare with 750-87,000 kilos annual production.

Out of the 6,376 hectare mussel farms, Barangay Bunu-

anan has 0.04 hectare farm with 10,000 kilos or 10 tons annual production; Pangdan, Catbalogan, Samar with .5875 hectare, giving an annual production of 142,850 kilos or 142.85 tons; Jiabong, Samar had developed 5.7503 hectares mussel farms with yearly production of 1,398,750 kilos or 1,398.750 tons as reported by the Bureau of Fisheries, Catbalogan Branch. The farm sites are properly pinpointed in the map of Samar Island. Figure 3 is the map showing the tahong farms in Jiabong.

De Leon (1982:180) reported that the tahong industry in the municipal waters of Jiabong, Samar is a lucrative one, in the sense that production has reached its peak which had led to its exportation to nearby provinces and cities. Because the supply of tahong become so abundant during certain months of the year, it is important to preserve the harvested tahong for future use. To preserve it, we must cope with its spoilage, and to cope with spoilage we must know what causes it and how it is brought about. Basically, natural foods are perishable because they are biological materials and are rich substrates of all enzymes, both those normally present in the food and those found in molds, yeasts, and bacteria which contaminate the food. In food preservation man is in a constant race with these agents of spoilage. Molds, yeasts, and bacteria are found in the air, in the

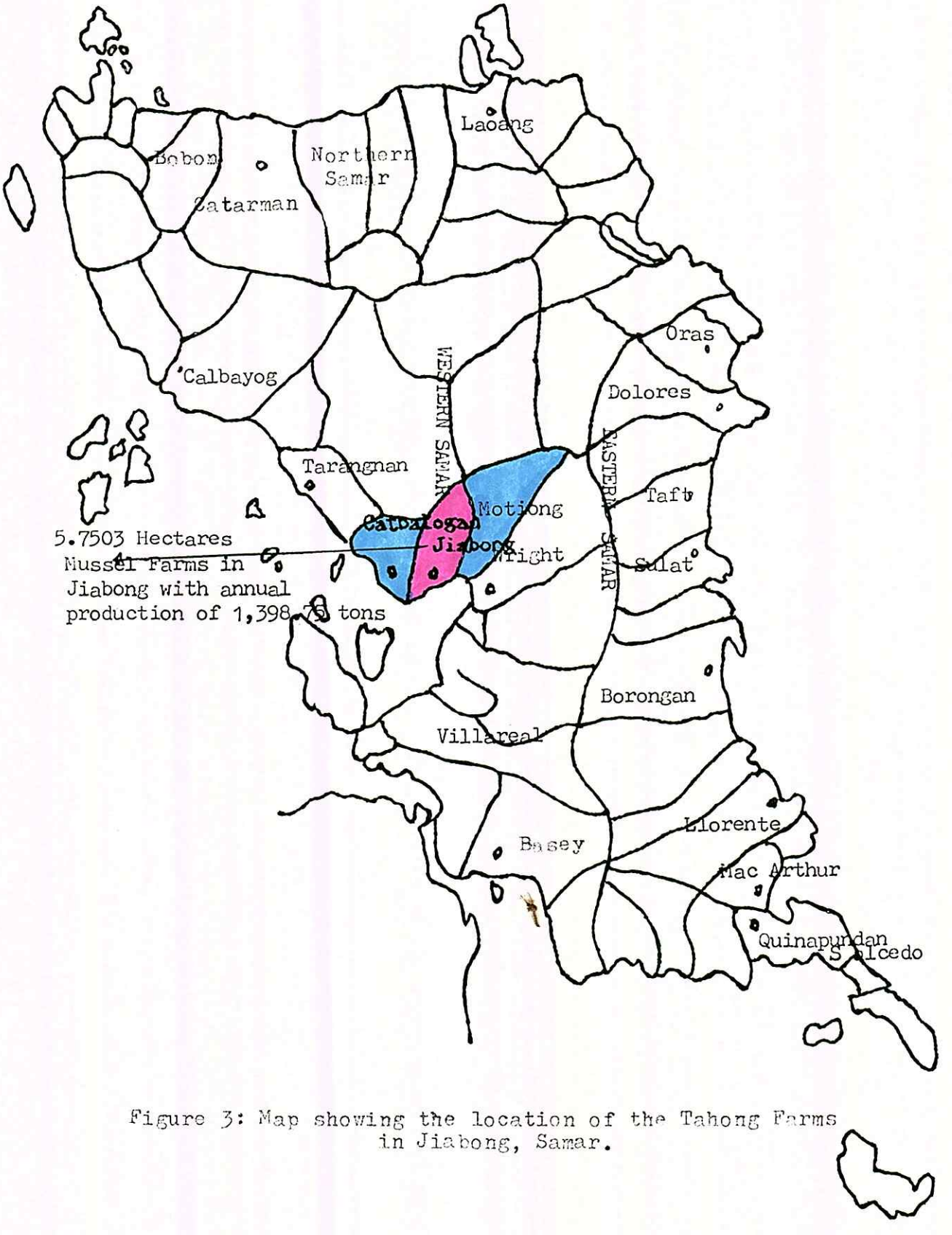

Figure 3: Map showing the location of the Tahong Farms in Jiabong, Samar.

soil, and in the water. Food is exposed to them and when conditions is favorable, these spoilage agents grow and demonstrate evidences of their presence in the form of changes in appearance, flavor, and texture of the food.

Canning is one effective method of food preservation. Canning is the application of heat to food in hermetically sealed container either in the cans or glass jars, at a given time and temperature enough to destroy microorganisms likely to cause spoilage.

However, only a sound knowledge of canning principles and their application, would enable one to engage in these venture. Unless the canned products are safe from a public health stand-point and are as palatable as freshly cooked dishes, one does not get the feeling of having achieved something really worthwhile.

This study aims to standardize canning procedures appropriate for the mussel industry in Jiabong, Samar considering that of all the fish processing methods, canning is the best, though its procedure is complicated. Canning retains the original flavor of the food, improves the nutritive value of the products especially when additives are used, lengthens shelf-life up to two years and facilitates transport.

With this information, the mussel canning industry in the municipality of Jiabong will be intensified through

the operation of a canning factory. After this study, the search for the best sytles and standardized canning procedures would have been conducted and determined. Also, a manual for tahong canning had been formulated to facilitate the operation of a Tahong Canning on commercial scale.

Statement of the Problem

The study aims to determine the effects of canning style on the microbial stability and acceptability of the mussel.

Specifically, the study seeks to answer the following questions, to wit:

1. What is the degree of acceptability of the canned mussel as to:

    1.1. the five styles (Tahong in Chili Sauce, Tahong in Tomato Sauce, Tahong in Adobo, Tahong in Sweet and Sour Sauce, and Tahong in French Style)

    1.2. the four attributes (color, odor, flavor, and texture)

    1.3. the four attributes in the five styles of preparing canned mussel.

2. What are the significant effects of the number of microorganisms on the microbial stability of tahong canned in the five styles?

3. What manual for tahong canning can be drawn based on the study?

Hypotheses:

The hypotheses to be tested in the study are:

1. There are no significant differences on the acceptability of the canned mussel/tahong using the five styles.

1.1 There are no significant differences on the acceptability of the canned mussel/tahong among the five styles.

1.2. There are no significant differences on the acceptability of canned mussel between the four attributes (color, odor, flavor, and texture)

1.3. There are no significant differences on the acceptability of the four attributes on the five (5) styles of preparing canned tahong/mussel.

Theoretical Framework:

The study entitled "The Canning Styles, Microbial Stability, and Acceptability of Canned Mussel" is intended to standardize the canning procedure for mussel using the five styles.

The five styles of canning mussel will be considered in the study to be able to determine the most appropriate style of canning mussel on commercial scale. This is

anchored on the theory that the maintenance of high quality, tasteful menu, and careful processing are all necessary to obtain high production, acceptability, and to increase sale (Campbell, 1982:22).

This study is envisioned to come up with an acceptable standard procedure of canning mussel in tin cans so that factories can be operated on commercial scale in the vicinity of Jiabong where the mussel farms are situated, and so that the freshness of the mentioned species and its continuous supply can be maintained even during inclement weather and in time of scarcity. The standardized style of canning tahong considering quality, acceptability and palatability will be determined. A manual on tahong canning will be prepared and made available for distribution to fishery minded individuals who would want to venture on the canning of tahong on the commercial scale. More so, the manual on tahong canning will provide alternative or option to fisher folks and other residents of Jiabong, Samar so that the family source of income will be augmented.

A well conceived manual will serve as a vehicle in the development of the canning industry in places where tahong are abundantly found and farmed.

The operation of the canning factories for mussel will generate more employment and will partake in making

the country self-sufficient of quality canned mussel.

Conceptual Framework

Figure 4 shows the conceptual framework of the study. The frame on the left contains the independent variables which are the raw materials and the five styles of canning. The second frame represents the processes by which the standards were measured which includes sensory evaluation, statistical analysis,and, microbial analysis. The third frame provides us with the information upon which the processed/canned mussels were evaluated.

The last frame projects the realization of a manual for tahong canning on commercial scale or on small localized operation. With this in mind, the operation of a tahong canning plant will be enhanced as a result of the study.

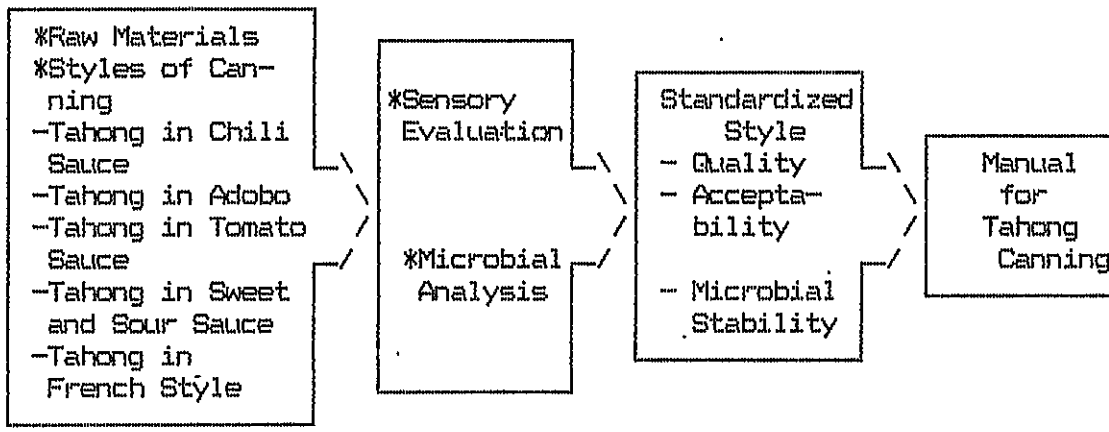

Figure 4. Diagram showing the Conceptual Framework of the Study

Importance of the Study:

Through the findings of this study, individuals who would like to venture on mussel canning through the operation of processing plant or factory can embark on the canning industry, since the best style of canning mussel has been identified and standard procedure has been attained.

Having identified the best and appropriate style of canning tahong/mussel, the municipality of Jiabong, province of Samar and the entire country will be assured of the continuous supply of quality canned mussel.

With the establishment of the mussel canning factory, the tahong farms operators in Jiabong will have a ready market for their produce. Those with limited capital but interested to process the fresh mussel into canned products can start with small localized operation.

The establishment of the tahong canning factory in Jiabong, Samar will certainly provide job opportunities to the residents and will encourage more residents to engage in tahong culture. As a result, the socio-economic condition of the entire province of Samar will be improved.

The students will have additional insights and information in the preservation of tahong. The findings of this study will facilitate more researches, so that more value-added mussel products will be produced.

In a nutshell, the Manual for Tahong Canning, as a result of the study will by all means open the portal to the development of tahong canning industry in the province of Samar, specifically in Jiabong. The Samareños will be most benefited in terms of income-generation, the first to avail the sound and appropriate technology in canning mussel for a productive and profitable endeavor, and above all, the first to be supplied with quality and palatable canned mussel. Certainly, the post harvest technology "Tahong Canning" will lead to the production of value-added products. The making available of the manual for tahong canning will undoubtedly ameliorate the living condition of the residents of Jiabong through the operation of tahong canning plant.

Post harvest technology "Tahong Canning" can make a switch from the simple selling live and fresh tahong to interested buyers at a very low cost to the production of value-added product.

Ultimately, the tahong canning industry will contribute to the quality of life of the low-income families in Jiabong. Furthermore, it will contribute toward national self-sufficiency in fishery canned products. Also, it will contribute to the national econo-my through replacement of imported food with local tahong canned product. And certainly, the mussel canning

industry in Jiabong may stimulate national investment to maximize its production, so as to satisfy the demands for more canned tahong.

Moreso, the occurence of Red Tide will not in a way effect the continuous supply of tahong in different market outlets since the production of quality canned tahong had considered the occurence of this natural phenomenon.

Scope and Delimitation of the Study:

This study is primarily concerned with the canning of tahong using five styles; Tahong in Chili Sauce; Tahong in Adobo; Tahong in Tomato Sauce; Tahong in Sweet and Sour Sauce, and Tahong in French Style.

It is limited to the determination of the microbial stability and acceptability of the canned tahong using the sensory, and microbial evaluation.

The marketable tahong (two to three inches in length) to be used in the study will be taken from the municipal waters of Jiabong, where the tahong farms are successfully operated.

The canning activity using the five styles was done summer, 1991 to facilitate the storing of the canned mussel for eight months before subjecting to sensory and microbial analysis.

The stored canned products were evaluated in February, 1992 through sensory evaluation and microbial

analysis.

The canning activity was done at the Fish Processing Laboratory of the Samar Regional School of Fisheries.

For microbial analysis, the sampled canned tahong were brought to Zamboanga State College of Marine Sciences and Technology. The service of the Fish Processing Instructor and their facilities were utilized in the determination of the bacterial load through a standard plate count. A manual for tahong canning was conceived to facilitate the operation of a canning plant in the municipality of Jiabong.

Definition of Terms:

For clarity and understanding of this study, the following are conceptually and operationally defined.

Acceptability. The degree of satisfaction by which the mussel canned product is measured/evaluated in terms of its attributes/characteristics: color, odor, flavor, and texture.

Canning. Wheaton (1985:54) defined canning as the method of preservation in which spoilage of the products is prevented by killing the microorganisms through heat.

Commensal bacteria. Lackey, R., and Nielson, L. (1980:31) defined it as a kind of bacteria that derive benefit from the host like mussel and other mollusks.

Commensalism is a relationship between two population in which one is benefited and the other is assumed to be unaffected.

Culture. The human effort in increasing the maximum production of cultivated species. The rearing of mussel seedlings to marketable size.

Degree of freedom. Webster (1976:2093) defined it as the number of interval in which the frequency may be arbitrarily assumed in a statistical distribution with equal intervals of the statistical variable.

Depuration. A method used to remove microorganisms from the body of the mussel either by stocking the species in clean water or by stocking it in an environment with good water quality and fed with flour for a short period before it is used for canning.

Freshness. Canned product in the state of good condition and fit for human consumption.

Green Mussel. Formerly known in science as "Mytilus smaragdinus" and now "Perna viridis", locally known as "tahong", is the most common bay mussel in the Philippines. It is popular among the Filipinos as a sea delicacy and an important source of shellfish protein.

Hedonic Scale. The nine point Hedonic scale contains a scale value of 9-1, and descriptive terms meaningful to the taster panel found in the sensory

evaluation sheet.

