

JELLYFISH (*SEMI-CHINA TYPE*) PROCESSING FOR HUMAN CONSUMPTIONS IN DARVEL BAY, SABAH, MALAYSIA

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Abstract

Large seasonal aggregates of jellyfish are harvested and are processed for human consumptions. This paper studies the optimum processing of jellyfish (semi-China type) caught around Darvel Bay, Sabah. The edible components of jellyfish; the umbrella were processed by using mixture of salt (NaCl) and aluminum salt. During processing, the products underwent various stages of salting for 21 days which consists of a step-wise reduction of the water content, using a mixture of salt and aluminum salt at various compositions which are then compared to the conventional method of salting with salt alone. It is known that the conventional method produces a fair and soft product; however the proposed method of processing produces a firmer desirable texture with high acceptability to the consumer. In order to prove the statement, series of consumer acceptability tests using a nine-hedonic scale were also conducted on the products. The results of tests shown that the product with 30% NaCl and 2% aluminum salt was given the highest scale with 20 random panelists gave an average 6.75 over 9.00. The study showed that jellyfish could produce a good quality product for human consumption with the optimum processing method of 30% NaCl and 2% aluminum salt.

Keywords: Jellyfish, Umbrella, Processed, Salt & Sensory evaluation

Introduction

*Jellyfish*¹ or medusae are conspicuous and common inhabitants of both open seas and coastal waters. It is estimated that 80-90% of the jellyfish population tend to thrive near the water surface at any one time (Kingsford, Mike. And Pitt, Kylie, 2006). They are carnivorous, capturing a variety of zooplanktonic prey by *tentacles*² that can be extended for considerable distances into the surrounding water by capture more dispersed prey equipped with stinging cells called *ematocysts* and bringing to the mouth which is located on the underside of the bell (Lalli, C. and Parsons, T.R. 1997). In term of *processing*³ jellyfish for human consumption, it can be dried using *alum*⁴ method with the shrinkage of the bell approximately is reported at 14% (Hudson, Russel J., Bridge, Natalie, F. and Walker, Teren, L. 1997) however it was also noted that jellyfish processing of aurita type was unsuccessful Sloan N.A. and Gunn C.R, 1995).

Jellyfish is harvested in Darvel Bay for human consumptions and it is known to have *Collagen*⁵ medicinal benefits (Hsieh, Y-H. and Rudloe, J. 1995). Generally, the jellyfish found in this area are classified on the basis of its colour and size: the red type which is known as *Rhopilema spp*⁶. and the white type which is identified as *Lobonema smithii* (see figure 1). The red type, which is also known as Semi-China type, has higher commercial value and more expensive at market compared to the white type. The red type jellyfish have *umbrella*⁷ that can reach 300-600 mm diameter while the white type is smaller where the umbrella can only reach a maximum diameter of 500 mm (Omori, M. and Nakano, E. 2001).



Figure 1. Red / Semi-China type or *Rhopilema esculentum* (L) and white type or *Lobonema smithii* (R) (adapted from Dong et al., 2007)

Dried jellyfish is processed as a salted product through various stages of processing. The main principal of this process is by the osmosis mechanism where the different gradient of salt concentration pushed the water from living cell, where in this case is by dehydrating the jellyfish (Krishnan, G.S. 1984). In this study, the main component is NaCl as salt while with aluminium salt (SO_4) as a hardening agent by reducing the pH level. The jellyfish samples were *graded*⁸ according to the diameter of the umbrella/discs; those with a diameter of 33 cm and above being

graded as Grade I, 23-33 cm as Graded II, 17-25 as Grade III and other as off grade (Subasinghe, S. 1982) and other as off grade (Rumpet, Richard 1991).

