Utilization of Spotted Jellyfish (*Mastigias Papua*) for Gelatin Production in Palompon, Leyte Phils.: Basis for Product Commercialization

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***Abstract*—Spotted jellyfish are prevalent in both inshore seas and oceans in mostly warm tropical waters. They are an indicator for water quality and it contains a variety of some important nutrients found in this kind of jellyfish. The study aimed to determine the capabilities of producing gelatin compound utilizing the collagen from spotted jellyfish *(Mastigias Papua*) which has less carbohydrate and fats and perfect for food diet. A survey was conducted through ocular visitation. A sample was randomly taken and was brought to the laboratory for analysis. Each collected sample was examined quantitatively with the following morphological features in terms of diameter size, visceral mass, structure and color dimorphism. The methods involved in making gelatin were done by pre-treatment, cooking, filtration, and drying process. Based on the findings, the pH value of the mixture after cooking had gradually decreased from 6.37 (slightly acidic) to 4.59 (more acidic) due to enzymatic activity and protein synthesis. The temperature was constantly measured at 50 ^{0}C to avoid the degradation of protein structure and other amino acids. The product yield of 0.35 grams of gelatin per grams of raw jellyfish was produced containing 30% pure collagen and 70% seaweeds extract. The cost of raw materials over the daily income from the product sales is about 70%. Thus this project proved that the production of gelatin using the collagen from spotted jellyfish were technically and economically feasible to invest on. However, due to the time limitations, further studies would still recommended for further development of the process.**

***Keywords*— *Mastigias Papua*, collagen, seaweeds extract, product yield, Palompon.**

I. Introduction

Palompon, a community is located along the coastal area and it is greatly known for its abundance of marine resources and other sea creatures. It supports an exceptionally high diversity of marine life including spotted jellyfish, lagoon jelly, golden medusa, or papuan jellyfish. They are prevalent in both inshore seas and oceans in mostly warm and tropical waters. They are also an indicator for water quality**,** as the Oxygen rate in the water goes down, so to do the respiratory rate of the jellyfish. Spotted jellyfish are abundant in the coastal area in Palompon and across the Philippine seas. They are found in the ocean where it tends to dwell within the top 2.5 m of the water during the day to allow its symbiotic zooxanthellae access to light. All measures of total asexual reproduction indicated that mid- to-high temperatures would lead to faster production [Wen-Chen Lu et. al, 2009].

Researchers at Tele Aviv University, however, thought jellyfish could perhaps be the source for highly absorbent and biodegradable material. Their bodies are 90 percent water, yet they don't disintegrate or dissolve in the sea. It is many times more absorbent than paper towels, and which is derived from jellyfish bodies plus nanoparticles for antibacterial properties. It is less expensive than the synthetic super-absorbing polymers in current use. Jellyfish are also harvested for their collagen and it can be used in many beauty products.

It has been thought also that jellyfish, a great source of nutrients. It can have a positive impact on our health. They contain a lot of calcium binding proteins which improve memory and help to fight age related cognitive decline. Jellyfish is mostly protein and water that it is a very lean source of amino acids with very few carbohydrates or fats making them the perfect diet food. In a recent study, 56 participants were put on a jellyfish diet and it was found that 57% of them experienced memory improvements [Jacoby, 2011].

However, the process of making gelatin is usually derived from collagen, a natural protein substance present in mammals. It is produced by boiling the connective tissues, bones and skins of animals, usually cows and pigs. It has the ability to form strong, transparent gels and flexible films that are easily digested, soluble in hot water, and capable of forming a positive binding action have made it a valuable commodity in food processing, pharmaceuticals, photography, and paper production.

As a foodstuff, gelatin is the basis for jellied desserts; used in the preservation of fruit and meat, and to make powdered milk, meringue, taffy, marshmallow, and fondant. It is also used to clarify beer and wine. Some producers were grinding the set gelatin into a fine powder or cutting it into sheets.

So far, no studies yet conducted on the capabilities of producing gelatin compound from spotted jellyfish were done, hence, the researcher wanted to produce a gelatin utilizing the collagen from spotted jellyfish *(Mastigias papua*) which had less carbohydrate and fats and perfect for food diet. Specifically, it would investigate the morphological characteristics and production rate of gelatin from utilization of spotted jellyfish *(Mastigias papua*). Further, the researcher

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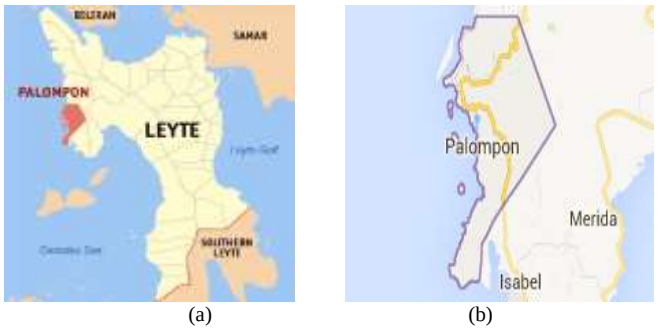
from Palompon Institute of Technology had become interested in "spotted jellyfish" to support the livelihood of our local fishermen.