Microbial Content. According to Froilan (1982:6) microbial content is the number of colonies or microorganisms present per 1 gram or 1 ml. of the sample.

Microbiological Analysis. The scientific method of determining the standard plate count and demonstration of the pressure or absence of coliform and other microorganisms per 1 ml. or 30 grams of the sample products after culturing for 24-48 hours at 55°C on agar.

Multiple Scoring Test/Comparison. Destroiser (1984:413) defines this as a reference on standard sample which is labeled R and presented to the panelists with 2 or more coded samples, can be used efficiently to evaluate 4-5 samples at a time.

pH. Negative logarithm of the hydrogen-ion concentration, measured with the use of pH paper, pH meter and color comparator.

Quality Control. Connel (1980:1) defined it as it embrace intrinsic composition, degree of contamination with undesirable materials, nutritive value, degree of spoilage, damage, deterioration during processing, storage, distribution, sale, and presentation to the consumer, hazards to health, satisfaction on buying and eating, aesthetic considerations, yields, profitability to the producer and middlemen.

Style. Ways of preparing or manner of preserving mussel through canning to prevent spoilage.

Sensory Evaluation. Herson(1981:84) defined the term as a valuable tool in solving problems involving food acceptability. It is useful in product development, and market research.

Shelf-life. Webster (1976:2098) defines this term as the period of time during which the materials may be stored and remain suitable for use; called also storage-life.

Standardized Styles. The term refers to the ways of preparing or preserving canned mussel that had obtained a high acceptability as a result of sensory evaluation.

Standard Plate Count. Is also called the aerobic count or pour plate, a method commonly used for enumerating aerobic microorganisms or for determining the colony forming unit after having been cultured for 24-48 hours at $55^{o}C$.

CHAPTER II

REVIEW OF RELATED LITERATURE AND STUDIES

If only to give more meaning and substance to this study, the researcher finds all possible ways and means to review documents, unpublished theses, dissertation, books, journals, and other reading materials available in the libraries and locality.

CONCEPTUAL LITERATURE

A. Foreign

A review on the views and contribution of foreign authors on canning and other vital information on the preservation of mussel formed part of the conceptual literature of the study.

The conventional and traditional way of preserving the tahong had paved the way to further investigate the possibility of putting up the most appropriate canning style and procedure so that quality canned products can be produced. Post harvest technology therefore, is required for product development and quality management.

The World Health Organization (1974) stipulated that the maintenance and further expansion of the product "tahong" in the market are becoming increasingly dependent not only on the traditional commercial but also on the

bacteriological quality of the product, as the role of fish foods in the transmission of disease becomes recognized.

Destrosier (1984:413) stated that the asceptic canning process involves special techniques and equipment. The basic operation connected with the convention process are: The preparation of food-a variety of processes such as grading, trimming, washing, blending, pre-cooking, etc. are employed. The pre-canning operation should be carried out effectively but rapidly since unnecessary delay at this stage will permit the development of rapidly growing microorganisms which may render the heat process inadequate. The operation of food which are of significance to the microbiologist are 1) washing, 2) peeling, 3) blanching, since all these operation should lead to a reduction in the number of contaminating organisms which are present on the surface of the product.

Ball (1975:558-590) said that the container to be used in canning must be sterilized to inactivate microorganisms. A vacuum inside the can is necessary for the following reasons: (1) to prevent chemical reaction and iron base of the tin plate; (2) to prevent spore formation of aerobic bacteria; (3) to maintain the normal position of can ends; (4) to minimize rancidity of the products

during storage. Canning is the method of preservation in which spoilage of the product is prevented by killing the microorganisms through heat. The thermal treatment of the entire can contents must be at least equivalent to 4 minutes at 120°C or 10 minutes at 115°C. In addition, additives, such as salt, glutamate, oil or acid may further prevent spoilage or may reduce the heat requirement since heating may cause undesirable flavor and texture changes. After canned foods are sterilized and deactivated by heat, the container protects the food from spoilage which is due to recontamination by microorganisms. The food may be stored for many months if not subjected to extreme environment conditions or if the container is not ruptured.

The factors affecting the canning process are: condition of raw material; containers, filling; vacuum; canning-up time and; time and temperature relationship.

1. Containers - canned fish containers are most commonly made from either tinplate, aluminum sheet, and laminated aluminum foil or glass. Tinplate coated with special enamels to minimize reactions between the active constituents of canned fish products and their containers. Abrasions, gap on thin areas in the enamel will permit reactions between the tinplate and the contents to occur and this may affect quality in several ways. A common

type of reaction with most fish products result in the formation of a black iron sulphide stain on the surface of the food or on the outside wall of the container. These strains are not harmful but they detract from the appearance of the product. If the canned product contains acidic ingredients, failure of the protective enamel may lead to reactions with the metal in which hydrogen gas is formed. If sufficient gas is generated, its pressure will cause the container to become a swell.

2. Filling - In filling containers, account must be taken of the fact that the contents will expand as contract in volume more than the container will with changes in temperature. This means that the amount of headspace in containers of canned fish will be decreased as the temperature is lowered. Most containers need some headspace to prevent them from bursting or becoming permanently distorted during the heat process. The amount of headspace will depend on a number of factors including the size and type of the container and the nature of the product. Large headspace will also permit freer movement of the contents during handling and this may be detrimental to the appearance and texture of the product. Furthermore, the product may appear to be deceptively packaged if the containers are not filled reasonably close to their capacity.

3. Vacuum - There are four good reasons for wanting a partial vacuum in a can.

a. During heat processing the positive pressure in a can increases considerably and the partial vacuum present helps to reduce the pressure, and in doing so reduces the chance of distortion and damage to the same.

b. After processing and cooling, the vacuum, causes the ends of the can to be collapsed, that is concave. Cans not evacuated may appear to be blown,but in fact are still quite wholesome. This occurs when the headspace of the can increases due to considerable rise in temperature over that of packing, or due to the pack being exposed to lower atmospheric pressure that is at higher altitudes. The vacuum prevents this from occuring.

c. The presence of vacuum in the can reduces the oxygen content of the headspace and therefore the extent of internal corrosion is prevented.

d. Oxygen also causes discoloration of many products and if present in any appreciable amount it may oxidize vitamins C and A, with resultant loss of nutritive value. Vacuum can be obtained either by heating exhausting or vacuum seaming.

3. Air in the retort - the complete elimination of air from the retort is a vitally important factor in steam processing, and unless special provision is made to

maintain a uniform steam-air mixture, serious under-processing may result. Retorts or cookers should be so constructed that removal of air is facilitated. This is brought about by a procedure known as "venting", the steam before it is brought to operating temperature. One effect resulting from the presence of air in the retort is that for any given pressure the temperature is lower than that obtained with steam alone.

4. Coming-up time - To Lopez (1982:56), this is time required to reach the required processing temperature and pressure. There is a minimum limit for the coming-up time from retort by venting during this period. When venting is inadequate for rapid removal of the air, a very short coming up time is likely to result in under-processing. A coming-up time shorter than the minimum for which the retort has been demonstrated to give satisfactory result should not be used. With some vacuum packed products, it is advisable to heat the cans sufficiently to dissipate the internal vacuum before the pressure in the retort is permitted to become greater than two pounds, otherwise the cans may panel or even collapse.

5. Time and Temperature relationship - According to Eisner(1972:55-57) a knowledge of the time-temperature relations in the cans during the sterilizing process is desirable as an aid to their application in the

scientific study of food sterilization. He also pointed out that the destruction effect is greater with rising temperature, and that the holding time at the higher temperatures can be shortened, on condition that they act for sufficient time at the "cold spot" of the product. In other words, the achievement of the F_o value necessary for sterilization is shortened by employing higher temperatures, to the extent of the rise in temperature.

6. Initial temperature - Stumbo (1973:16) defines initial temperature as the temperature of the food at zero time of heating on cooling. Eisher (1972) said that just prior to the start of the process, the contents of the container used for checking the initial temperature should be shaken or stirred and the temperature determined. This container should be representative of the coldest cans in the retort load and should have an initial temperature equal to or in between commercial limits of 54.4°C.

The initial temperature influences greatly time of heating required to administer a process of any given lethality, the higher the initial temperature, the shorter is the time required.

7. Acidity - American workers, Herson and Hulland (1980:85) have shown that the type of microbial spoilage occuring in under-processed packs is related to the acidity of the food. According to the authors, Bigelow

and Cameron in 1932, the classification of canned foods based on acidity are as follows:

a. non-acid food: pH value above 6.0

b. semi-acid foods: pH value between 4.5 and 6.0

c. acid-foods: pH value below 4.5

The principal demarcation in the acidity classification is between the medium acid and acid groups, that is at pH of 4.5 and 6.0. Below pH 4.5, the growth of clostridium botulinum, the most heat resistant of food poisoning organism, is generally regarded as being inhibited, and for foods with pH values below 4.5, pressure in processing, therefore, considered to be unnecessary.

Iyer(1971:60) said that the indices used in quality control vary and may comprise one or more of the following groups: Total counts-usually required in the form of the Standard Plate Count (SPC) at 35^{o}C but may be desired as aerobic surface counts at 20, 25, 30 or 35^{o}C; counts of organisms of public health significance-this group comprises coliforms, faecal coliforms (E. coli), and total clostridia; counts of potential food-poisoning bacteria; Staphylococcus aureus, Clostridium prefungers (Welchie), Vibrio parachaemolyticus and Bacillus cereus and absence of food bone pathogens, Sammonelle, Vibrio cholrea (comma) and Clostridium.

Hobbs (1970:17) made mentioned that the purpose of quality control is to keep the customer happy and to maintain or increase profitability to everyone involved in selling and/or processing fish. Bacteriological testing of products is now all recognized as an integral part of quality control procedure in food industries throughout the world. To be truely effective, it needs to commence with the raw materials used in food manufacture and continue through succeeding stages of processing and transport until it reaches the consumer. The particular relevance of micro-biological quality control to the shellfish industry was discussed in detail.

Cann (1974:462), Bendless (1975) stated that Dick (1970) reviewed the arguments for and against the application of microbiological standards of foods. Where standards are applied there are serious disadvantages in the application of the severe and too rigid limits on the principle of making foods "safer than safe".

Today, shellfish products in international trade must not only be competitive in terms of price and eating quality but must also meet the bacteriological requirements of importing health authorities.

Shellfish in their natural environment carry a commensal bacterial load, the composition of which may be governed by such factors as their feeding and living

habits, the geography of the area, the seasons, and the temperature and quality of the waters which the mussel found best for growing.

According to Hallegraeff et al (1989:32), any sample containing more than 80 ug of toxin per 100 gram of mussel is considered dangerous consumption.

Hallegraeff, G.M., and Maclean, J.L. (1989:2-3) discovered that toxic Pyrodinium red tide were first found in the Philippines in mid-1983, in the Samar sea. A second major outbreak occured in mid-1987. They were reported in the Samar sea by September. All these events resulted to many illness and deaths.

The occurence of natural phenomenon known as "Red Tide" refers to the reddish-brown discoloration of sea water caused by he proliferation of microscopic organisms called dinoflagellates. The species causing red tide in the Philippines is named Pyrodinium bahamense var-compressum. Human can become ill from eating seafood products contaminated with red tide organisms. The most notorious seafood causing illnesses are bivalve shellfish such as the green mussel, oysters, scallops, cockles, and limpets cut, the gills and guts of small fish such as sardines and anchovies can also become contaminated. The illness following consumption of green mussel is called paralytic shellfish poisoning (PSP). Diagnostic symptoms

are tingling or burning sensation of the lips, gums, tongue and face progressing to the neck, arms, fingertips and toes. In severe cases, inability to walk, difficulty in breathing, swallowing and speaking do occur and patients may die from respiratory analysis. Shellfish poisoning is caused by the neuro-toxins from the dinoflagellates held in small fishes stomachs. The toxins are stable found in water.

James and Krone (1987:3) revealed that the number and types of bacteria present in a shellfish product will reflect the changes that have taken place in the initial flora and contamination that may have occured during catching, handling, and processing. Consequently, the development of a shellfish product export industry depends on a thorough knowledge of the bacteriology of the products to be marked so that adequate control can be applied.

According to Semple (1960:101-102) the development of shell products must, therefore, take into consideration the bacteriological specifications, limits and standards that are required by potential foreign importers and realistic appraisal of whatever or not those requirements can be met must be made by all sections of industry and government concerned.

The processors can now grade their products and choose their markets according to the requirements of foreign importers. Where products are of unacceptable quality they can either be reprocessed or put to alternative use, thus eliminating the unethical and costly procedure of touting shipments from port in the hope of eventual acceptance by a less vigilant port health authority.

Jones (1988:2) reported that substantial spoilage loses occur in processed products. Oxidation problems, partially controllable by adequate handling and storage techniques, can arise with fatty species.

Avery (1950:140) revealed that the invention of the tin cans made it simplier to preserve food without pickling, salting, drying or smoking. Egra, Daggat, who acquired his knowledge on canning in Europe, was the first to start canning in the United States. He cannned oyster, lobster, and salmon in New York. In 1819, Thomas Kanset found canned sea foods in the same state. William underwood from England had worked and learned preserving and pickling in a canning factory in London. He opened the first successful cannery in Boston, Massachussets in the Unites States.

In the Book of Knowledge (1972:12), Nicholas Appert, a French candy maker is regarded as the father of canning. He experimented on certain methods of preserving food for

nine years, and had long struggled with the problem of food spoilage until finally his work paid off in the form of preserved food in sealed glass containers.

Louis Pasteur, a great French scientist proved the causes of spoilage of products. Pasteur admired Appert's method of canning and consider it the basis of today's canning process.

According to Perovic (1975:30), there are few different methods of canning sardines but all of them are commonly divided into six operations; Pre-treatment (including weighing, pre-cooking, filling oil or tomato sauce); packing cans; pre-cooking; filling (oil or tomato sauce) and steaming; sterilization; and final operations.

According to Wheaton and Lawson (1985:155), before being packed into cans, the materials are first cleaned, butchered and pre-cooked. Nearly all fish and seafoods products are pre-cooked before they are packed. The canning operation entails steps; Packing the prepared products into the cans; Adding substances to enhance flavor; to improve quality or to help preserve the product; Exhausting, i.e., applying a vacuum to remove air from the cans; closing and sealing the cans; and heating or retorting.

As revealed by Herson and Hulland, the result of the extension survey conducted by Feller showed that the number of organisms per gram by plate count is less than ten (10). The fish was of good quality and there was no off flavor.

A freshman reported excellent results with canning of frozen herring. The fish was of good quality and there was no off flavor. However, the fish was not quite as white as it would have been if fresh fish had been used. The results were very similar with those obtained in canning of fish which had been kept in cold storage at temperature above freezing for a few days before canning.

B. Local

Relevant ideas of scholars and authorities in the Philippines were considered for a better understanding of the subject given utmost priority.

Calmorin (1990:150-154) stressed that in the Philippines, there are three (3) canning styles, namely: Salmon Style, Spanish of Sardines Style, and French Style. The ingredients used are salt and oil in brine solution only. For Spanish Style or Sardines Style, the ingredients are salt, oil and tomato sauce. Salt, oil, and species are the ingredients for French Styles.