Objectives of this research

Jellyfish constitute a fishery resource, which is processed and marketed locally or exported to Japan, a leading consumer of jellyfish. This commodity is known as one of the main sources of national revenue and fishermen incomes in Asia. Jellyfish in Sabah is quite abundant and, therefore can be a valuable marine resource. Unfortunately, there is lack of food processing technology that can utilise the abundance of jellyfish around Sabah sea. The conventional method that involves salt alone makes the jellyfish very soft and undesirable for local and overseas consumption. The main objective of this study is to compare the product prepared by conventional method of drying jellyfish using NaCl alone and the method involving NaCl and aluminium salt. Moreover, an optimum compositions of NaCl and aluminium salt for drying jellyfish of high quality can be investigated and determined.

The outcome of this research is that fishermen can utilise this method to process jellyfish and generate greater cash revenue. Since jellyfish would give more income than other sea products, there is less pressure for the fishermen to catch other fish stock and over exploitation can be avoided. Hence, the development in seafood technology processing can be more economic and efficient for marine resources.

Methodology

Duration and Location of this Study

The study was undertaken starting from September 2008 to December 2009 and was conducted at the Laboratory of the University Malaysia Terengganu (UMT), formerly known as Kolej University Sains dan Teknologi Malaysia (KUSTEM), Terengganu.

The samples were collected from Darvel Bay, the biggest bay in Sabah which is located in the east coast of North Borneo. It has a long coastline from Lahad Datu to Kunak district (Figure 2). In this paper, the red Semi-China type (*Rhopilema esculentum*) jellyfish was caught by scoop nets and studied. The weight of the jellyfish captured was taken and the diameter of the disc was measured.

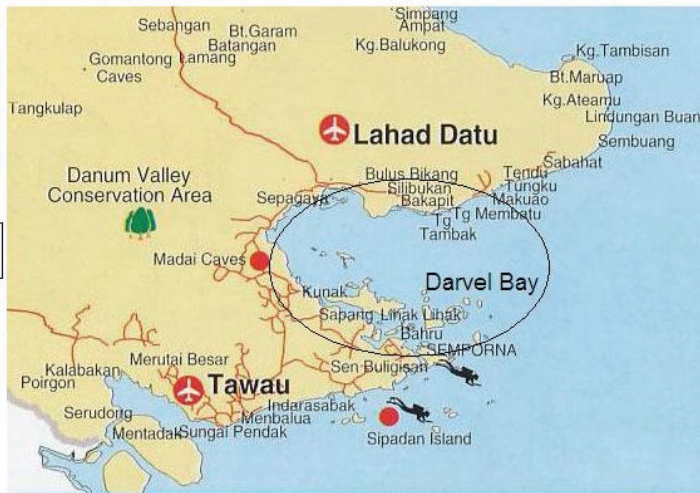


Figure 2. Location of the study which is around Darvel Bay, Sabah, Malaysia (adapted from http://www.asianinfo.org/asianinfo/countries_map/map-picture/malaysia_pol98.jpg)

Processing

A wooden knife was used during the eviscerating and cleaning of the bells and tentacles. This type of knife was used to avoid damage to the bells. The very soft tissue of the bells could easily be cut if not carefully handled. The bells were uncurled and flattened to facilitate the further trimming of the edges of left out portions of tentacles. Salt^o water was used for cleaning. Fresh water could also be used with a ratio of 3.0% salt. The solution would protect the bell from being spoiled due to excessive bacterial growth.

Before undergoing processing, the mucus of the jellyfish was removed with seawater. The bells were measured and weighed before undergoing treatment. Fourteen jellyfish were used for *physio-chemical tests*¹⁰ and the other fourteen jellyfish for *sensory evaluation*¹¹.

Treatment Procedures

Salting bells with 30% NaCl and with 2% alum

The fresh jellyfish were processed and mixed with salt and alum at the ratio of 30% NaCl (food grade) and 2% alum. One gram of sodium carbonate was added throughout stage one and two. The flow chart process is shown in Figure 3.

