Assessment of the Quality of Myanmar Shrimp Paste Products under Different Storage Conditions

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Abstract

Shrimp paste being the seasonal goods, was stored at least one year. Lower deterioration of amino acid in shrimp paste was required from the aspect of quality products. In this research, four types of storage conditions such as earthen jar, plastic container, plastic bag and glass bottle were used. Types of shrimp paste (paste form, powder form and tablet form) and containers for storage (glass, plastic and glazed earthen pot) were influencing factors to assess the quality of shrimp paste products. Shrimp paste powder and tablets were prepared and stored in different containers. The qualitative analysis of these samples and also Thailand and Malaysia commercial samples were carried out. High performance liquid chromatography (HPLC) was used to determine the quantitative determination of amino acids in stored samples under different storage conditions. The dissolved amino acids in the shrimp paste tablet and powder were comparable to Thailand and Malaysia commercial products. The HPLC patterns of the dissolved amino acids in the shrimp paste tablet and powder were similar to those of Thailand and Malaysia commercial products. After being stored one year, the dehydrated tablet and powder were found to have the highest amount of amino acids whereas sample stored in earthen pot was the lowest. Based on the both of qualitative and quantitative aspects, it could be considered as relatively safe for human consumption.

Introduction

Myanma Ngapi (Shrimp Paste) is an important source of low cost dietary protein. Shrimp paste or shrimp sauce, is a common ingredient used in Southeast Asian and Southern Chinese cuisine (Myint Myint Sein, 1999). It is known as terasi in Indonesia, ngapi in Myanmar, kapi in Thai, Khmer and Lao, belacan (also spelled *belachan*, *blachang*) in Malay, mắm ruốc, mắm tép and mắm tôm in Vietnam, bagoong alamang in Philippines, haam ha/ha jeung and hom ha/hae ko in Chinese. Shrimp paste can be used in most meals in Myanmar, Laos, Thailand, Malaysia, Singapore, Indonesia and the Philippines. It is often an ingredient in dipping sauce for fish or vegetables. Its colour ranges from light pink to dark brown.

Shrimp paste varies in forms, some are almost liquid or liquid, some are smooth or other consistencies of paste and some are used as air-dried block forms or powder, depending on the region of the production, or the end product and its uses. At the end of the manufacturing process, shrimp paste is usually dried to reduce the moisture content and to produce a semi-solid product.

Raw and processed (except sterile) foods contain different types of moulds, yeasts, bacteria, and viruses. Microorganisms get into foods from both natural (including internal) and from external sources to which a food comes into contact from the time of production until the time of consumption. An understanding of the sources of microorganisms in food is important to develop methods to control access of some microorganisms in the food, develop processing methods to kill them in food, and determine the microbiological quality of food, as well as set up microbiological standards and specifications of foods and food ingredients. Microorganisms present in raw and processed (non-sterile and commercially sterile) foods are important for their involvement in food borne diseases, food spoilage, and food bio-processing. These are generally accomplished through the growth of microorganisms (except for viruses and protozoa) in foods. Microbial growth in laboratory media is also important for quantitative and qualitative detection of the microbiological quality of a food. Microbial growth in laboratory

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High-performance liquid chromatography or high-pressure liquid chromatography (HPLC) is a chromatographic method that is used to separate a mixture of compounds in analytical chemistry and biochemistry so as to identify, quantify or purify the individual components of the mixture.

Materials and Methodology

Materials

Fresh shrimp paste from Naukmee Village, Pyapon Township, Pyapon District, Ayeyawady Region was used for this research work [Figure (1)].