For canning purposes, glass jars and tin cans are

used. The differences between glass jars and tin cans as given by Calmorin are as follows:

	Glass Jars	Tin Cans
1.	Bare hands used in sealing	- An automatic can sealer is used
2.	Half-sealed during processing	-Completely sealed during processing
3.	Longer processing time	-Shorter processing time
4.	Petcock is not opened after processing time	-Petcock is open gradually after processing
5.	Cooled at room temperature	-Cooled in running water
6.	Slow heat penetration and cooling process	-Rapid heat penetration and cooling process
7.	Can be reused	-Cannot be reused
8.	Products can be easily seen and inspected	-Products cannot be seen are difficult to inspect
9.	Minimal chemical reaction between the food material and the container	-Chemical reaction occurs due to ferrous oxide content of the can
10.	Heavy and fragile	-Light and unbreakable
11.	Easy to open	-Difficult to open
12.	Discoloration of products due to light striking	-No discoloration of product

Commercially sterile may be defined as cans which have been so processed that the food under ordinary storage condition, will neither spoil nor endanger the health point of view and requires that for all low and medium-acid packs, the processing of food should have been adequate for the destruction of Clostridium botulinum

spores. Organisms of lower heat resistance such as cocci and non-sporing rods should be eliminated in all heat-processed canned products.

Panggat (1987:26) defines canning as a process of preserving food achieved by the application of thermal sterilization procedure to products packed in hermitically sealed containers. Thus, the canning process may be carried out, either; 1) by filling the product into container, sealing it hermitically and subsequently heating and cooling the container and contents until all microorganisms capable of growth in the food are destroyed or 2) by sterilizing the product continuously in line by heating and cooling it in heat exchangers and then filling it aseptically into pre-sterilized containers which are subsequently sealed under aseptic conditions.

According to Lopez (1975:3), the Bacterium, Clostridium is the microrganisms of most concern to commercial canners. This organism is capable of developing very strong toxins if allowed to survive. It does not grow well at pH lower than 4.6, but most fishery products fall in pH ranges 5.0 to 6.8. The Clostridium botulinum is highly resistant to heat, therefore, sterilization process which assures destruction of this

organism is necessary. This process also kills other microorganisms capable of spoiling canned foods under normal handling and storage condition.

The Philippine Fisheries Commission, Estuarine Fisheries Division (1967:4) stated that the cotribution of post-harvest technology to wider programmes of fisheries development and food production lies in:

Improving the economic and total production of the industry through the avoidance of gross wastage, in improvement of yield and quality by taking account sociological factors, the adequacy of return on investment, and the wider consideration of food safety. The two broad categories of wastage may be distinguished as follows:

1. Large quantities of fish, for instance the shrimp by catch, are discarded on the vessel because currently it is uneconomic to preserve it.

2. Considerable wastage of fish occurs after capture. Microbial spoilage represents the most serious loss of wet fish, and serious problems can arise from contamination by pathogenic microorganisms. The economic aspect of culturing mussel is included in this paper.

According to Calmorin et al (1990:150), Fish processing is very important because it lengthens the shelf-life of fish and other fishery products, thus saving

fish and other fishery products which may be wasted during glut season. It retains or imporved the nutritive value and the odor, color, and texture of fish and other fishery products. It alleviates the ever-growing malnutrition problem of the country. It lessens food problems in time of scarcity, reduces importation of canned fishery products, thus, increases dollar reserves. It solves unemployment problems of the country where fish processing graduates are encouraged to be self-employed. It makes the country self-sufficient through exportation of fish and fishery products. It encourages the fishermen to improve their method and techniques in catching fish inorder to have good supply for fish processors. It helps in the socio-economic development of the country. It encourages Filipinos to be protein-eaters rather than fat-eaters, thus, alleviating hypertension needs.

According to Dagoon (1986:2), the major factors to be controlled in order to reduce spoilage and maintain quality are: 1) time; 2) temperature; 3) contamination; and 4) damage.

In addition to their qualitative aspects, tastes and their acceptance must be considered from quantitative viewpoint. However, high intensities of sweetness and saltiness in foods may be claying or satisfying and

thirst-producing, a low level of sourness may be disappointing in juice and high level of bitterness in chocolate can be tolerated if it does not last too long. The manner in which the taste factors interplay also affects acceptance.

According to Mendoza (1961:6), Pasteur proved the "spontaneous generation" concept error. He also showed the fallacy of the "vacuum theory" and clearly proved that microorganisms are the real cause of spoilage and that heating canned foods preserve them by killing the microorganisms.

RELATED STUDIES

A. Foreign

Foreign investigations and researches having direct bearing on the present studies were reviewed to better prepare the researcher in designing and conducting her own investigation.

A food need not be liked to be accepted. It needs only to emit sensory impressions that are perceived as affirmative responses to the questions. "It is edible". "Shall I eat it".

Edibility means fit to be eaten. Sight, a physically sense, which enables one to judge the appearance of food is the first clue to its identity and often a prediction

of the degree of satisfaction or pleasure to be derived from eating.

Meat flavor is sometimes predictable by color. Color is probably the most important of the sight factors in acceptance or rejection of foods. Depth of color frequently denotes strength or weakness of flavor.

It is known that pleasing-looking food promotes the flow of digestive juices and thereby enhances the digestability of food. In a meal, variety of color promotes eye-appeal and often implies variety of flavor and texture.

Quality of a food can be defined as those characteristics or attributes which make it acceptable to the consumer. It can be defined as the maintenance of quality at a level that satisfies the consumer and that is economical to the producer.

Quality control is normally based on agreed procedures and specifications which are designed to maintain quality or reduce defects: 1) of the raw materials; 2) during all stages of processing; 3) of the final product.

Hayt et al (1938:47) investigated the effects of air in lowering the efficiency of steam sterilization and their conclusions were:

a. Air reduces the retort temperature and this is an uneven phenomenon because air, being heavier than steam, tends to stratify below the steam;

b. A mixture of air and steam at any temperature is not as efficient as saturated steam at the same temperature;

c. Air in the retort cuts down the penetration of the steam.

Shewan (1977:11) discovered that the total viable counts on shellfish after spoilage in ice are of the order of 10^7 - 10^8/gram at 20°C with the flora dominated by one of the other of the gram-negative Pseudomonas or Moraxella/Acisse to bacter genera, although it is probable that even within this group only a relatively low proportion of the total number are active spoilage agents.

The most commonly used "indicator organisms" in international trade in shellfish are Escherichia coli or faecal coli forms and Straphylococcus aureus. Shewan (1970) in a comprehensive review of the food poisoning hazard in fishery products stated that, with certain reservations, they are still amongst the safest articles of food.

Murateedhoran (1982:16) undertook a study on the method of preparing different types of delicious ready to serve pickled products from storage characteristics. Of

the three(3) products, namely dried and pickled, fried and pickled and light smoked and pickled, the last one had the best shelf-life. The optimum conditions of frying and smoking for preparing such type of pickles are also reported.

Unnikrishman (1983:116) undertook a similar study entitled "Preparation of Mussel Meat By Drying". It describes a simple and cheap process of mussel meat preservation by drying. The methods involves the blanching of mussel meat shucked from purified live mussel in 5% boiling moisture of 10 to 15%. The product stored in glass bottles or polyethelene bags suitably sealed has a storage-life of about 6 months after which the organoleptic qualities begin to deteriorate. No preservative is used at any stage of processing and the yield of the products is approximately 20%. The major type of spoilage due to insect infestation is also common unless packed properly.

Fillsworth (1952:120) showed that steaming time of 6 minutes sterilized cockles and mussel. Mussel collected from Calicut area were transported to laboratory in a refrigerated van. Small lots were cooked in a steam at atmospheric pressure for different lengths of time to determine the optimum cooking period as judged in appearance and flavor. Half of the lot was cooked for 15

minutes and allowed to cool. The raw mussel were immediately cooled. The meat was separated from both quick-frozen at 40°C with water as glazed and stored at 23°C. Then the frozen stored materials were sampled at intervals, thawed at 4°C and analyzed for physical, organoleptic and chemical characteristics. Total water extractable nitrogen (WEN), non-protein nitrogen (NPN) and free amino, nitrogen (a-NH2N) were used as chemical indices of quality.

Bergen (1953:220), from Denmark carried out experiment in canning of frozen bean products. They showed a definite change of texture from the frozen product in a way that the flesh was found considerably dried than in products made from fresh sprouts.

Ball (1975:559-560) observed that the thermal treatment of the entire can contents must be at least equivalent to 4 minutes at 120°C or 10 minutes at 115°C in order to kill the most heat-resistant strains.

Heat kills bacteria and destroys their performed toxins. Its effect however is dependent on time and temperature. Heat treatments of shellfish usually vary from scalding, which merely opens the shells of mollusc, to full cooking, by boiling or either free or low pressure steaming.

According to Ball (1955:559-560), Vaillard report that 70-80% of the cans (presumably sound) he examined were unsterile, the organisms presents were cocci, sporing and non-sporing rods and moulds.

Herson and Hullad (1980:84) reported on the extensurvey made by Feller (1926) on canned salmon. Of 5,276 cans of normal quality, 3.4% were considered to be unsterile. He further states that of the cans containing aerobes, 70% showed less than 10 organisms per grams by plate count. Over 50 % of spore-forming aerobes grow in canned salmon under nearby perfect and aerobic conditions.

B. Local

Studies or investigation taken in local setting "Philippines" were reviewed to better prepare the present researcher in the formulation of problems and to facilitate in the making of the conceptual framework.

Apolinario (1979:18-31) conducted a study to standardize canning procedure for stuffed squid packed in tomato sauce mussel product such as Tahong Adobo, Smoked Tahong in Oil, and Tahong in its Own Broth. A series of formulation were made until highly acceptable products were obtained based on sensory evaluation. These formulated products were packed in C-enameled cans, exhausted to an internal temperature at 180^{o}F and sealed

immediately. The canned products were subjected to heat penetration test and death time studies using P.A. 3679 as the reference in microorganisms. The minimum process time of 240°F and 250°F were calculated based on the results of the above spoilage rate at one can per 10,000 cans. From the results obtained, the minimum processing time, temperature combinations and 70 values for the aforementioned products in different can sizes were established.

According to Bulut (1983:4) boiling hot brine, made by dissolving 454 grams salt in each 4.5 liters of water is added to the can just before sealing, some headspace is left, usually about ¼ inch for can holding 142 grams to 170 grams of meats. The size of can requires about 25 minutes heat processing in a retort at 115°C (10.5 pounds (lbs) per square inch gauge pressure or 30 minutes of the cans are loaded cold). Meats packed with sauce, a smoked meat in oil instead of brine, need sterilizing in a similar manner.

The study conducted by de Guzman (1985:33) revealed that moisture, fats, protein contents and sensory quality attributes of mussel depurated in stagnant water sucrose solution (200 ppm.), and water and sucrose solution changed every two (2) hours. The moisture content were observed after twenty four (24) hours. Sensory evaluation indicated that color, texture and flavor and general

acceptability were not affected by depuration methods employed in the study.

Apolinario conducted a study to standardize canning procedure for stuffed packed in tomato sauce and mussel product such as tahong adobo, smoked tahong in oil, and tahong in its brown broth. The canned products were then subjected to heat penetration test and death time studies using P.A. 3679 as the reference microorganisms. The minimum process time of 240^{o}F and 250^{o}F were calculated based on the results of the test.

Bulut reveals that the size of can requires about 25 minutes heat process in a retort at 116 at 10.5 pounds pressure. Meat packed with sauce, a smoked meat in oil instead of brine need sterilizing in similar manner.

Ball observed that the thermal treatment of the entire cans contents must be at least equivalent to 4 minutes at 120^{o}C or 10 minutes at 115^{o}C in order to kill the most heat resistant strains.

Herson and Hulland revealed that of the 5,276 cans of normal quality, 3.4% were considered unsterile, and 70% showed less than 10 organisms per gram by plate count.

Shewan determined the total viable counts of shell-fish after spoilage in ice are of the order of 10^{7} - 10^{8}/ gram at 20^{o}C with the flora dominated by.

Relationship with the Present Study

The studies cited were similar to the study for two reasons:

1. All the studies investigated on the canning of mussel, to standardize its canning styles and procedures and had considered the element of time(processing) temperature and pressure.

2. A study was conducted to determine the total viable counts on shellfish after spoilage.

The present study differed from the aforecited studies for it would like to investigate not only the standard style and procedures of canning mussel but to conceive a Manual for tahong canning that will enhance the operation of a canning plant/factory.

As a result of the study recommendations for further study to discover more post harvest technology will be the ultimate purpose so that the maximum production of value-added products can be worked out and therefore consumers will be supplied with quality canned mussel throughout the year.

CHAPTER III

METHODOLOGY

This chapter made provision for the utilization of the most appropriate research design in conformity with the study being undertaken the composition of the taster panel, the collated data and data analysis.

Research Design

A Quasi Experimental Design was used to determine the degree of acceptability, the most appropriate canning style and procedures, and above all, to come-up with a workable manual for tahong canning to pave the way to the long felt need for the development of the Tahong Canning Industry in the province of Samar specifically in Jiabong Samar.

Subject of the Study

The tahong canned in five different canning styles is the subject of the study. Tahong harvested from the municipal waters of Jiabong was utilized for canning purposes.

The canned tahong were stored for eight months before subjecting to sensory evaluation and microbial analysis. For every style, twelve cans were produced. Out of 12 cans 8-9 cans of every style were taken for sensory evalu-

ation, and three (3) cans for every style were incubated for twenty (20) days at 55°C before the canned products were subjected to microbial analysis.

Canning Styles and Procedures

The equipment, kitchen utensils, materials, and procedures in Canning Tahong using five styles of canning considered in the study (Tahong in Chili Sauce, Tahong in Adobo, Tahong in Tomato Sauce, Tahong in Sweet and Sour Sauce, and Tahong in French Style) are presented.

Equipment

1. Pressure Cooker
2. Can Sealer
3. Weighing Scale "Electronic Balance"
4. Gas Stove

Pressure Cooker. An equipment used to can fish above boiling temperature (100°C) and with pressure.

Can Sealer. An equipment used to seal the tin cans with two operation rolls. The first operation roll is used to half seal or clinch the cans, and the second to completely seal the seams of the cans.

Weighing Scale "Electronic Balance". A device used to measure the weight of the tahong and canned product.

Kitchen Utensils and Materials

Carajay	Laddle
Knife	Mixing Bowl
Basin	Collander
Spoon	Measuring Cup
Tin Cans "211 x 300"	

Procedures in Canning Tahong/Mussel using the Five Styles considered in the Study

Tahong in Chili Sauce

Ingredients:

2 kilos tahong meat/mantle

2 cups vinegar

1 cup sugar

1 tablespoon salt

½ cup soy sauce

1 teaspoon monosodium glutamate (MSG) - Ajinomoto

1 tablespoon black pepper

Procedure:

1. Fresh tahong are thoroughly washed. The tahong are steamed for ten (10) minutes to open up their valves. The mantle/meat is separated by hand.

2. The mantle/meat of the tahong is marinated for two (2) hours using the proportion given above.

3. The marinated tahong are dried for a while and then fried until brown in color.

4. Packing. The fried tahong are packed into can, and all other ingredients are added:

2 cups chili sauce

1 cup corn oil

½ cup water

1 tablespoon corn starch

¼ MSG/Ajinomoto

The sauce is boiled before it is added to cans.