Stage 1

A mixture of salt, alum and sodium carbonate was spread over the jellyfish layer for dehydration. The treated jellyfish were kept in a plastic container for three days in ambient temperature before being transferred to the second stage.

Stage 2

The jellyfish were weighed and then transferred to a second container. A mixture of salt, alum and sodium carbonate was applied to the jellyfish. This stage lasted seven days before the third stage took place.

Stage 3

The jellyfish from stage two were weighed and transferred to a new plastic container. Some of the 30% of the salt was added and then the jellyfish were kept in this stage for seven days.

Stage 4

The jellyfish from stage three were weighed, transferred and heaped in layers in a plastic container with meshes to facilitate removal of the excess water. The product was left to dry for four days, where every day the heaps were reversed in position. Those layers at the bottom were put onto the top to give an equal chance for the water to be drained out from each layer through compression by wood or brick and by their own weight.

Store

The processed bodies of jellyfish were packed in a polythene bag before being stored in the cool room at 4°C.

Yield

The jellyfish were weighed at the beginning of each processing and also in every stage of the salting treatment, from the first stage to the final stage. The final product was weighed to form the yield.

The calculation formulae used were:

$$\% \text{ Yield (after processing)} = \frac{\text{Processing weight}}{\text{Whole weight}} \times 100$$

Sensory evaluation

The sensory evaluation survey tests were conducted in Lahad Datu, Sabah. There were 20 random public survey panellists. Those involved were adult males and females. The umbrella as a final product was displayed on a tray and the panellists give their opinion according to colour and taste of the product.

Acceptability test

Table 1: The nine hedonic scales

Point	Hedonic scale
9	Like extremely
8	Like very much
7	Like moderately
6	Like slightly
5	Neither like nor dislike
4	Dislike slightly
3	Dislike moderately
2	Dislike very much
1	Dislike extremely

Panellists conducted an acceptable test to determine the acceptable product from the treatment. The tests were each attached with survey forms by using a nine point hedonic scale. Table 1 shows nine hedonic scales, which were used in this opinion survey for acceptability test.

The 20 Panellists were asked to state their opinion about the product according to the nine point hedonic scale about the product; score 9 was the highest while score 5 was neutral and 1 was the lowest score.