Figure (1) Commercial Shrimp Paste from Pyapon Township, Ayeyarwady Region

Methodology

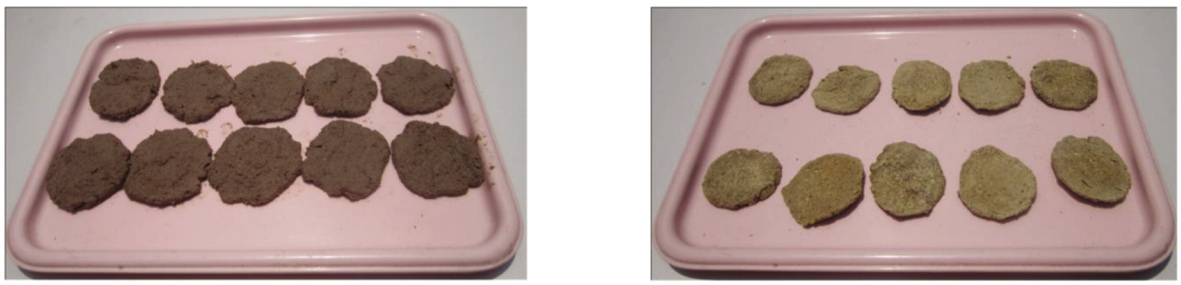
Preparation of Shrimp Paste Powder and Tablets from Commercial Shrimp Paste

Shrimp Paste Powder

Fresh commercial shrimp paste (Pyapon Township) 100 g was made into pellets and sun-dried at 35-38˚C for 5 days [Figures (2)]. During the rainy season, drying was conducted in an oven at 35˚C for 40 hours. The dried pellets were ground with mortar and pestle. The shrimp paste powder was screened with screen of different mesh sizes 30, 60, 120 mesh respectively [Figure (3) (a)]. Then the shrimp paste powder (120 mesh) was stored in plastic bottle and packed with air tight plastic packing.

Shrimp Paste Tablets

The shrimp paste powder was pressed with mold [Figure (4)] to obtain shrimp paste tablets [Figure (3) (b)]. Shrimp paste tablets were wrapped with aluminum foil and packed in plastic container.



(a) (b)

Figure 2. Shrimp Paste Pellets

(a) Shrimp Paste Pellets before Sun-Drying

(b) Shrimp Paste Pellets after Sun-Drying

(a) (b)

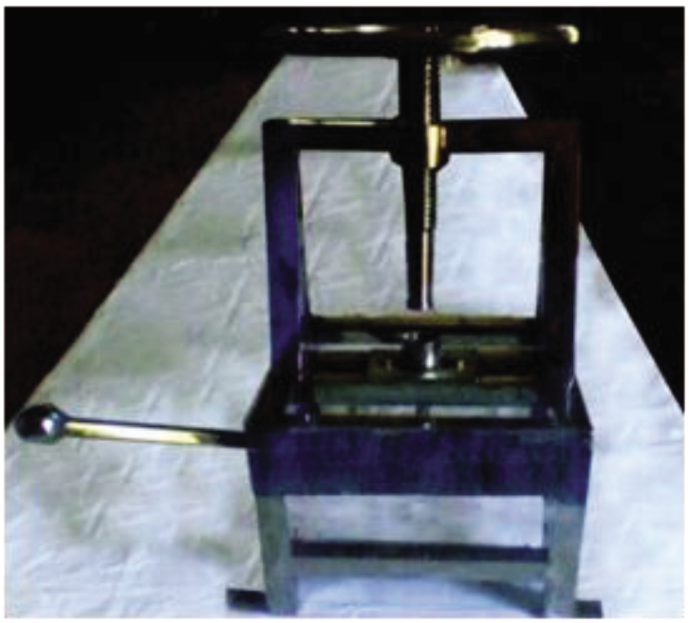
Figure3. Shrimp Paste Powder and Tablets

(a) Shrimp Paste Powder

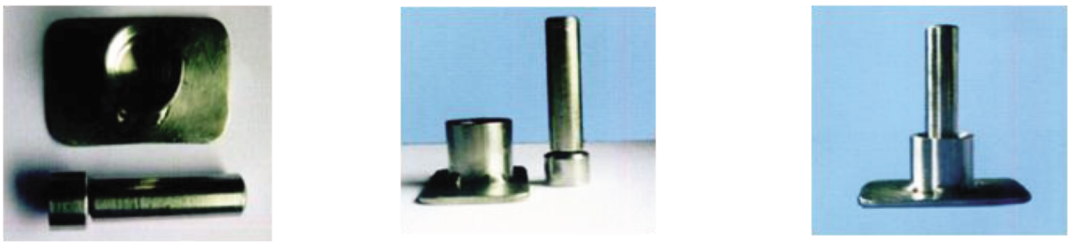
(b) Shrimp Paste Tablets (2.1 cm Diameter & 5 cm Thickness)

Analysis of Shrimp Paste Stored in Different Containers

Different forms of commercial shrimp paste (Pyapon Township, Malaysia and Thailand) were stored in different containers, such as glass bottle, plastic container, polypropylene bag and glazed earthen pot [Figure (5)(a)]. Shrimp paste powder was packed in plastic bottle [Figure (5) (b)]. Prepared shrimp paste tablets were wrapped with aluminum foil and packed in plastic container [Figures (5) (c)]. During one year storage, the deterioration level of different forms of shrimp paste were determined at two months intervals.