5. Clinching. Cans are half-sealed using the first operation roll of a Can Sealer.

6. Exhausting. Cans are placed in a Pressure Cooker for twenty (20) minutes. The purpose is to remove the air inside the can.

7. Complete sealing with the use of a Can Sealer. The cans are sealed permanently by using the second operation roll.

8. Processing. Sealed cans are processed for twenty minutes at ten pounds (lbs) pressure at $24^{o}F/115.6^{o}C$.

9. Cooling. Cans are cooled with running water.

10. Storing. The canned tahong are kept in a dry and clean place after labelling.

11. Packaging. The canned products are packed in preparation for distribution.

12. Distribution. The canned tahong are distributed to different market outlets.

Tahong in Adobo

Ingredients:

2 kilos tahong meat/mantle

2 cups vinegar

1 cup sugar

½ cup soy sauce

1 tablespoon salt

1 teaspoon salt

1 teaspoon monosoduim glutamate (MSG) - Ajinomoto

Procedure:

1. Fresh tahong are thoroughly washed. The tahong are steamed for ten (10) minutes to open up their valves. The mantle/meat is separated from the shells by hand.

2. The mantle/meat of the tahong is marinated for two hours using the proportion given above.

3. The marinated tahong are dried for a while and then fried until brown in color.

4. Packing. Then the fried tahong are packed into cans. No sauce needed.

5. Clinching. Cans are half sealed using the first operation roll of a Can Sealer.

6. Exhausting. Cans are placed in a Pressure Cooker for exhausting for twenty (20) minutes. The purpose is to remove the air inside the can.

7. Complete sealing with the use of a Can Sealer. The cans are sealed permanently by using the second operation roll.

8. Processing. Sealed cans are processed for twenty (20) minutes at ten (10) pounds (lbs) pressure 240°F/115.6°C.

9. Cooling. Cans are cooled with running water.

10. Storing. The canned tahong are kept in a dry and clean place after labelling.

11. Packaging. The canned products are packed in preparation for distribution.

12. Distribution. The canned tahong are distributed to different market oulets.

Tahong in Tomato Sauce

Ingredients:

- 2 kilos tahong meat/mantle
- 2 cups vinegar
- 1 cup sugar
- ½ cup soy sauce
- 1 tablespoon salt
- 1 teaspoon monosoduim glutamate (MSG) - Ajinomoto

Procedure:

1. Fresh tahong are thoroughly washed. The tahong

are steamed for ten (10) minutes to open up their valves.

2. the mantle/meat of the tahong is marinated for two hours using the proportion given below.

3. The marinated tahong are dried for a while and then fried until brown in color.

4. Packing. The fried tahong are packed into cans, and all other ingredients are added:

4 cups tomato sauce

2 cups corn oil

½ cup corn starch

¼ teaspoon MSG/Ajinomoto added to each can

5. Clinching. Cans are half-sealed using the first operation roll of a Can Sealer.

6. Exhausting. Cans are place in a Pressure Cooker for exhausting for twenty (20) minutes. The purpose is to remove the air inside the can.

7. Complete sealing with the use of a Can Sealer. The cans are sealed permanently by using the second operation roll.

8. Processing. Sealed cans are processed for twenty (20) minutes at ten 10 pounds (lbs) pressure at 240°F/115°C.

9. Cooling. Cans are cooled with running water.

10. Storing. The canned tahong are kept in a dry and

clean place for labelling.

11. Packaging. The canned products are packed in preparation for distribution.

12. Distribution. The canned tahong are distributed to different market outlets.

Tahong in Sweet and Sour Sauce

Ingredients:

- 2 kilos tahong meat/mantle
- 2 cups vinegar
- 1 cup sugar
- 1 teaspoon salt
- 1 teaspoon monosoduim glutamate (MSG) - Ajinomoto
- 1 tablespoon black pepper

Procedure:

1. Fresh tahong are thoroughly washed. The tahong are steamed for 10 minutes to open their valves. The mantle/meat is separated from the shells by hand.

2. The mantle/meat of the tahong is marinated for two hours using the proportion given above.

3. The marinated tahong are dried for awhile and then fried until brown in color.

4. Packing. The fried tahong are fried into cans, and all other ingredients are added:

2 cups water

½ cup vinegar

1 ½ cups sugar

4 tablespoon cornstarch

The sauce is boiled before it is added to cans.

5. Clinching. Cans are half-sealed using the first operation roll of a Can Sealer.

6. Exhausting. Cans are place in a Pressure Cooker for exhausting for twenty (20) minutes. The purpose is to remove the air inside the can.

7. Complete sealer with the use of a Can Sealer. The cans are sealed permanently by using the second operation roll.

8. Processing. Sealed cans are processed for twenty (20) minutes at ten (10) pounds (lbs) pressure at $240^{o}F/115.6^{o}C$.

9. Cooling. Cans are cooled with running water.

10. Storing. The canned tahong are kept in a dry and clean place after labelling.

11. Packaging. The canned products are packed in preparation for distribution.

12. Distribution. The canned tahong are distributed to different market outlets.

Tahong in French Style

Ingredients:

2 kilos tahong meat/mantle

2 cups vinegar

1 cup sugar

½ cup soy sauce

1 tablespoon salt

1 tablespoon monosoduim glutamate (MSG) - Ajinomoto

1 tablespoon black pepper

Procedure:

1. Fresh tahong are thoroughly washed. The tahong are steamed for ten (10) minutes to open up their valves. The mantle/meat is separated from the shells by hand.

2. The mantle/meat of the tahong is marinated for two (2) hours using the proportion given above.

3. The marinated tahong are dried for a while and then fried until brown in color.

4. Packing. The fried tahong are packed into tin cans, and all other ingrediens are added:

10 tablespoon corn oil

1 piece bay leaf

7 pieces black pepper

6 pieces (slice) carrot

¼ tablespoon monosoduim glutamate (MSG) - Ajinomoto

The sauce is boiled before it is added to cans.

5. Clinching. Cans are half-sealed using the first operation roll of a Can Sealer.

6. Exhausting. Cans are placed in a Pressure Cooker for exhausting for twenty (20) minutes. The purpose is to remove the air inside the can.

7. Complete sealing with the use of a Can Sealer. The cans are sealed permanently by using the second operation roll.

8. Processing. sealed cans are processed for twenty (20) minutes att ten(10) pounds (lbs) pressure at 240^{o}F/115.6^{o}C.

9. Cooling. Cans are cooled with the running water.

10. Storing. The canned products are packed in preparation for distribution.

11. Distribution. The canned tahong are distributed to different market outlets.

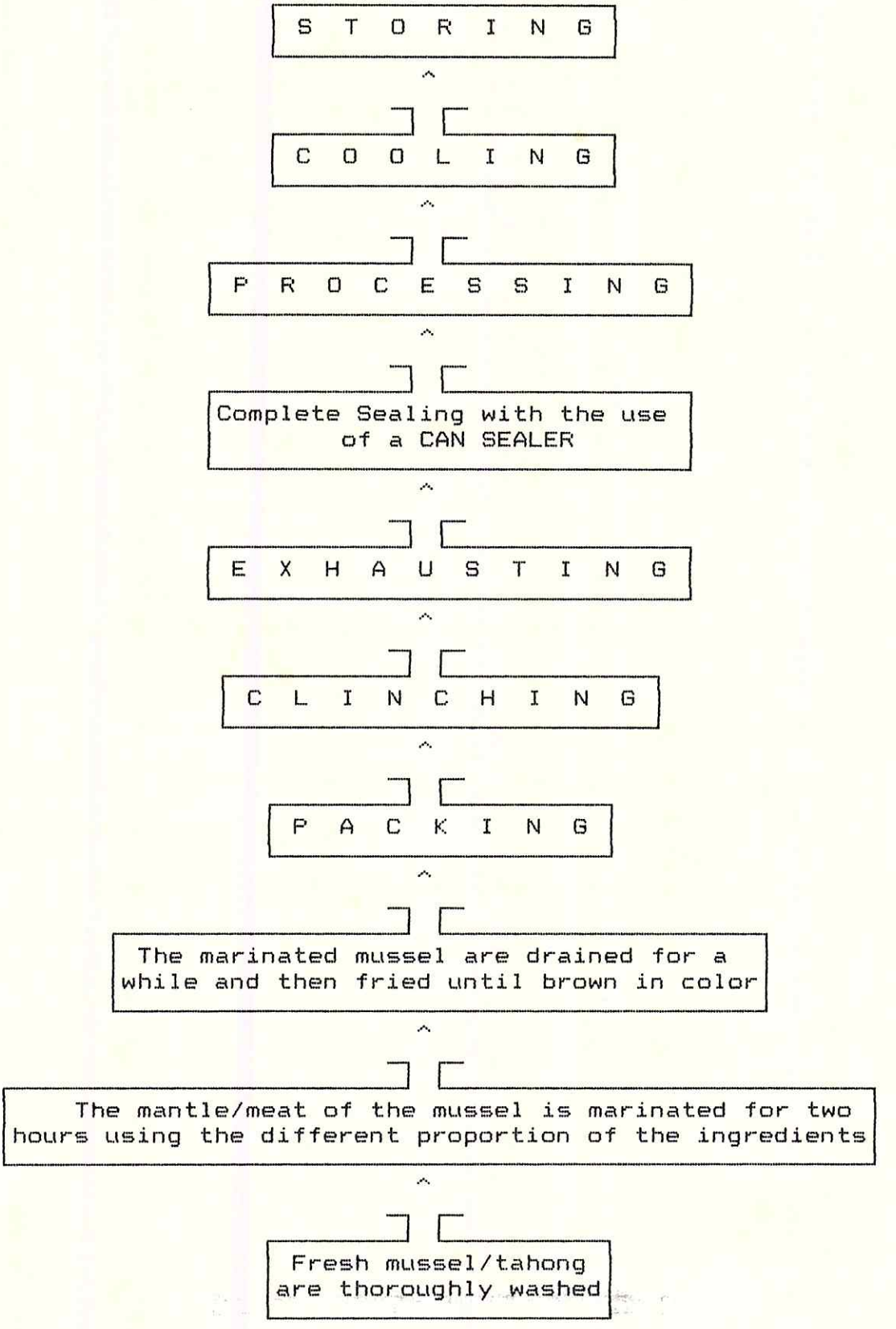

Figure 5. Flow Chart in Canning Mussel

Sampling Procedure

Since the number of canned tahong for every style was only twelve (12) all the twelve cans were used for both sensory and microbial analysis.

The Zamboanga State College of Marine Sciences and Technology, Rio Hondo, Zamboanga City facilities were utilized for microbial analysis of the canned mussel after storing it for eight (8) months.

For sensory evaluation, the Fish Processing Laboratory of the Samar Regional School of Fisheries was utilized.

Data Gathering Techniques

To enable the researcher to gather data, sensory evaluation, microbial analysis, and statistical analysis were undertaken in the study.

Sensory Evaluation

For sensory evaluation, the 28 taster panelists facilitated the researcher in collating the data. Of the 28 taster panelists, two (2) were food Technology and Homemaking major, five (5) were Fish Processing Instructors; fifteen (15) are students major in Fish Processing and the remaining six (6) are teachers and employees who have the skill in food preparation. A stratified random sampling was used in the determination of the 28 taster

panelists. Also the researcher had considered their educational backgrounds, their major fields of specialization, their skills, expertise and experiences in the preparation of different menu/recipes.

A Multiple Comparison Scoring Test was used. Coded sample products representing the five styles of canning used in this study were evaluated based on the specified characteristics/attributes: color, odor, flavor, and texture. The taster panelists recorded their evaluation on a score sheet and descripttive terms were used since both are meaningful to the panelists.

The data on sensory characteristics were obtained through the use of a sensory evaluation sheet, using the 9-point Hedonic Scale.

The preference/acceptance test was used to determine the relative preference of the taster panelists among the given samples. In the Hedonic Scaling Test, the taster panelists had observed and tasted the five coded canned tahong samples representing the five styles used in the study, and were asked to express their degree of liking and dislike.

Through sensory evaluation using Hedonic Scaling Test, the five styles in canning tahong were evaluated to determine its acceptability. Please see Appendix A (Sensory Evaluation Sheet).

Microbial Analysis

To determine the microbial load or standard plate count microbial analysis of the samples was done. The number of Colony Forming Unit (CFU) in standard plates were counted to determine whether sample products "canned tahong" were fit for human consumption. In determining the number of bacteria in the representative sample in the five (5) styles of canned tahong, only thirty (30) grams of the sampled products were utilized for microbial analysis. The 30 grams was taken from each canned mussel to grow microorganisms capable of causing spoilage for 24-48 hours at 55^{o}C.

To make the analysis and interpretation of the data laudable and credible, the relevant data were collated and presented in Tabular Form.

Statistical Analysis

To be able to analyze the data objectively and comprehensively, the two-way analysis of Variance "ANOVA", Scheffe's Test to further test if the Hypothesis is rejected and the basic measures of central tendency like arithmetic mean were used in sensory evaluation while the arithmetic count and weighted mean count were used in microbial analysis. The formula for the statistical tools used in the study are hereby presented:

Two-way Analysis of Variance "ANOVA"
(Downie and Heath, 1975, pp. 204-206)

1. $SS_t = \Sigma X_t^2 - \frac{(\Sigma X_t^2)}{N_t}$

Where:

SS_t = the total sum of square or total variability

X^2_t = total sum of raw score in column

ΣX^2_t = total sum of square of the raw score, which can be obtained by squaring each of the separate score and summing the squares

$(\Sigma X_2)^2$ = total sum of raw score in column is then squared

2. $SS_w = \Sigma X^2_t - \frac{(\Sigma X_k)^2}{N}$

Where:

SS_w = the within sum of squares

K = the number of cell group

N = the number of cases in each cell

ΣX_k = the sum total of the raw score in rows

3. $SS_c = \frac{\Sigma(\Sigma X_c)^2}{N_c} - \frac{(\Sigma X_2)^2}{N_t}$

Where:

SS_c = column or variability or column sum of square

ΣX_c = the sum of raw score values in column

$$4.\quad SS_r = \frac{\Sigma(\Sigma X_r)^2}{N_r} - \frac{(\Sigma X_t)^2}{N_t}$$

Where:

SS_r = raw variability or raw sum of square

N_r = sample size or number of cases for each row

ΣX_r = the sum of the raw score in each row

$$5.\quad SS_{cr} = SS_t - SS_w - SS_r$$

After all the sum of squares have been determined, the usual ANOVA Table is set up and each SS is divided by its appropriate degree of freedom to obtain the main effects of factors C (Column), and R (Row) and the interaction effect are then valuated by making an F-test for each by dividing each MS by the MS_c.

Scheffe's Test (Downie and Heath, 1975:204-206)

$$F = \frac{(\bar{X} - \bar{X}_2)^2}{S^2_w \frac{(N_1 + N_2)}{N_1 N_2}}$$

Where:

$\bar{X}$ = mean of the first item

$\bar{X}_2$ = mean of the second group

S^2_w = mean square within group.pa

Weighted Mean Count (Reilley, 1982:79)
(The Weighted Mean for Bacterial Count)

$$\bar{X} = \frac{d^1 (C_1 + C_2 + C_3)}{N_1 \; t \; N_2/10^t \; N_3/100}$$

Where:

$\bar{X}$ = weighted mean

d^1 = reciprocal dilution of the first countable plate with a total count C, Colonies and N_1 replicates, C_2 is the total number of colonies at the net dilution with N_2 replicates plates, C_3 is the total number of colonies at the next dilution with N_3 replicate plates etc.