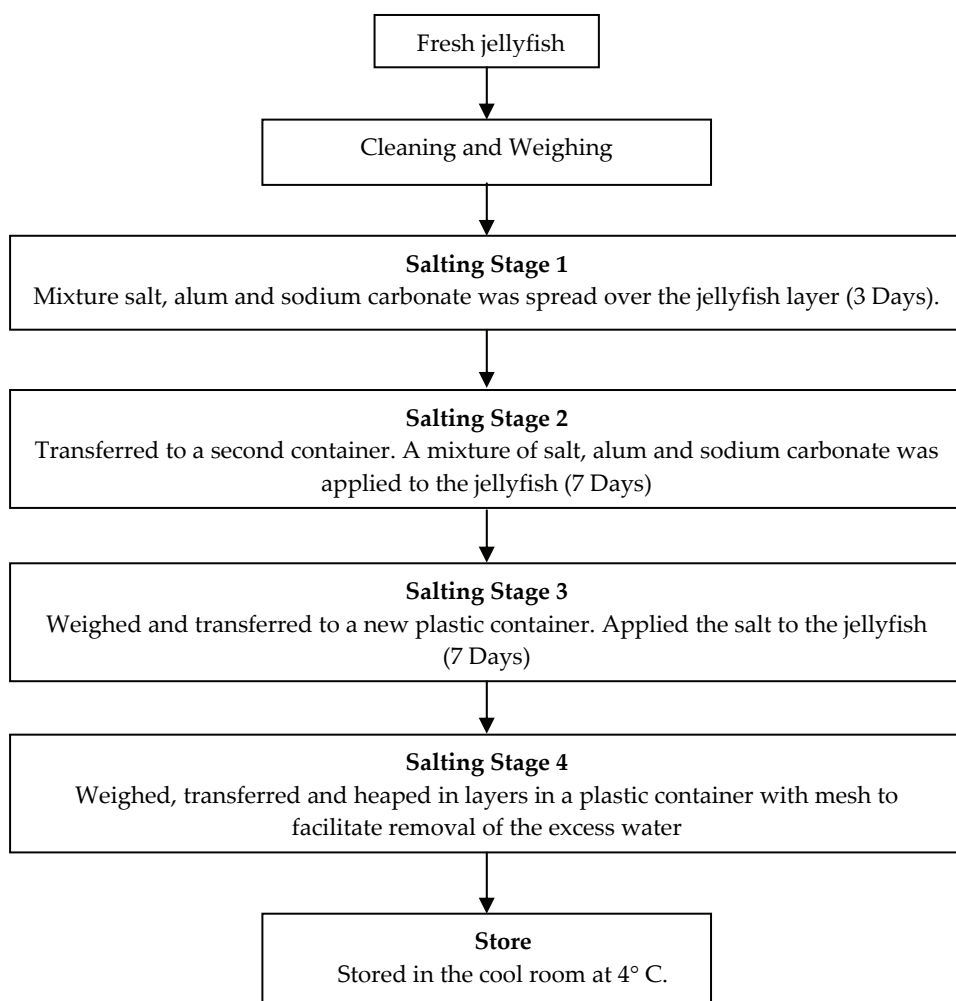


Figure 3. Flow chart of salting process

Analytical test

The analytical tests were used to determine the moisture content by using an adaptation of the Convection Oven Method, water activity using Water Activity Meter and salt contents of the products using Volumetric Method (Official Method of Analysis, 1994).

Moisture Content

Convection Oven Method

The jellyfish samples from the fresh jellyfish and for every treatment were analysed for moisture content. A sample in a clean and dry moisture pot with lid was weighted accurately to four decimal places on a Sartorius analytical balance. Approximately 2 g of the homogenised flesh was then added to the dish and the weight recorded to four decimal places. The drying dish and flesh samples were then placed into a Contherm Series 5 hot air drying oven with a set of clean dry clamps. The oven temperature was preheated to 105°C. The samples were left to dry for at least 24 hours after the lids were placed on top of the dishes. These dishes were then placed into a desiccator to cool for 30 minutes. The dishes were removed using clean, dry, cotton lined clamps and these were then reweighed.

The moisture content was expressed as a percentage according to the following equation:

$$\% \text{ Moisture} = \frac{\text{Initial sample weight} - \text{Final sample weight}}{\text{Initial sample weight}} \times 100$$

$$\text{Sample calculation: } \frac{2.000 \text{ g} - 0.4000 \text{ g}}{2.000 \text{ g}} \times 100 = 80\% \text{ Moisture}$$

Salt (Sodium Chloride) Content

Volumetric Method

A sample of approximately 5 grams of homogenised processed jellyfish was weighed accurately to four decimal places, then placed into a 200 mL conical flask. Fifty mL 0.1 N AgNO₃ was added then followed by 20 mL of HNO₃. The mixture was left to boil for 15 minutes on a hot plate in a fume cupboard. It was then allowed to cool before adding 50 mL of distilled H₂O and 5 mL of ferric indicator. The solution was filtrated against 0.1 N NH₄ SCN until the solution became permanent light brown. A percentage of salt NaCl) could be calculated.

The contents can be calculated from the formulae:

$$\% \text{ NaCl} = \frac{(50 - \text{mL NH}_4\text{SCN}) \times 0.585}{\text{Sample weight}} \times 100$$

Water activity

Method for measuring water activity meter:

The water activity of the samples was measured using a Novasina 'Aw centre' water activity meter, which was connected to a computer. Water activity data was recorded on the computer using Blast software. All measurements were taken at 25 °C +/- 0.3 °C.