II. MATERIALS AND METHODS

In order to attain the objectives of the study, the following were utilized as strategies in which necessary data and relevant information were obtained.

a. Study site

Palompon (11° 3' 0'' North, 124° 22' 59'' East) is a second class municipality in Leyte in Region VIII (Eastern Visayas), which is about 538 km south-east of Manila, Philippines (Figure 1).



(a) (b)

Fig. 1. (a) Map of Leyte highlighting the municipality of Palompon. (b). The boundaries of Palompon

b. Sampling method

A survey was conducted through ocular visitation. A sample was randomly taken and was brought to the laboratory for analysis.

c. Identification of Species/Morphological Variations

The collected samples was placed in a bucket of seawater. Measure the diameter size using Vernier caliper and placed into individual plastics in an ice chest. Upon return to the laboratory, the samples were rinse off in seawater to remove excess salt. Mark the sample using a marker pen, then let it dry on a plastic tray to remove excess water and weigh.

d. Quantitative Morphological Features

To stabilize the nomenclature of the species collected at various sampling points, reexamined morphological features in detail and described each species. All specimens were examined immediately at the place of collection. Each collected sample was examined quantitatively with the following morphological features in terms of diameter size, visceral mass, physical structure and color dimorphism.

e. Procedures

Raw Materials

Prepare 100 grams samples of spotted jellyfish *(Mastigias papua*), 100 ml of vinegar (Acetic Acid), 20 grams seaweeds and 10 ml mineral water

Removal of tentacles

The collected samples of spotted jellyfish were placed in a bucket of seawater. When the jellyfish took at the laboratory, they were inspected for its quality. Rotted parts or any discoloration of tissue were discarded. The samples were weighed to know the visceral mass with a tentacle on it. Then after weighing, the samples were placed on a chopping board to remove the tentacles and internal parts of spotted jellyfish on the other hand, the jellyfish head were measured for its diameter size. After measuring, the jellyfish was weighed again to know the actual weight of the sample.

Pretreatments

Soaked the jellyfish with vinegar and water solution (10:1 ratio) in order to remove the itchy substance and bacteria from the animal parts. This acid treatment soaking required 5 minutes that resulted in almost complete conversion to the pure product. The jellyfish were then put in a fine screen and washed with free flowing water for about 1 minute to remove excess solution. Then drained it completely.

Cooking of jellyfish

After the preparation of the raw materials, the jellyfish was placed to a beaker or any aluminum container for cooking. Cooked the jellyfish with a constant temperature at 50^0C for 30 minutes.

Preparation of seaweeds as binding agent

The seaweeds were inspected for quality. Rinsed the seaweeds with a tap water. Placed it to the chopping board and chopped using kitchen knife to cut the seaweeds into small pieces.

Pretreatments

Soaked the seaweeds with vinegar and water solution (10:1 ratio) in order to remove the impurities such as saltiness and the remaining bacteria in the seaweeds. This acid treatment soaking required 5 minutes. The seaweeds were then put in a fine screen and wash it with free flowing water for about 1 minute to remove excess. Then drained it completely.

Cooking of seaweeds

After the preparation, the seaweeds were placed to a beaker or any aluminum container for cooking. Cooked the seaweeds gently until it dissolved.

Filtering process

After cooking the raw materials, in a two separate container, pour the jellyfish solution and the seaweeds solution in a fine screen or cheese cloth to separate the solids or undissolved materials.

Mixing process

Combined the two solutions in another clean and empty container and mixed it for 5 seconds. Poured the mixed solutions in a molder to a desired sheet like acetate to achieve a very thin result.

Drying process

The next step was to dry the solution from their respective molder using sun drying

Pulverization

The dried gelatin were then pulverize using mortar and pestle.

Flavoring and Coloring

If the gelatin was used by food industry, sweeteners, flavorings and colorings may be added at this point. Pre-set amounts of these additives were thoroughly mixed into the powdered gelatin.