CHAPTER IV

PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

This chapter analyzes and interprets the data gathered through sensory evaluation, statistical analysis, and microbial analysis to determine the number of bacterial load or count through a Standard Plate Count so that effect of canning styles on the microbial stability and acceptability of canned mussel can be properly evaluated, and the most appropriate canning style and procedures can be identified.

Acceptability of Canned Mussel

The importance of determining the degree of acceptability of the canned mussel pave the way to subjecting the canned products to sensory evaluation.

The mussel canned products subjected to sensory evaluation were processed using the five canning styles (Tahong in Adobo, Tahong in Chili Sauce, Tahong in Tomato Sauce, Tahong in Sweet and Sour Sauce, and Tahong in French Style). Then the canned product were stored in a clean and dry place.

The size of the enameled tin cans used in canning is 211 x 300, which means that the can has a diameter of 2 x $11^{1}/16$ of an inch and weights 42.38 grams.

The weight of the canned tahong were determined through the use of a weighing scale "Electronic Balance".

The drained weight, gross weight, and net weight of the canned tahong (Tahong in Chili Sauce, Tahong in Adobo, Tahong in Sweet and Sour Sauce, and Tahong in French Style) are presented in Table 1.

Table 1

Drained Weight, Gross Weight and Net Weight of Canned Mussel

Canned Tahong	Drained Weight in Grams	Gross Weight in Grams	Net Weight in Grams
Tahong in Chili Sauce	215.22	265.95	223.57
Tahong in Adobo	180.03	188.16	125.82
Tahong in Tomato Sauce	216.19	259.86	217.48
Tahong in Sweet and Sour Sauce	228.63	259.88	217.50
Tahong in French Style	200.00	260.00	217.62

After the canned mussel/tahong had been stored for eight (8) months, sensory evaluation using the 9-Hedonic Scoring Test was conducted to determine the degree of liking or disliking. The data were analyzed and presented on Table 2. The weighted mean on the responses of the taster panel on the acceptability of the canned mussel among the five styles were determined.

Table 2

Weighted Mean on the Responses of the Taster Panel on the Acceptability of the Canned Mussel Among the Five Styles

Attributes	Methods of Canned Mussel				
	Tahong in Chili Sauce	Tahong in Adobo	Tahong in Tomato Sauce	Tahong in Sweet and Sour	Tahong in French Style
Color	7.714	6.714	7.535	6.428	5.964
Odor	7.285	7	7.428	6.428	6.678
Flavor	7	6.642	7.214	6.5	6.571
Texture	7.214	6.892	6.564	6.5	6.678
Total	29.213	27.248	29.141	25.856	25.891
Group Mean	7.30325/ 7.3	6.812/ 6.81	7.28525/ 7.285	6.464/ 6.46	6.47275/ 6.47
Rank	1	3	2	5	4

Table 2 reveal that the Tahong in Chili Sauce obtained a weighted mean of 7.30, Rank 1; Tahong in Tomato Sauce with a weighted mean of 7.285, Rank 2; Tahong in Adobo with a weighted mean of 6.81, Rank 3; Tahong in French Style having a weighted mean of 6.47, Rank 4; and Tahong in Sweet and Sour Sauce obtaining a weighted mean of 6.46, Rank last, among the five styles of canned tahong based on the degree of liking and disliking as judged by the twenty-eight (28) panel tasters. As gleaned from Table 2, the taster panel accepted the five styles of canning mussel since the weighted mean for Tahong in Chili Sauce, Tahong in Tomato Sauce, and Tahong in Adobo, Ranked 1, 2, and 3 respectively. The three (3) styles used in the study were liked moderately by the taster panel. While Tahong in French Style and Tahong in Sweet and Sour Sauce, Ranked 4 and 5 respectively, they were liked slightly by the taster panel.

The findings revealed that the five style of canning do not differ significantly on the degree of liking and acceptability.

Table 3

Two-way Analysis of Variance "ANOVA" on the Acceptability of the Canned Mussel/ Tahong among the Five Styles

Canning Styles	Source of Variation					
	SS	df	MS	F Value	Tabular F value for α = .05 and df_1=4;df_2=400	Decision
Between*	76.85	4	19.21	7.87	2.39	Reject H_o

*Tahong in Chili Sauce, Tahong in Adobo, Tahong in Tomato Sauce, Tahong in French Style, and Tahong in Sweet and Sour Sauce

As seen in Table 3, the computed F-value for columns on the five styles of canned tahong is 7.85 which exceed the Tabular F value of 2.39 at α = .05 and for degrees of freedom df_1= 4 and df_2 = 400. This led to the rejection of the Null Hypothesis (Ho_1), to the conclusion that the five styles significantly differ on its acceptability.

A further test using Scheffe's Test Analysis was considered since the Null Hypothesis was rejected and so as to be able to determine the best styles for canning tahong. The result of the further test revealed the following: Tahong in Chili Sauce, Tahong in Tomato Sauce and Tahong in Adobo are equally preferred by the tasters so are Tahong in Adobo, Tahong in French Style and Tahong

Table 4

Scheffe's Test Analysis to further Test the Acceptability of the Canned Mussel/ Tahong among the Five Styles

Canning Style	F_{Comp}*	Evaluation
Tahong in Chili Sauce vs Tahong in Adobo	1.493	Not Significant
Tahong in Chili Sauce vs Tahong in Tomato Sauce	.002	Not Significant
Tahong in Chili Sauce vs Tahong in Sweet and Sour Sauce	4.360	Significant
Tahong in Chili Sauce vs Tahong in French Style	4.278	Significant
Tahong in Adobo vs Tahong in Tomato Sauce	1.384	Not Significant
Tahong in Adobo vs Tahong in Sweet and Sour Sauce	.750	Not Significant
Tahong in Adobo vs Tahong in French Style	.716	Not Significant
Tahong in Tomato Sauce vs Tahong in Sweet and Sour Sauce	4.175	Significant
Tahong in Tomato Sauce vs Tahong in French Style	4.064	Significant
Tahong in Sweet and Sour Sauce vs Tahong in French Style	.000367	Not Significant

*This value is compared with the critical value of 3.027 which is derived from the formula $\sqrt{(k-1) \times 2.39}$

in Sweet and Sour.

The Scheffe's Test Analysis to further test the acceptability of the canned mussel among the five styles is shown in Table 4.

Acceptability of canned mussel between the four attributes (color, odor flavor, and texture is presented in Table 5).

Table 5

Two-way Analysis of Variance on the Acceptability of Canned Mussel Between the four Attributes

Attri-butes	Source of Variation					
	SS	df	MS	F Value	Tabular F value for α = .05 and df_1=3;df_2=400	Decision
Between Rows*	2.29	3	.76	.311	2.62	Accept H_o

*Color, Odor, Flavor and Texture

As Shown in Table 5, the four attributes did not significantly affect the acceptability of the canned mussel. Using the Statistical Tool "Two-way ANOVA" the computed F-value for Rows, that is on the four attributes/characteristics (color, odor, flavor, and texture) is equal to .311 which is less the Tabular F value at α = .05 and degrees of freedom df_1 = 3 and df_2 = 400.

So in this case Ho_2 is accepted, to the conclusion that the four attributes did not significantly affect the acceptability of the canned tahong/mussel.

Table 6

Two-way Analysis of Variance"ANOVA" on the Acceptability Between the Four Attributes on the Five Styles of Preparing Canned Mussel

Attributes	Source of Variation					
	SS	df	Ms	F Value	Tabular F value at α = .05	Decision
Between Columns	76.85	4	19.21	7.87	2.39	Reject H_o
Rows	2.29	3	.76	.311	2.62	Accept H_o
Interaction	22.87	12	1.91	.78	2.39	Accept H_o
Within	315.22		559			

The data presented in Table 6, revealed that through Statistical Analysis "2-Way ANOVA", the computed F-Value for interaction equal to .78 is less than the Tabular F value of 2.39, therefore conclusion drawn, is that, the attributes (color, odor, flavor, and texture) did not significantly affect the acceptability of the canned mussel.

According to Campbell (1982:154), the maintenance of high quality, tasteful menu preparation, and careful

processing were all necessary to increase production, acceptability and increase sale.

In support to this finding, a man who came to Zamboanga had described the durian in brief "it smells like Hell but taste like Heaven".

Its implication is that, the four attributes (color, odor, flavor, and texture) did not have a direct bearing on the canned tahong, since all the five styles were accepted/ liked by the taster panel.

Effect of the number of microorganisms on the microbial stability of tahong canned in Five Styles

To provide a tangible answer to the problem raised the researcher deemed it very necessary to subject the canned products to microbial analysis. The purpose is to indicate the presence or absence of microbes in a fixed quantity of product or to measure total number of organisms. The test was done under generally recognized standards and is referred to, as the Standard Plate Count (SPC).

According to Wheaton and Lawson (1985:155) the standard plate count gives a comparative mmeasure of the over-all degree of contamination.

The main reason for subjecting the canned products to microbial test is that the development of shellfish

products must take into account the bacteriological specificattion, limits, and standards that are required by potential foreign exporters, and realistic appraisal, of whether or not those requirement can be met, must be made by all sections of industry and government concerned.

After the canned tahong had been stored for eight (8) months, the canned products were incubated for twenty (20) days at 55^{o}C in an incubator to determine the number of colonies of microorganisms found in every representative sample of the five (5) styles of canned tahong. The microbial analysis was done in three (3) replicates to ascertain that its results were valid and reliable. The 270 ml. sterile with 0.1% pepton plus thirty (30) grams of sample taken from the five styles of canned tahong with .1 ml. solidified agar in a petri disc were used to determine the number of colonies in every representative sample of the canned tahong after having been cultured for 24-48 hours at 55^{o}C in an incubator. The Table is hereby presented to project a better picture and appropriate findings as a result of the Microbial Analysis through a Total Plate Count (NA) in the determination of the colony forming unit (CFU).

Table 7 indicates the number of colonies of microorganisms like bacteria and molds found in the five styles of canned tahong. For Tahong in Chili Sauce, the colony forming unit at 10^1 = 15 and 0, and at 10^2 =4 and 1. For Tahong in Adobo, the colony forming unit is high at 10^1 = 11 and 7. For Tahong in Tomato Sauce, the colony forming unit as a result of the Total Plate Count were 10^1 =3 and 1, 10^2 = 3 and 2 while 10^3 = 4 and 0. For Tahong in Sweet and Sour Sauce, the Total Plate Count were 10^1=8 and 3 while 10^2 = 1 and 0. For Tahong in French Style, the Total Plate Count were 10^1 = 6 and 12, for 10^2 - molds were evident and 2, and for 10^3 =0 and 19. The number of Colony Forming Units in the five styles is less than thirty (30), hence the products are fit for human consumption.

Table 7

Number of Colonies of Microorganisms Found in the Five Styles of Canned Tahong Cultured for 24-48 Hours After 20 Days Incubation at 55°C in an Incubator

Replicates	Total Plate Count				
	Tahong in Chili Sauce	Tahong in Adobo	Tahong in Tomato Sauce	Tahong in Sweet and Sour Sauce	Tahong in French Style
1	10^1=15 10^1=0	10^1=11 10^1=7	10^1=3 10^1=1	10^1=8 10^1=3	10^1=6 10^1=12
2	10^2=4 10^2=4	10^2=2 10^2=5	10^2=3 10^2=2	10^2=1 10^2=0	10^2=Molds 10^2=2
3	10^3=0 10^3=0	10^3=2 10^3=4	10^3=4 10^3=0	10^3=0 10^3=0	10^3=0 10^3=19

The result of the Microbial Analysis "bacterial count" through a Total Plate Count in the determination of the colony forming unit was that the canned tahong were fresh and fit for human consumption since the bacterial load was less than thirty (30). The canned products "Tahong" had shown no sign of defects, hence their freshness were maintained even after storing the canned mussel for eight (8) months. The processing time and temperature (20 minutes at 10 pounds pressure at 240°F/115.6°C) were sufficient and quality control was

observed throughout the processing period.

According to Shewan (1972:5) Total viable counts on shellfish after spoilage in ice are of the order of 10^7 - 10^8/gram at 20^oC with the flora dominated by one or the other of the gram-negative Pseudomonas or Moraxella/Acisse to bacter genera, although it is probable that even within this group only a relatively low proportion of the total number are active spoilage agents.

Also, Dagoon (1986) stated that quality control is normally based on agreed procedures and specification which are designed to maintain quality or reduce defects: 1) of the raw materials; 2) during all stages of processing; 3) of the final product. And that the major factors to be controlled inorder to reduce spoilage and maintain quality are: 1) time, 2) temperature, 3) contamination, and 4) damage.

With the findings, the five styles used in canning tahong will guarantee the freshness of the shellfish "tahong" for a longer period of time. Therefore, the continuous production and supply of fresh tahong will enhance the maximum production and supply of canned tahong the whole year round.

The five styles of canned tahong were subjected to Standard Plate Count to determine the Colony Forming Unit (CFU). The first canned tahong subjected to microbial

analysis was the Tahong in Chili Sauce. The result of the analysis is presented in Table 8.

Table 8

Dilution, Number of Plate Used, Colony Count/ Plate Total Mean, Colony Forming Unit/ Gram (CFU/g) Arithmetic Mean, and Weight Mean Count for Tahong in Chili Sauce

Dilution	N	Colony Count/ Plate	Total	Mean	CFU/g
10	2	15, 0	15	7.5	7.5×10^1
10^2	2	4, 1	5	2.5	2.5×10^2
10^3	2	0,0	0	0	0×10^3
Arithmetic Mean Count = 7.5×10^1					
Weighted Mean Count = 0.901×10^2 CFU/g					

Table 8 presents the results of the Standard Plate Count (SPC) also called the Aerobic Plate Count or Pour Plate on Tahong in Chili Sauce. Based on the microbial analysis, the Tahong in Chili Sauce obtained an arithmetic mean count of 7.5×10^1 and a eighted mean count of 0.901/g x 10^2 (dilution), CFU/g.

Since the count per plate is less than thirty (30) colonies, result is reported as 30 x N CFU/g with N as the

reciprocal of the dilution. This means that the count is insignificant and the Tahong in Chili Sauce is properly process and safe for human consumption. Based on the analysis, there was no gas formation.

Table 9

Dilution, Number of Plate used, Colony Count/ Plate, Total Mean, Colony Forming Unit/ gram (CFU/g), Arithmetic Mean Count and Weighted Mean Count for Tahong in Adobo

Dilution	N	Colony Count/ Plate	Total	Mean	CFU/g
10^1	2	11, 7	18	9	9×10^1
10^2	2	2, 5	7	3.5	3.5×10^2
10^3	2	2, 4	6	3	3×10^3
	Arithmetic Mean Count		= $\underline{9 \times 10^1}$		
	Weighted Mean Count		= $\underline{0.396 \times 10^2 CFU/g}$		

Table 9 indicates the count per plate for Tahong in Adobo as less than 30 colonies, since the arithmetic mean count is 9×10^1 and the weighted mean count is 0.396×10^2 (dilution) CFU/g with N as the reciprocal of the dilution. This means that the bacterial count was insignificant and the product was properly processed and

fit for human consumption. There was gas formation. The canned tahong had not shown any sign of defects, hence its freshness was maintained ever after storing it for eight (8) months. The processing and temperature used were sufficient and quality control was observed throughout the processing period.