(a)



(b_1) **(b_2)** **(b_3)**

Figure4. Pressed Machine for Shrimp Paste Tablets

(a) Makeshift Pressed For Tableting Shrimp Past Powder

(b_1), (b_2), (b_3)Parts of the Mold in Machine

Determination of Total Nitrogen Content

Total Nitrogen content of eight stored shrimp paste samples were determined during two months intervals by Kjedahl Method and the results are described in Table (1).

(a)

(b) (c)

Figure 5. Shrimp Paste stored in different types of containers

(a) Shrimp paste stored in glass bottle, plastic container, polypropylene bag and glazed earthen pot

(b) Shrimp Paste Powder in plastic container

(c) Shrimp Paste Tablets packed with aluminum foil

Determination of Total Volatile Basic Nitrogen (TVB-N) Content

The mg/100 g of total volatile basic nitrogen can be determined by using Foss Application Sub NoteASN3140 Method and calculated by the following equation:

$$\text{TVB-N} = \frac{(T - B) \times N \times 14.007 \times 100}{W\ (g)}$$

T = resultant volume from sample titration (ml)

B = resultant volume from blank titration (ml)

N = Normality of titrant

W= Sample weight (g)

The results of all the samples are shown in Table (2).The pH of the samples were determined by Hanna pH Meter H12211 and salt content was also determined Atago Salt Meter ES421.

Determination of Calcium, Iron and Lead Contents in Stored Shrimp Paste

Shrimp paste is the good source of calcium, iron and some B group vitamins. Calcium and Iron content of the six types of stored shrimp paste and commercial shrimp paste (Thai and Malaysia) after eight months of storage period were determined by Atomic Absorption Spectrophotometer (AA-6300 Shimadzu) in the quality control laboratory, Amtt Co., Ltd. It is necessary to determine whether the shrimp paste stored in glazed earthen pot was contaminated with lead or not. The results are shown in Table (3).

Microbiological Analysis of Shrimp Paste

The microbiological analysis of stored shrimp paste were carried out by using the Bacteriological Analytical Manual (BAM) laboratory methods. Microbiological analysis of eight types of shrimp paste samples in different containers were also carried out at the Department of Chemical and Petroleum Engineering, Curtin University, Sarawak, Malaysia.

Determination of Total Plate Count

All total plate counts (aerobic plate count) were recorded and computed from duplicate plates by using the following formula. For the plates with 25-250 CFU, the formula is

$$N = \frac{\sum C}{[(1 \times n_1) + (0.1 \times n_2)] \times (d)}$$

Where, N =Number of colonies per ml or g of product
$\sum C$ =Sum of all colonies counted on all plates
n_1 =Number of plates counted in first dilution
n_2 =Number of plates counted in second dilution
d =Dilution from which the first counts were obtained

(Bacteriological Analytical Manual, 2001) (Conventional Plate Count Method)

Enumeration of *E.coli* and Coliform Bacteria

The enumeration of *E.coli* and Coliform bacteria was carried out by using the 3 tube MPN-method. (Bacteriological Analytical Manual- Chapter 4)(Conventional Method for Determining Coliforms and *E.coli*)

Determination of *Salmonella*

The determination of *Salmonella* was conducted by Bacteriological Analytical Manual-Chapter 5.

Qualitative and Quantitative Analysis using High Performance Liquid Chromatography

Analysis using high performance liquid chromatography (HPLC) is carried out for the comparison of total dissolved amino acids in stored shrimp paste samples. The equipment used for this research was HPLC -UV system (Agilent 1200, Agilent Technologies). The chromatographic separation was performed in an analytical column, C 18, particle size of 0.5 μm (2.1mm x 100 mm) and a UV detector was used with wavelength at 299 nm. Flow rate of the system was 0.42 ml/minute. The mobile phase is acetonitrile: water (90:10). The oven temperature was 40° C. The results are recorded as HPLC chromatograms and the relevant graphs can be seen in Figure (6).