III. Results And Discussion

The morphological characteristics of spotted jellyfish (*Mastigias papua*) using three different samples in terms of diameter size; visceral mass; structure and color dimorphism were shown in Table 1. Samples 1 and 2 were almost the same in size while sample 3 had six times bigger than its regular size. They had same structure with and color dimorphism.

TABLE 1: MORPHOLOGICAL CHARACTERISTICS OF SPOTTED JELLYFISH

Characteristics	Sample 1	Sample 2	Sample 3	Average
visceral Mass				
**with tentacles*	59 grams	56 grams	379 grams	164.67 g
**w/o tentacles*	36 grams	30 grams	233 grams	99.67 g
diameter size	7.32 cm	7.48 cm	11.38 cm	8.73 cm
structure color dimorphism	round with spots in the rim			
	dark to light brown			

The temperature and pH value of the mixture before heating was measured as shown in the Figure 2. It was shown that the solution had pH value of 6.37 was slightly acidic and temperature was 27.9 ^{0}C

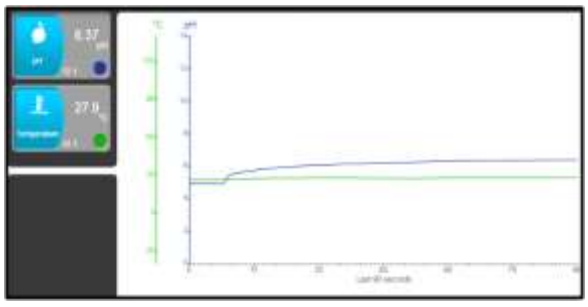


Fig. 2 Temperature and pH reading of the mixture before heating

The temperature and pH value of the mixture after heating was measured as shown in the Figure 12. It was shown that the solution had pH value of 4.59 was become more acidic because of the enzymatic reactions and protein synthesis. The temperature was constantly measured at 50 ^{0}C to avoid any degradation of protein structure and other amino acids..

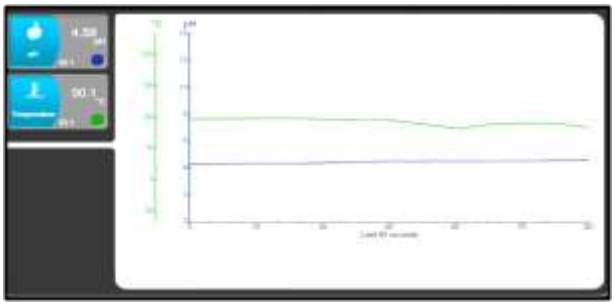


Fig. 3 Temperature and pH reading of the mixture after heating

Determination of gelatin production rate from utilization of spotted jellyfish *(Mastigias papua*)

Quantity of raw materials

Incoming streams and outgoing streams were listed in Table 2, including the cost/price of these components. They were labeled as feedstocks, product, wastes and utilities. The price and source of the raw materials for these components were summarized in Table 1.

TABLE 2. SUMMARY OF FEEDSTOCK, PRODUCT, WASTES AND UTILITIES

Components	Materials		Cost/Price [Php]	Unit
1. Incoming Streams				
1.1 Feedstocks	spotted jellyfish	(per 100 g)	-----	g
	vinegar	(per 50 ml)	2.50	ml
	seaweeds	(per 20 g)	2.00	g
	mineral water	(per 10ml)	1.50	ml
1.2 Utilities	Fuel alcohol	(50 ml)	5.00	ml
	tap water		-----	ml
2. Outgoing Streams				
2.1 Product	unflavored gelatin	(per 50 g)	20.00	g
2.2 By-product	solid waste	(per 10 grams)	5.00	g
2.3 waste	washed water		-----	g

a. Based on local market, 2016

Determination of the product produced in grams per hour, product yield and waste generated

Figure 4 presents the overall process yields and utilities needed for the production of gelatin. The detailed process yields and utilities for the different processes involved were shown in Appendix 1.