Table 10 presents the result of the microbial analysis through a Standard Plate Count on Tahong in Tomato Sauce.

Table 10

Dilution, Number of Plate Used, Colony Count/ Plate, Total Mean, Colony Forming Unit per gram (CFU/g), Arithmetic Mean Count and Weighted Mean Count for Tahong in Tomato Sauce

Dilution	N	Colony Count/ Plate	Total	Mean	CFU/g
10^1	2	3, 1	4	2	2×10^1
10^2	2	3, 2	5	2.5	2.5×10^2
10^3	2	4, 0	4	2	2×10^3
Arithmetic Mean Count = $\frac{2 \times 10^1}{}$					
Weighted Mean Count = $\frac{0.586 \times 10^2 CFU/g}{}$					

Table 10 presents the arithmetic mean count for Tahong in Tomato Sauce which is 2×10^1 and a weighted mean count of 0.586×10^2 (dilution) CFU/g which is 30 x N CFU/g with N as the reciprocal of the dilution. Just like the other canned products, the Tahong in Tomato Sauce had been analyzed to be properly processed, for its freshness was maintained after it had been stored for eight (8) months. The bacterial count is very negligible in the sense that the count per plate was less than 30 colonies.

The determination of the total bacterial load of the sample is very relevant because the total amount of microorganisms in a given sample will give the degree of freshness or spoilage of the product which the human senses cannot detect. In short, total bacterial load is an object index of the quality of the product.

Table 11 presents the result of microbial analysis through Standard Plate Count on Tahong in Sweet and Sour Sauce.

Table 11 reveals the result of the analysis conducted on the Tahong in Sweet and Sour Sauce with a storage life of eight (8) months which obtained an arithmetic mean count of 5.5×10^1 and a weighted mean count of 0.541×10^2 CFU/g. It implies therefore, that the count per plate

Table 11

Dilution, Number of Plate Used, Colony Count/ Plate, Total Mean Colony Forming Unit/ gram (CFU/g), Arithmetic Mean Count and Weighted Mean Count for Tahong in Sweet and Sour Sauce

Dilution	N	Colony Count/ Plate	Total	Mean	CFU/g
10^1	2	8, 3	11	5.5	5.5×10^1
10^2	2	1, 0	1	0.5	0.5×10^2
10^3	2	0, 0	0	0	0×10^3
Arithmetic Mean Count = $\underline{5.5 \times 10^1}$					
Weighted Mean Count = $\underline{0.54 \times 10^2}$ CFU/g					

is less than 30 colonies which means that the count is very insignificant and therefore, is not in the position to cause spoilage.

If the number of counts per plate is insignificant, this can be attributed to the right application of time and temperature. According to Brennan (1981) heat kills bacteria and destroyed their performed toxins. Also, she stated that the microbiological stability and eating quality of heat processed foods are affected by the tem-

perature and duration of the thermal process. Under processed food will be liabble to bacterial spoilage, and over-processed food will be nutritionally and organoleptically inferior.

Table 12 indicates the result of bacterial count through a Standard Plate Count or Pour PLate on the Tahong in French Style.

Table 12

Dilution, Number of Plate Used, Colony Count/ Plate, Total Mean, Colony Forming Unit per gram (CFU/g), Arithmetic Mean Count and Weighted Mean Count for Tahong in French Style

Dilution	N	Colony Count/ Plate	Total	Mean	CFU/g
10^1	2	6, 12	18	9	9×10^1
10^2	2	0, 2	2	1	1×10^2
10^3	2	0, 19	19	9.5	9.5×10^3
Arithmetic Mean Count = $\underline{9 \times 19^1}$					
Weighted Mean Count = $\underline{1.757 \times 10^2 \text{ CFU/g}}$					

Table 12 reveals the findings of the microbial analysis conducted on Tahong in French Style as less than thirty (30) colonies per plate. This means that the

counts are very insignificant and the canned product was properly processed and safe for human consumption. Like the other four styles of canning tahong, it was observed to be free of gas formation. The five styles used in canning tahong were processed at the optimum temperature and time (240^{o}F/115.6^{o}C at 20 minutes at ten pounds (lbs) pressure), hence their freshness were maintained even after having stored them for 8 months. As a result of the microbial analysis, the count were neglible and insignificant since it is less than thirty colonies, attributed to the introduction of heat. It is a layman's knowledge that heat is sterilizing agent. The precise action of heat is to coagulate bacterial protein and to inactivate enzymes, an identical process. The more drastic the heat treatment, the more organisms will be killed up to the degree of heating that will sterilize the product. It be can said therefore, that the aim of processing is to inactivate the enzymes; to destroy part or all of the microorganisms present; and to improve the texture, flavor, and appearance of food by cooking.

Brennan (1981:256) reported that hermetic sealing prevents the entrance of microorganisms from the outside and the heating process performs four distinct functions namely: 1) it cooks the food; 2) it destroys or renders inactive part of all of the microorganisms in the food;

and 4) it creates a vacuum within the container which makes possible a reliale hermetic seal.

Ultimately, the result of microbial analysis "bacterial count" through a Total Plate Count in the determination of the Colony Forming Unit was that the canned tahong were fresh and fit for human consumption since the bacterial load was very negligible. The five styles of canned tahong products had shown no sign of defects even after having attained a storage-life of eight months. The processing time and temperature used were observed to be sufficient and quality control was given due accord throughout the processing time.

With the findings, the five styles used in canning tahong will guarantee the freshness of the shellfish products even for a longer period of time. Therefore, the continuous production and supply of fresh tahong will, by and large enhance the maximum supply of quality and palatable canned tahong even in time of scarcity.

Based on the different styles used to canned mussel, the five styles appeared to be safed for human consumption, as revealed by the result of the bacterial count. In this connection, The five styles used in canning tahong can guarantee its freshness, can generate a con-

tinuous supply of canned tahong, and above all can warrant the acceptance of the products which have been valuated through a sensory evaluation.

Through a very simple statistical test using the mean weight,the twenty-eight (28) panel tasters had pinpointed the five styles to be appropriate and acceptable. Therefore, the findings reveals that there is no apparent standard procedure for canning mussel.

To embark on the Tahong Canning Industry, the five styles and their procedures can be utilized for the purpose without any apprehension, since the styles had been tried out,tasted,and valuated using sensory evaluation, statistical and microbial analysis, and the results had been proven to be very remarkable and promising.

As a whole, the five most appropriate styles and procedures for canning tahong can salvage the produce of the Tahong Farms for it can lengthen the freshness of the species without necessarily alternating its original flavor and taste; it improves the nutritive value and specifically it prevent spoilage during glut season.

The panel tasters had accepted the five styles of canned tahong as evidenced by the result of the sensory evaluation. Furthermore, the study provided a ready answer to those in wanton to know the most appropriate

styles and procedures in canning tahong with the ultimate aim of providing a better avenue for the development of Tahong Canning Industry in Samar, particularly in Jiabong, Samar where the fresh tahong are readily available.

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The summary of the study, its findings, and conclusions are contained in this chapter. Recommendations are made to further test the results of the study, and to better improve the Manual for Tahong Canning, so that a more efficient and effective tahong cannery can be achieved.

Summary of Findings

The following findings were gathered from the study:

1. Acceptability of canned mussel between the four attributes (color, odor, flavor, and texture)

The four attributes did not significantly affect the acceptability of the canned mussel, since the computed F-value for rows is equal to .311 which is less than the tabular F-value of 2.62 at $\alpha = .05$, for degrees of freedom, $df_1 = 3$ and $df_2 = 400$. This means that the four attributes (color, odor, flavor, and texture) did not in any way affect the acceptability of the canned mussel.

The data further revealed that the computed F-value for interaction equal to .78 which is less than the tabular F-value of 2.39 at $\alpha = .05$. The conclusion drawn is that the four attributes did not significantly affect the acceptability of the canned mussel.

2. Effect of the number of microorganisms on the microbial stability of the tahong canned in five styles

Based on microbial analysis, the Tahong in Chili Sauce obtained an arithmetic mean count of 7.5×10^1 and a weighted mean count of 0.901×10^2 Colony Form Unit (CFU)/gram. This is an indication that the number of bacterial count per plate is less than 30 colonies. This means that the count is insignificant and the Tahong in Chili Sauce was properly processed and therefore safe for human consumption.

Tahong in Adobo, indicated that the count per plate is less than 30, since the arithmetic mean count is 9×10^1 and the weighted mean count is 0.39×10^2 CFU/g with N as the reciprocal of the dilution. This means that the number of bacteria was so negligible because the canned tahong was properly processed and is therefore fit for human consumption/utilization.

The three (3) other styles of canning tahong had given the same results since the number of CFU/g is less than 30 colonies. Tahong in Tomato Sauce obtained an arithmetic mean count of 2×10^1 and a weighted mean count of 0.586×10^2 CFU/g. Tahong in Sweet and Sour Sauce had obtained an arithmetic mean count of 5.5×10^1 and weighted mean count of 0.541×10^2 CFU/g. While Tahong in French Style upon subjecting to microbial analysis ob-

tained an arithmetic mean count of 1.757×10^2 CFU/g. The findings revealed that the counts were very insignificant to cause spoilage to the canned products "tahong". The canned mussel were processed at optimum temperature and time (twenty minutes at 10 pounds (lbs) pressure at $240^{o}F/115.6^{o}C$), hence the freshness were maintained.

3. Standard Procedure in Canning Tahong

The over-all findings reveal that there is no apparent standard canning procedure for canning tahong, since all the five styles of tahong canning were accepted by the taster panel and had passed the test on microbial analysis.

The five styles of canning tahong (Tahong in Chili Sauce, Tahong in Adobo, Tahong in Tomato Sauce, Tahong in Sweet and Sour Sauce, and Tahong in French Style) were proven to be effective in the preservation of live and fresh tahong.

With these findings, a Manual for Tahong Canning was drawn to facilitate the operation of a canning plant in the vicinity of Jiabong , Samar, the source of marketable tahong.

Conclusions

Based on the findings of the study, several conclusions were drawn:

1. That the five styles of canning tahong like Tahong in Chili Sauce, Tahong in Tomato Saucce, Tahong in Adobo,Tahong in Sweet and Sour Sauce, and Tahong in French Style will be appropriate in the operation of a tahong canning plant or factory.

2. If only to maintain the freshness of canned tahong, the sealed cans should be processed for twenty (20) minutes at ten (10) pounds (lbs) pressure at 240^{o}F/115.6^{o}C. This is to keep the product commercially sterile, so that it will not get spoiled nor will endanger the life and the health of the consuming public.

3. Having subjected the canned tahong to both sensory and microbial analysis, the five styles used in canning tahong were all found to be acceptable or liked by the taster panel, and the number of microorganisms did not impair the quality of the canned tahong nor did not make the product unfit for human consumption.

4. Live and fresh tahong used in the study gave a remarkable findings; that is, the product contained the least number of bacteria, hence, the canned products were fit for human consumption.

5. If the canned tahong had maintained its freshness, this can be attributed to the way it was processed and how it had observed the importance of optimum temperature and time ($240^{o}F/115.6^{o}C$ and twenty (20) minutes processing time).

6. The live and fresh tahong had been canned using the five styles of canning were not contaminated with toxic organisms like dinoflagellates "Pyrodinium" hence are fit for human consumption.

7. Since the Manual for Canning Tahong came to birth after the completion of the study, fishery minded individuals in wanton to have the post-harvest technology, can make use of the manual to effect the immediate operation of a tahong canning plant/factory in the vicinity of Jiabong, where the tahong are farmed and harvested throughout the year.

8. Any of the five styles of canning tahong used in the study may be put in actual application through the operation of a tahong factory, so that the preservation and exportation of quality canned tahong can be made possible, as the five styles had provided encouraging result in the study conducted.

9. Both sensory evaluation and microbial analysis provided very vital and wanting information that is, the five styles were all acceptable and that the four

attributes/characteristics (color, odor, flavor, and texture) did not affect the acceptability of the canned product. Also, the microbial load had been determined through microbial analysis, and findings reveal that the canned products contain very minimal number of bacteria, unable to cause spoilage on the canned products.

Recommendations

On the basis of the foregoing findings and conclusions of this study, the following are recommended:

1. The live tahong to be free from toxic organisms like dinoflagellates "Pyrodinium" should be first depurated in clean and fresh water or should be placed in clean water and fed with flour. This is now a necessity since the occurence of Red Tide a natural phenomenon, affects the tahong being a filter feeder. Tahong infected with this microorganisms can threaten the life of human being, hence any method of depuration should be applied to safeguard the canned products.

2. People in the province of Samar, specifically in Jiabong, Samar can now start the development of tahong industry since a Manual for Tahong Canning is already available.

3. Similar studies must be conducted to further discover new processing technolgy suitable for tahong, so

that value-added products can be produced in large quantity and on commercial scale.

4. Other styles of canning may be tried out, so that improvement of the canned mussel can be facilitated.

5. Any similar study that will be undertaken should consider other techniques in analyzing the canned products aside from sensory evaluation, and microbial analysis, so that a more improved palatable canned products can be produced.

6. Both, Tahong Farm Industry and Tahong Canning Industry will pave the way to the development of Jiabong, Samar, thus making the residents economically sound and stable.

7. In the end, the realization of the Manual for Canning Tahong can lead to the operation of a canning factory on commercial scale or in a small-localized canning operation. With this on hand the municipality of Jiabong will be able to generate more income from the production of a value-added product "Canned Tahong" using any of the five styles of canning, as it has been discovered to be liked or accepted, and its procedures within its acceptable standard.

CHAPTER VI

MANUAL FOR TAHONG CANNING

The findings of the study provided the researcher the opportune time to come up with a workable manual for canning tahong that will serve as the starting point in the development of Tahong Canning Industry in the municipality of Jiabong, Samar and other parts of the country with abundant supply of mussel/tahong.

The manual is simplified so that any one who decides to engage in the canning of tahong either on small localized operation or commercial scale can avail of the newly discovered technology for actual canning operation.

The establishment of a tahong canning plant or factory will come in handy when the five styles of canning mussel will be applied in the actual canning operation.

Further, the manual will prime-pump the development of the tahong canning industry in the municipality of Jiabong, Samar. As a result, post harvest technology will be introduced to maximize the production of value-added products (quality canned tahong rich in protein).

A MANUAL FOR TAHONG CANNING

A MANUAL FOR TAHONG CANNING

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FOREWORD

A Manual for Tahong Canning was conceived as a result of a study conducted. The Manual orchestrated the possibility of developing the tahong canning industry in Samar, specifically in Jiabong, Samar.

It is envisioned to provide a post-harvest technology "Tahong Canning" to enable one to produce value-added product like canned tahong. The canned tahong will be comparable to other canned products in terms of quality acceptability, and palatability.

The preparation of a Manual for Tahong Canning will answer the demand of time that is to provide the residents of Jiabong, and other parts of the country graced with abundant and continuous supply of mussel with the appropriate canning styles, so that a canning factory or plant can be constructed and operated either on commercial scale or in small localized operation depending on the capital to be invested for the purpose.

Those places showered with abundant supply of high quality, live, and fresh tahong should be the working environment for the Tahong Canning Factory/Plant.

The actualization/application of what is in the Manual will in a large measure contribute to the long felt need for tahong cannery.

Lastly, the operation and functionalization of a canning factory will ascertain the continuous supply of a quality tahong canned product.