The machine was calibrated using three saturated salt solutions of known water activity: MgCl₂ (Aw 0.53), NaCl (Aw 0.75), and BaCl₂ (Aw 0.902). These solutions were placed in 25 mm diameter plastic containers and were inserted into the sample part of the water activity meter and left to equilibrate. Equilibration was judged to be complete when one full computer screen of the same water activity value was achieved.

Sample preparation involved cutting with knife the samples into approximately 1 mm pieces. The samples were then placed into the 25 mm diameter plastic sample containers, until the containers were filled level with the top. A lid was placed on the container to stop moisture absorption or loss until the samples were analysed.

The samples were analysed in a manner identical to that of the saturated solutions. The lid was removed from the 25 mm container and the sample was then placed into the sample part of the water activity meter and left to equilibrate. The time taken to reach equilibration was approximately 30 minutes. Equilibration was judged to be complete, when one full computer screen of the same water activity value was achieved. The results were printed out on a dot matrix printer, which was connected to the computer.

Results

The average yield was 3% from the total weight at the beginning. Results of analytical test showed Moisture contents 58.80 (w/w %), Salt contents 5.30 (w/w %) and water activity 0.74 (Aw) for the product.

The moisture content of the product was 68.2% for the bells when treated with a mixture of salt and alum. On the other hand, the results of the study for the processing of the jellyfish showed that this method of processing could produce a good quality product using a mixture of salt and aluminium salt or alum.

The jellyfish processed with salt and alum, produced a firm, harder and desirable texture compared to the product using salt alone. Alum helped to reduce the pH, acted as a disinfectant and also as a hardening agent. The alum had coagulated the protein content and made it insoluble in water. The salt helped to dehydrate the water content and maintained the microbial stability of the product. Using a mixture of 30% salt and alum caused the product to dry faster.

Table 2: Results of acceptability test using the nine Hedonic scales

Sample Panellist	Jellyfish with 30% NaCl and with 2% alum. Sensory score
1	3
2	4
3	6
4	6
5	6
6	6
7	6
8	6
9	7
10	7
11	7
12	7
13	7
14	7
15	8
16	8
17	8
18	8
19	9
20	9
Average	6.75
Std dev	1.48235
Panellists	20

Results of analytical test showing Moisture contents 58.80 (w/w %) and Salt contents 5.30 (w/w %) for the product

Photo 1: The processing jellyfish *Semi-China Type*



Source: Photo by Hamid Awong

Plate 2. The dried jellyfish *Semi-China Type*



Source: Photo by Hamid Awong

Conclusions

This treatment produced good products and acceptable to the consumers (Table 2). Alum salt had coagulated and hardened the product and gave a special crunchy and crispy texture. Salt level used in this study was suitable for the preservation of jellyfish and produced a good texture, colour and appearance in the product (Table 3). Seventy percent of the total weight came from the bells. The weight lost of the final product was approximately 90% for the bells when treated with a mixture of salt and alum.

Endnotes

¹*jellyfish* the common name for any of the two-layered bell shaped coelenterates.

²*tentacles*, which contain microscopic stinging cells known as nematocysts.

³*processing* is preserves, dehydrates and improves the properties of the final product.

⁴*alum* contains several allied aluminium compounds had coagulated the protein content and made it insoluble in water.

⁵*Collagen* has great medicinal promise because it is an essential building material of cell tissue.

⁶*Rhopilema spp.* Jellyfish found along the coastal seas of Sabah, East Malaysia.

⁷*Umbrella* disc bell size in diameter.

⁸*graded* according to the disc bell diameter and the number of holes of the disc bell.

⁹*Salt* a component of poly-phosphate mixtures helped to dehydrate the water content and maintained the microbial stability of the product.

¹⁰*physio-chemical tests* to determine physical and chemical properties.

¹¹*sensory evaluation* is a scientific discipline that applies principles of experimental design and statistical analysis to the use of human senses for the purposes of evaluating consumer products.

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