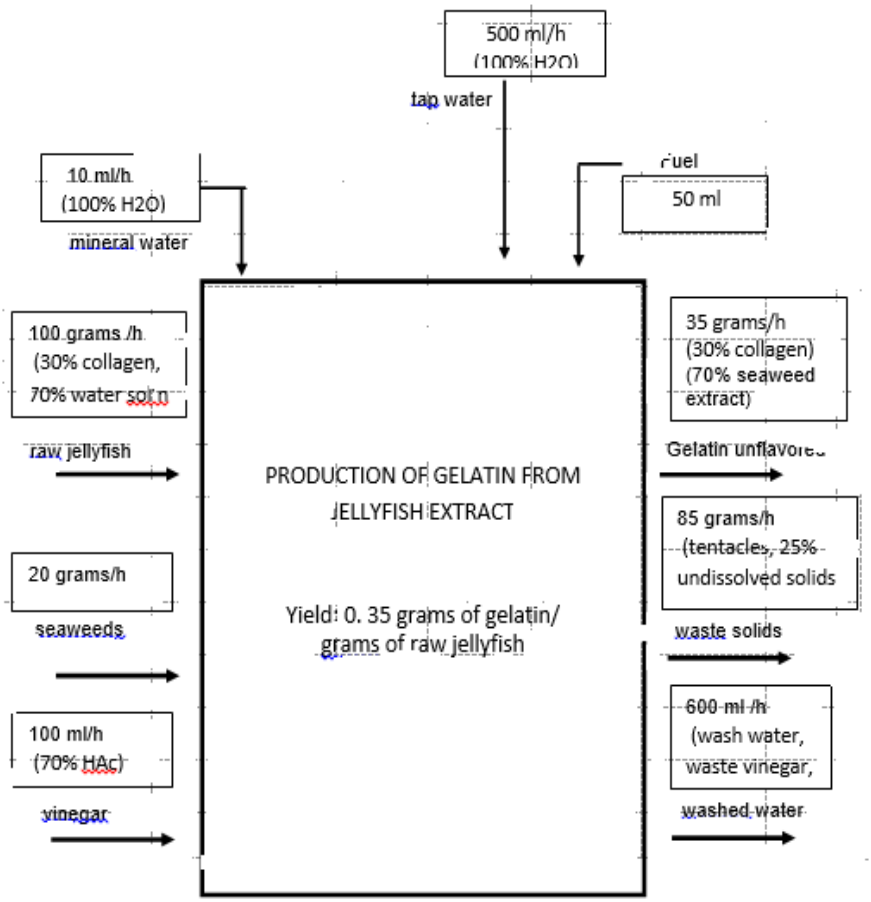


Fig. 4 Overall process yield in production of gelatin from spotted jellyfish

Economic Margin

In this process, 100 grams of raw jellyfish is needed to produce 35 grams of unflavored gelatin per day. The total daily cost of the raw materials fed to the process about Php 6.00. The daily income from product sales is Php 20.00 The economic margin is equal to Php 14.00 per day. The cost of raw materials over the daily income from the product sales is about 70%. This indicates that about 30% is an assured turnover of sales with respect to the expense of raw materials. At least 30% gross turnover ratio is an indicator that a given project/venture is viable.

Ideally, the cost of the raw materials must not exceed 30% of the price of the product to have an economically sound operation. Thus an economic margin of 70% or more from the total annual revenues is desired.

Implications

The production of gelatin from utilization of collagen from jellyfish has been proved to be technically feasible and can be operationalized in a microscale production. Hence, the community development program on cultivation of jellyfish and marine products must be initiated sand implemented within the locality. Initially, it has to be drafted with an action plan with the involvement of LGU, local fishermen and businessmen. This program or community based project can alleviate the socio-economic status of our local fishermen and provide additional income to our local businessmen. With the full support from the Department of Science and Technology (DOST) as well as Department of Tourisms (DOT) as our great companion in boosting the technology transfer and tourism industry in the community.

Its economic margin has proved that this process is economically viable. The raw materials are relatively cheap and available. The product gelatin using collagen from spotted jellyfish can be commercialized with a greater price comparable with the exiting gelatin in the market. The product has been known to have high nutritional value and medicinal value, for it has less fats and carbohydrates and perfect for food diet [Jin-Feng Ding, 2011 et. al.]

The waste products including the tentacles and undissolved solids can be more interesting because it can be recycled and perhaps it can generate income to our local industry. Consequently, these solid waste produced during the process can be used to feed for sea turtles and other animals, others it can be recycled to an organic fertilizers.

Iv. CONCLUSIONS

The process can be made more profitable and economically appealing by optimizing the operations in order to increase the production Thus this project proved that the production of

gelatin using the collagen from spotted jellyfish are technically and economically feasible to invest on. However, due to the time limitations, further studies would still recommended for further development of the process.

V. RECOMMENDATIONS

1. The spotted jellyfish should undergo series of tests to determine the nutritional analysis of the species in terms of proximate nutrients and mineral concentrations.
2. The product should undergo series of laboratory tests to ensure its food quality and good packaging.
3. Follow-up researches and experiments about spotted jellyfish in terms of growth and reproduction as well as its species diversity in the locality.
4. The properties of gelatin gels should be characterized and its solubility test or gel strength using the Bloom test.
5. Further research study on the utilization of the waste generated during the process by recycling the waste into usable products.

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