TABLE OF CONTENTS

RATIONALE

This handbook for tahong canning was prepared to answer the needs for the most appropriate styles of tahong canning. It has been written with these general and specific objectives.

Goal

The residents of the municipality of Jiabong will be able to operate a tahong factory/plant either on commercial scale or in a small localized canning operation.

Objectives:

The residents of the municipality of Jiabong and some businessmen will be provided with a Manual for Tahong Canning. Contained in the Manual are the five (5) styles of Tahong Canning tested and proven as to its acceptability and palatability a requirement to effect the operation of a canning plant.

The Manual for Canning Tahong will provide deeper insights on the preparation of the canned tahong using any of the five (5) styles (Tahong in Chili Sauce; Tahong in Tomato Sauce; Tahong in Adobo; Tahong in Sweet and Sour Sauce; and Tahong in French Style).

More so, the ultimate purpose of the Manual is to effect the maximum production of the canned tahong, using any of the canning styles. The basic procedure in canning (tahong) is presented in a simplified form for an efficient and effective operation of a canning plant/factory.

CANNING PROCEDURE

The equipment, kitchen utensils, materials, and procedures in Canning Tahong using the five (5) styles of canning considered in the study (Tahong in Chili Sauce, Tahong in Adobo, Tahong in Tomato Sauce, Tahong in Sweet and Sour Sauce, and Tahong in French Style) are presented.

Equipment

1. Pressure Cooker
2. Can Sealer
3. Weighing Scale "Electronic Balance"
4. Gas Stove

Pressure Cooker. An equipment used to can fish above boiling temperature (100°C) and with pressure.

Can Sealer. An equipment used to seal the tin cans with two operation rolls. The first operation roll is used to half seal or clinch the cans, and the second, to completely seal the seams of the cans.

Weighing Scale "Electronic Balance". A device used to measure the weight of the tahong and canned product.

Kitchen Utensils and Materials

- carajay
- knife
- basin
- spoon
- tin cans "211 x 300"
- ladle
- mixing bowl
- collander
- measuring cup

PROCEDURES IN CANNING TAHONG/MUSSEL USING THE FIVE (5) STYLES CONSIDERED IN THE STUDY

Tahong in Adobo

Ingredients:

- 2 kilos tahong meat/mantle
- 2 cups vinegar
- 1 cup sugar
- ½ cup soy sauce
- 1 tablespoon salt
- 1 teaspoon monosoduim glutamate (MSG) - Ajinomoto

1. Fresh tahong are thoroughly washed. The tahong are steamed for 10 minutes to open up their valves. The mantle/meat is separated from the shells by hand.

2. The mantle/meat of the tahong is marinated for two (2) hours using the proportion given above.

3. The marinated tahong are dried for a while and then fried until brown in color.

4. Packing. The fried tahong are packed into cans. No sauce needed.

5. Clinching. Cans are half-sealed using the first operation roll of a Can Sealer.

6. Exhausting. Cans are placed in a Pressure Cooker for exhausting for twenty (20) minutes. The purpose is to remove the air inside the can.

7. Complete sealing with the use of a Can Sealer. The cans are sealed permanently by using the second operation roll.

8. Processing. Sealed cans are processed for twenty (20) minutes at ten (10) pounds (lbs) pressure at 240^{o}F/115.6^{o}C.

9. Cooling. Cans are cooled with running water.

10. Storing. The canned tahong are kept in a dry and clean place after labelling.

11. Packaging. The canned products are packed in preparation for distribution.

12. Distribution. The canned tahong are distributed to different market outlets.

Good for four (4) servings.

Tahong in Sweet and Sour Sauce

Ingredients:

2 kilos tahong meat/mantle

2 cups vinegar

1 cup sugar

1 tablespoon salt

1 teaspoon monosodium glutamate (MSG) - Ajinomoto

1 tablespoon black pepper

1. Fresh Tahong are thoroughly washed. The tahong are steamed for 10 minutes to open up their valves. The mantle/meat is separated from the shells by hand.

2. The mantle/meat of the tahong is marinated for two (2) hours using the proportion given above.

3. The marinated tahong are dried for a while and then fried until brown in color.

4. Packing. The fried tahong are packed into cans, and all other ingredients are added:

2 cups water

½ cup vinegar

1½ cup sugar

4 tablespoon corn starch

The sauce is boiled before it is added to cans.

5. Clinching. Cans are half-sealed using the first operation roll of a Can Sealer.

6. Exhausting. Cans are placed in a Pressure Cooker for exhausting twenty (20) minutes. The purpose is to remove the air inside the can.

7. Complete sealing with the use of a Can Sealer. The cans are sealed permanently by using the second operation roll.

8. Processing. Sealed cans are processed for twenty (20) minutes at ten (10) pounds (lbs) pressure at 240°F/115.6°C.

9. Cooling. Cans are cooled with running water.

10. Storing. The canned tahong are kept in a dry and clean place after labelling.

11. Packaging. The canned products are packed in preparation for distribution.

12. Distribution. The canned tahong are distributed to different market outlets.

Good for four (4) servings.

Tahong in French Style

Ingredients:

2 kilos tahong mantle/meat

2 cups vinegar

1 cup sugar

½ cup soy sauce

1 tablespoon salt

1 tablespoon monosoduim glutamate (MSG) - Ajinomoto

1 tablespoon black pepper

1. Fresh tahong are thoroughly washed. The tahong are steamed for ten (10) minutes to open up their valves. The mantle/meat is separated from the shells by hand.

2. The mantle/meat of the tahong is marinated for two (2) hours using the proportion given above.

3. The marinated tahong are dried for a while and

then fried until brown in color.

4. Packing. The fried tahong are packed into cans, and all other ingredients are added:

10 tablespoon corn oil

1 piece bay leaf

7 black pepper

6 pieces (slice) carrot

¼ tablespoon monosoduim glutamate (MSG) - Ajinomoto

The sauce is boiled before it is added to cans.

5. Clinching. Cans are half-sealed using the first operation roll off a Can Sealer.

6. Exhausting. Cans are placed in a Pressure Cooker for exhausting for twenty (20) minutes. The purpose is to remove the air inside the can.

7. Complete sealing with the use of a Can Sealer. The cans are sealed permanently by using the second operation roll.

8. Processing. Sealed cans are processed for twenty (20) minutes at ten (10) pounds (lbs) pressure at 240^{o}F/115.6^{o}C.

9. Cooling. Cans are cooled with running water.

10. Storing. The canned tahong are kept in a dry and clean place after labelling.

11. Packaging. The canned products are packed in

preparation for distribution.

12. Distribution. The canned tahong are distributed to different market outlets.

Good for four (4) servings.

Tahong in Tomato Sauce

Ingredients:

2 kilos tahong meat/mantle

1 cup sugar

2 cups vinegar

½ cup soy sauce

1 tablespoon salt

1 teaspoon monosoduim glutamate (MSG) - Ajinomoto

1. Fresh tahong are thoroughly washed. The tahong are steamed for ten (10) minutes to open up their valves.

2. The mantle/meat of the tahong is marinated for two (2) hours using the proportion given above.

3. The marinated tahong are dried for a while and then fried until brown in color.

4. Packing. The fried tahong are packed into cans, and all other ingredients are added:

4 cups tomato sauce

2 cups corn oil

1 cup water

½ cup corn starch

¼ teaspoon MSG/Ajinomoto added to each can

The sauce is boiled before it is added to cans.

5. Clinching. Cans are half-sealed using the first operation roll of a Can Sealer.

6. Exhausting. Cans are placed in a Pressure Cooker for exhausting for twenty (20) minutes. The purpose is to remove the air inside the can.

7. Complete sealing with the use of a Can Sealer. The cans are sealed permanently by using the second operation roll.

8. Processing. Sealed cans are processed for twenty (20) minutes at ten (10) pounds (lbs) pressure at 240^{o}F/115.6^{o}C.

9. Cooling. Cans are cooled with running water.

10. Storing. The canned tahong are kept in a dry and clean place after labelling.

11. Packaging. The canned products are packed in preparation for distribution.

12. Distribution. The canned tahong are distributed to different market outlets.

Tahong in Chili Sauce

Ingredients:

2 kilos tahong mantle/meat

2 cups vinegar

1 cup sugar

1 tablespoon salt

½ cup soy sauce

1 teaspoon monosoduim glutamate (MSG) - Ajinomoto

1 tablespoon black pepper

1. Fresh tahong are thoroughly washed. The tahong are steamed for ten (10) minutes to open up their valves. The mantle/meat is separated by hand.

2. the mantle/meat of the tahong is marinated for two (2) hours using the proportion given above.

3. The marinated tahong are dried fo a while and then fried until brown in color.

4. Packing. The fried tahong are packed into cans, and all other ingredients are added:

2 cups chili sauce

1 cup corn oil

½ cup water

1 tablespoon corn starch

½ MSG/Ajinomoto for each can

The sauce is boiled before it is added to cans.

5. Clinching. Cans are half-sealed using the first operation roll of a Can Sealer.

6. Exhausting. Cans are placed in a Pressure Cooker for exhausting for twenty (20) minutes. The purpose is to remove the air inside the can.

7. Complete sealing with the use of a Can Sealer.

8. Processing. Sealed cans are processed for twenty (20) minutes at ten (10) pounds (lbs) pressure at $240^{o}F/115.6^{o}C$.

9. Cooling. Cans are cooled with running water.

10. Storing. The canned tahong are kept in a dry and clean place after labelling.

11. Packaging. The canned products are packed in preparation for distribution.

12. Distribution. The canned tahong are distributed to different market outlets.

Good for four (4) servings.

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APPENDICES

APPENDIX A

SENSORY EVALUATION SHEET
Using the 9-Point Hedonic Scale

Name:_____ Date:_____

DIRECTIONS: Kindly taste test the coded samples and assign an appropriate scale/number which best describes your feeling on the given attributes of the canned products "Tahong".

Responses	Scale Value
Like Extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

SAMPLE CODE

ATTRIBUTES					
Color	_____	_____	_____	_____	_____
Odor	_____	_____	_____	_____	_____
Flavor	_____	_____	_____	_____	_____
Texture	_____	_____	_____	_____	_____
General Acceptability	_____	_____	_____	_____	_____

COMMENTS:

_____
_____
_____
_____
_____

APPENDIX B

Raw Data Collated through sensory evaluation on the four attributes

	I	II	III	IV	V	I^2	II^2	III^2	IV^2	V^2
	8	9	7	6	4	64	81	49	36	16
	6	8	8	6	8	36	64	64	36	64
	8	5	8	3	6	64	25	64	9	36
	9	6	9	8	7	81	36	81	64	49
	9	8	8	7	7	81	64	64	49	49
	8	6	7	6	6	64	36	49	36	36
	6	5	6	5	5	36	25	36	25	25
	8	7	8	8	7	64	49	64	64	49
	7	6	7	6	5	49	36	49	36	35
	8	6	8	6	7	64	36	64	36	49
	7	3	8	5	4	49	9	64	25	16
	6	7	7	4	4	36	49	49	16	16
	8	8	9	7	8	64	64	81	49	64
	8	6	7	7	7	64	36	49	49	49
Color	8	7	9	9	8	64	49	81	81	64
	7	7	5	5	5	49	49	25	25	25
	9	7	8	6	7	81	49	64	36	49
	8	8	9	8	8	64	64	81	64	64
	8	7	6	5	4	64	39	36	25	16
	9	5	7	6	6	81	25	49	36	36
	7	8	8	9	5	49	64	64	81	25
	9	6	6	4	1	81	36	36	16	1
	6	6	7	8	6	36	36	49	64	36
	8	8	8	7	7	64	64	64	49	49
	8	8	8	7	8	64	64	64	49	64
	8	6	8	8	7	64	36	64	64	49
	8	7	8	7	6	64	49	64	49	36
	7	8	9	7	7	49	64	81	49	49
	216	188	211	180	167	1690	1308	1649	1218	1106=6971

	I	II	III	IV	V	I^2	II^2	III^2	IV^2	V^2
	9	7	8	5	4	81	49	64	25	16
	7	7	8	8	7	49	49	64	64	49
	8	4	8	3	5	64	16	64	9	25
	8	7	6	6	8	64	49	36	36	64
	8	6	8	4	8	64	36	64	16	64
	7	8	8	7	7	49	64	64	49	49
	6	5	7	6	6	36	25	49	36	36
	9	6	7	6	7	81	36	49	36	49
	7	6	7	7	6	49	36	49	49	36
	7	7	7	8	8	49	49	49	64	64
	6	7	7	7	6	36	49	49	49	36
	6	8	8	5	6	36	64	64	25	36
	8	9	9	9	9	64	81	81	81	81
Odor	7	6	7	7	6	49	36	49	49	36
	8	8	9	8	7	64	64	64	81	49
	7	8	7	3	6	49	64	49	9	36
	8	6	8	8	8	64	36	64	64	64
	7	8	8	8	8	49	64	64	64	64
	7	8	6	6	4	49	64	36	36	16
	8	4	7	6	5	64	16	49	36	25
	8	7	8	7	7	64	49	64	64	49
	7	8	7	3	5	49	64	49	9	25
	7	7	8	9	7	49	49	64	81	49
	7	8	6	7	8	49	64	36	49	64
	7	7	7	6	9	49	49	49	36	81
	8	8	6	7	7	64	64	36	49	49
	7	9	8	7	6	49	81	64	49	36
	7	7	8	7	9	49	49	64	49	81
	204	196	208	180	187	1532	1416	1564	1232	1339=7083

	I	II	III	IV	V	I^2	II^2	III^2	IV^2	V^2
	8	9	6	7	4	64	81	36	49	16
	7	8	7	7	7	49	64	49	49	49
	6	4	7	3	6	36	16	49	9	36
	7	7	8	9	8	49	49	64	81	64
	9	7	8	4	8	81	49	64	16	64
	8	6	9	9	8	64	36	81	81	64
	4	4	4	4	6	16	16	16	16	36
	9	4	8	4	4	81	16	64	16	16
	6	7	7	6	5	36	49	49	36	25
	6	6	8	8	7	36	36	64	64	49
	6	5	8	5	7	36	25	64	25	49
Flavor										
	4	8	9	4	3	16	64	81	16	9
	8	9	8	9	9	64	81	64	81	81
	7	6	7	6	6	49	36	49	36	36
	7	7	8	8	8	49	49	64	64	64
	6	7	5	2	5	36	49	25	4	25
	8	7	7	7	8	64	49	49	49	64
	8	8	8	8	8	64	64	64	64	64
	7	6	8	5	4	49	36	64	25	16
	9	5	6	8	6	81	25	36	64	36
	7	7	7	8	6	49	49	49	64	36
	2	8	7	6	8	4	64	49	36	64
	6	7	6	9	7	36	49	36	81	49
	7	7	6	7	9	49	49	36	49	81
	9	7	7	6	8	81	49	49	36	64
	8	6	7	8	6	64	36	49	64	36
	8	7	8	8	7	64	49	64	64	49
	9	7	8	7	8	81	49	64	49	64
	196	186	202	182	184	1448	1284	1492	1288	1306=5512

I	II	III	IV	V	I^2	II^2	III^2	IV^2	V^2
8	9	6	5	4	64	81	36	25	16
6	7	8	8	7	36	49	64	64	49
8	4	6	3	5	64	16	36	9	25
7	7	7	8	8	49	49	49	64	64
9	7	8	5	8	81	49	64	25	64
8	6	8	7	5	64	36	64	49	25
4	4	4	5	6	16	16	16	25	36
9	4	7	7	7	81	16	49	49	49
8	7	8	6	5	64	49	64	36	25
8	8	8	8	9	64	64	64	64	81
8	5	7	6	6	64	25	49	36	36
5	6	8	4	3	25	36	64	16	9
Texture									
8	9	8	9	9	64	81	64	81	81
7	7	7	6	7	49	49	49	36	49
8	8	8	8	7	64	64	64	64	49
6	8	6	2	5	36	64	36	4	25
7	7	8	7	8	49	49	64	49	64
7	6	6	8	8	49	36	36	64	64
7	6	8	5	4	49	36	64	25	16
9	6	7	6	7	81	36	49	36	49
7	8	6	7	7	49	64	36	49	49
3	8	7	7	7	9	64	49	49	49
6	8	6	9	6	36	64	36	81	36
8	7	6	6	8	64	49	36	36	64
8	8	7	8	9	64	64	49	64	81
8	6	6	6	6	64	36	36	36	36
7	8	7	8	8	49	64	49	64	64
8	9	7	8	8	64	81	49	64	64
202	193	195	182	187	1512	1387	1385	1264	1319=6867

APPENDIX C

Data on the four attributes (color, odor, flavor, and texture) collated through sensory evaluation

Attributes

Color

Taster Panel	Tahong in Chili Sauce	Adobo Tahong	Tahong in Tomato Sauce	Tahong in Sweet and Sour Sauce	Tahong in French Style
1	8	9	7	6	4
2	6	8	8	6	8
3	8	5	8	3	6
4	9	6	9	8	7
5	9	8	8	7	7
6	8	6	7	6	6
7	6	5	6	5	5
8	8	7	8	8	7
9	7	6	7	6	5
10	8	6	8	6	7
11	7	3	8	5	4
12	6	7	7	4	4
13	8	8	9	7	8
14	8	6	7	7	7
15	8	7	9	9	8
16	7	7	5	5	5
17	9	7	8	6	7
18	8	8	9	8	8
19	8	7	6	5	4
20	9	5	7	6	6
21	7	8	8	9	5
22	9	6	6	4	1
23	6	6	7	8	6
24	8	8	8	7	7
25	8	8	8	7	8
26	8	6	8	8	7
27	8	7	8	7	6
28	7	8	9	7	7
Total	216	188	211	180	167
Mean	7.714	6.714	7.535	66.428	5.964

Odor

Taster Panel	Tahong in Chili Sauce	Adobo Tahong	Tahong in Tomato Sauce	Tahong in Sweet and Sour Sauce	Tahong in French Style
1	9	7	8	5	4
2	7	7	8	8	7
3	8	4	8	3	5
4	8	7	6	6	8
5	8	6	8	4	8
6	7	8	8	7	7
7	6	5	7	6	6
8	9	6	7	6	7
9	7	6	7	7	6
10	7	7	7	8	8
11	6	7	7	7	6
12	6	8	8	5	6
13	8	9	9	9	9
14	7	6	7	7	6
15	8	8	9	8	7
16	7	8	7	3	6
17	8	6	8	8	8
18	7	8	8	8	8
19	7	8	6	6	4
20	8	4	7	6	5
21	8	7	8	7	7
22	7	8	7	3	5
23	7	7	8	9	7
24	7	8	6	7	8
25	7	7	7	6	9
26	8	8	6	7	7
27	7	9	8	7	6
28	7	7	8	7	9
Total	204	196	208	180	187
Mean	7.285	7	7.428	6.428	6.678

Flavor

Taster Panel	Tahong in Chili Sauce	Adobo Tahong	Tahong in Tomato Sauce	Tahong in Sweet and Sour Sauce	Tahong in French Style
1	8	9	6	7	4
2	7	8	7	7	7
3	6	4	7	3	6
4	7	7	8	9	8
5	9	7	8	4	8
6	8	6	9	9	8
7	4	4	4	4	6
8	9	4	8	4	4
9	6	7	7	6	5
10	6	6	8	8	7
11	6	5	8	5	7
12	4	8	9	4	3
13	8	9	8	9	9
14	7	6	7	6	6
15	7	7	8	8	8
16	6	7	5	2	5
17	8	7	7	7	8
18	8	8	8	8	8
19	7	6	8	5	4
20	9	5	6	8	6
21	7	7	7	8	6
22	2	8	7	6	8
23	6	7	6	9	7
24	7	7	6	7	9
25	9	7	7	6	8
26	8	6	7	8	6
27	8	7	8	8	7
28	9	7	8	7	8
Total	196	186	202	182	184
Mean	7	6.642	7.214	6.5	6.571

Texture

Taster Panel	Tahong in Chili Sauce	Adobo Tahong	Tahong in Tomato Sauce	Tahong in Sweet and Sour Sauce	Tahong in French Style
1	8	9	6	5	4
2	6	7	8	8	7
3	8	4	6	3	5
4	7	7	7	8	8
5	9	7	8	5	8
6	8	6	8	7	5
7	4	4	4	5	6
8	9	4	7	7	7
9	8	7	8	6	5
10	8	8	8	8	9
11	8	5	7	6	6
12	5	6	8	4	3
13	8	9	8	9	9
14	7	7	7	6	7
15	8	8	8	8	7
16	6	8	6	2	5
17	7	7	8	7	8
18	7	6	6	8	8
19	7	6	8	5	4
20	9	6	7	6	7
21	7	8	6	7	7
22	3	8	7	7	7
23	6	8	6	9	6
24	8	7	6	6	8
25	8	8	7	8	9
26	8	6	6	6	6
27	7	8	7	8	8
28	8	9	7	8	8
Total	202	193	195	182	187
Mean	7.214	6.892	6.964	6.5	6.678

APPENDIX D

Computation using Two-way Analysis of Variance "ANOVA" to determine the degree of Acceptability of the Five Styles used in Canning Tahong

Table of Total

	A 1	B 2	C 3	D 4	E 5		
Color R1	216	188	211	180	167	962^2	925444
Color R2	204	196	208	180	187	975^2	950625
FlavorR3	196	186	202	182	184	950^2	902500
TextureR4	202	193	195	182	187	959	919681
							3,698,250

818_2 763_2 816_2 724_2 725_2 = 3,846
818^2 763^2 816^2 724^2 725^2 = 2,966,950
669124 524176
582169 525625 = 2,966,950
665856

Table of Square

	1	2	3	4	5		Total
Color	1690	1308	1649	1218	1106	=	6971
Odor	1532	1416	1564	1232	1339	=	7083
Flavor	1448	1248	1492	1288	1306	=	6818
Texture	1512	1387	1385	1264	1319	=	6867
	6182	5395	6090	5002	5070	=	27739

Total sum of Square (SS_t)

A. $$SS_t = EX^2_t - \frac{(\Sigma X)^2}{N_t}$$

$$= 27789 - \frac{(3846)^2}{560}$$

$$= 27789 - 26413.778$$

$$= 1325.222$$

B. $$SS_w = EX^2_t - \frac{(\Sigma X)^2}{N}$$

$$= 27739 - \frac{742442}{28}$$

$$= 27739 - 26515.78571$$

$$= 1223.21429$$

C. $$SS_c = \frac{\Sigma\ (\Sigma X_c)^2}{N_c} - \frac{(\Sigma X_t)^2}{N_t}$$

$$= \frac{2966950}{112} - 26413.778$$

$$= 2649.625 - 26413.778$$

$$= 76.847$$

D. $$SS_r = \frac{\Sigma\ (\Sigma X_r)^2}{N_r} - \frac{(\Sigma X_t)^2}{N_t}$$

$$= \frac{3698250}{140} - 26413.778$$

$$= 26416.07142$$

$$= 2.29342$$

E. $$SS_{cr} = SS_t - SS_w - SS_c - SS_r$$

$$= 1325.222 - 1223.21429 - 76.847 .2.29342$$

$$= 1325.222 - 1302.35471$$

$$= 22.86729$$

$$= 22.87$$

$df_t = N_t - 1 = 560 - 1 = 559$

$df_w = K\ (N-1) = 20\ (28-1) = 540$

$df_c = C - 1 = 5 - 1 = 4$

$df_r = R - 1 = 4 - 1 = 3$

$df_{cr} = (C-1)\ (1-1)$
$= (5-1)\ (4-1)$
$= (4)\quad (3)$
$= 12$
$540 - 12$

ANOVA TABLE

Source of Variation					
Between	SS	df	Ms	F	R
Columns	76.85	4	19.21	8.50	Reject
Rows	2.29	3	.79	.336	Accept
Intera-action	22.87	12	191	.895	Accept
Within	1323.21	540	2.26		
Total:	1325.22	559			

DR_c: Reject No if Fabs > 1.78

DR_r: Reject No if Fabs > 2.62

DR_{cr}: Reject No if Fabs > 1.78

DR_c Fabs 8.50 > 1.78 - Reject

DR_r Fabs .336 < 2.62 - Accept

DR_{cr} Fab 845 < 1.78 - Accept

I. Row

Ho_1 - There is no significant difference on the acceptability of canned mussel among the five styles.

Fabs for Column, on five styles, exceed the .05 table value of F= 1.78 for df 540,12. This lead to the rejection of the Ho and to the conclusion that the five styles significantly differ on its acceptability.

Ho_2

Fabs for Row, that is on the 4 attributes, it is less than the .05 table value of F = 2.62 for df = 3, 12. So in this case, Ho is accepted and we conclude that the 4 attributes significantly affect the acceptability of the canned mussel.

The computed F for interaction is less than the table value aand hence the acceptance of the Ho and we conclude that the attributes do not affect the acceptability of the canned mussel.

. Ho_1 - rejected - proceed to Scheffe's Test

$$F = \frac{(X_1 - X_2)^2}{Sw^2 \left(\frac{N_1 + N_2}{N_1 \quad N_2}\right)}$$

Ho: There is no significant difference on the acceptability of canned mussel among the five styles.

APPENDIX E

Scheffe's Test to further test the Hypothesis that was Rejected (Scheffe's test, 1957)

Formula:

$$F = \frac{(X_2 - X_2)^2}{S_w^2 \frac{(N_1+N_2)}{N_1 N_2}}$$

Tahong in Chili Sauce vs Tahong in Adobo

$$F = \frac{(7.303 - 6.812)^2}{2.46 \frac{(28 + 28)}{(28)(28)}}$$

$$= \frac{(.491)^2}{2.46 \frac{(56)}{784}} = \frac{.241081}{.161428}$$

$$= 1.4934$$

Tahong in Chili Sauce vs Tahong in Tomato Sauce

$$F = \frac{(7.303 - 7.285)^2}{.17428}$$

$$= \frac{(.018)^2}{.16142} = \frac{.00324}{.161428}$$

$$= .002807$$

Tahong in Chili Sauce vs Tahong in Sweet and Sour

$$F = \frac{(7.303 - 6.464)^2}{.17428}$$

$$= \frac{(.839)^2}{.17428} = \frac{.70392}{.161428}$$

$$= 4.36058$$

Tahong in Chili Sauce vs Tahong in French Style

$$F = \frac{(7.303 - 6.464)^2}{.17428}$$

$$= \frac{(.831)^2}{.161428} = \frac{.69056}{.161428}$$

$$= 4.27782$$

Tahong in Adobo vs Tahong in Tomato Sauce

$$F = \frac{(6.812 - 7.285)^2}{.161428}$$

$$= \frac{(.473)^2}{.161428} = \frac{.223729}{.161428}$$

$$= 1.38593$$

Tahong in Adobo vs Tahong in Sweet and Sour

$$F = \frac{(6.812 - 6.472)^2}{.161428}$$

$$= \frac{(.348)^2}{.161428} = \frac{.1211}{.161428}$$

$$= .750204$$

Tahong in Adobo vs French Style

$$F = \frac{(6.812 - 6.472)^2}{.161428}$$

$$= \frac{(.34)^2}{.161428} = \frac{.1156}{.161428}$$

$$= .7161$$

Tahong in Tomato Sauce vs Tahong in Sweet and Sour

$$F = \frac{(7.285 - 6.464)^2}{.161428}$$

$$= \frac{(.821)^2}{.161428} = \frac{.67404}{.161428}$$

$$= 4.17548$$

Tahong in Tomato Sauce vs Tahong in French Style

$$F = \frac{(7.282 - 6.472)^2}{.161428}$$

$$= \frac{(.81)^2}{.161428} = \frac{.6561}{.161428}$$

$$= 4.0643$$

Tahong in Sweet and Sour vs Tahong in French Style

$$F = \frac{(6.464 - 6.472)^2}{.161428}$$

$$= \frac{(.008)^2}{.161428}$$

$$= .000397$$

CURRICULUM VITAE

CURRICULUM VITAE

Name	**Leticia Ebol Delos Reyes**
Address	Mercedes, Catbalogan, Samar
Date of Birth	January 15, 1947
Place of Birth	Santa Maria, Zamboanga City
Present Position	Vocational School Department Head
Station	Samar Regional School of Fisheries Catbalogan, Samar
Civil Status	Single

EDUCATIONAL BACKGROUND

Elementary	Santa Maria Elementary School Santa Maria, Zamboanga City 1960
Secondary	Mindanao Regional School of Fisheries/Zamboanga State College of Marine Sciences and Technology, Rio Hondo Zamboanga City 1964
Post Secondary	Fishery Technical Education Mindanao Regional School of Fisheries/Zamboanga State College of Marine Sciences and Technology, Rio Hondo, Zamboanga City
College	Bachelor of Science in Education Sacred Heart College Catbalogan, Samar 1976
	Bachelor of Arts (AB) Sacred Heart College Catbalogan, Samar 1978

	Bachelor of Science in Fisheries Mindanao Regional School of Fisheries/Zamboanga State College of Marine Sciences and Technology Zamboanga City Summer, 1978
Graduate	Master of Technical Science in Fish Culture Sterling University, Scotland, Britain Auburn University, Alabama, USA 1981
	Master of Arts in Education Western Mindanao State University, Zamboanga City 1989
	Master of Public Administration Certificate of Governmental Management Western Mindanao State University Zamboanga City 1st Semester, 1988
Curriculum Pursued	Doctor of Philosophy
Major	Educational Management

CIVIL SERVICE ELIGIBILITY

Civil Service for Fishery Biologist

Civil Service Examination for Teachers

POSITION HELD

Secondary School Teacher	1968-1972
Junior College Instructor	1973-1978
Vocational School Department Head	1978-present

Special Training	Junior Executive Training/ JET – STREAM Civil Service Commission Region VIII, Tacloban City 1979

SCHOLARSHIP/FELLOWSHIP

Bachelor of Science in Fisheries	Mindanao Regional School of Fisheries/Zamboanga State College of Marine Sciences and Technology 1978
Master of Technical Science in Fish Culture	Sterling University, Scotland Britain and Auburn University. Alabama, USA 1981

HONORS/AWARD RECEIVED

With Honors	JET-STREAM 1979
With Distinction	Master of Technical Science in Fish Culture Sterling University, Scotland, Britain and Auburn University Alabama, USA 1981
Highest Achievement Award	The International Research Communication Center, Inc., Manila 1985
Bronze Service	Boy Scout of the Philippines Catbalogan, Samar 1985
Silver Anahaw Award	Girlscout of the Philippines Catbalogan, Samar 1989

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