Results and Discussion

Table (1) shows that protein content of stored shrimp paste samples were not markedly varied. This is because Kjeldahl method AOAC-2000 (920.152) represents total nitrogen content that includes both of nitrogen from protein and deterioration-nitrogen. Protein content of samples has been calculated from total nitrogen content. During storage, trimethylamine (TMA), dimethylamine (DMA) and ammonia are formed in shrimp paste by the break down of protein (amino acid). By the law of conservation, the nitrogen atom in valuable amino acid

undergoes to the nitrogen atom in foul smelling amines and ammonia by protein deterioration reaction.

Table (1) Changes in Nitrogen Content of Commercial Shrimp Paste during Storage Period

Sr. No	Type of Sample	Types of Container	Nitrogen % (w/w) during Storage Period (Month)			
			2	4	6	8
1	tablet	aluminum foil	6.232	6.242	6.246	6.3232
2	powder	plastic container	6.2624	6.2864	6.1808	6.6193
3	paste	plastic container	3.9632	3.8864	3.9104	4.0496
4	paste	glass bottle	3.9632	3.8448	3.9568	4.0336
5	paste	glazed earthen pot	3.9632	3.9008	3.6624	3.9168
6	paste	plastic bag	3.9632	3.904	4.1728	4.104
7	block (Malaysia)	wax paper & plastic bag	-	-	-	3.296
8	Paste (Thailand)	plastic container	-	-	-	4.7408

The total Volatile Basic Nitrogen (TVB-N) content of tablet and powder forms was lower than other paste form samples. Thus it can be proved that tablet and powder forms have less deterioration than all other paste forms. It can also be said that shrimp paste samples with higher moisture contents tend to have greater formation of TVB-N.

The sample stored in glazed earthen pot have the highest amount of moisture content and its TVB-N content is 536 mg/100g of sample. The sample stored in plastic bag have the highest amount of TVB-N (658 mg/100g).

The pH of all the samples has no correlation between the TVB-N content and the salt content of tablet and power form was the highest for the lower moisture content.

Table 2.Determination for TVB-N and some Characteristics of Commercial Shrimp Paste Stored in Different Containers (Storage Period = 8 months)

Sr.No	Type of Sample	Type of Container	TVB-N (mg/100g)	pH at 25°C	Salt (%)	Moisture (% w/w)
1	tablet	aluminum foil	48	7.05	29.4	10.09
2	powder	plastic container	73	6.9	31.0	7.53

Sr.No	Type of Sample	Type of Container	TVB-N (mg/100g)	pH at 25°C	Salt (%)	Moisture (% w/w)
3	paste	plastic container	513	8.08	18.9	48.65
4	paste	glass bottle	411	7.99	18.0	49.22
5	paste	glazed earthen pot	536	8.04	17.4	50.74
6	paste	plastic bag	658	8.13	17.9	49.05
7	block (Malaysia)	wax paper & plastic bag	311	7.68	24.0	42.72
8	paste (Thailand)	plastic container	434	7.71	23.6	33.93

In table (3), calcium contents of tablet and powder forms of shrimp paste are higher than that of other paste forms due to their lower moisture contents. Among all paste form samples, Malaysia shrimp paste has the highest calcium content. The mineral contents (Calcium and Iron) of shrimp paste stored in glazed earthen pot for 8 months are the highest among the other paste samples with same storage time and condition. The iron content of Malaysia shrimp paste was the highest amount (957 ppm). According to the results from Table (3), it was concluded that there is no lead contamination in all samples during 8 months although it is potential for lead contamination of shrimp paste stored in glazed earthen pot. The shrimp paste products as powder and tablet forms were found to be the best by the assessment of colour, odor, taste and nutritional facts. Furthermore, glass bottle is better than other three types of containers; earthen jar, plastic container and plastic bag.

Table 3. Determination of Calcium, Iron and Lead Content in Some Shrimp Paste Samples (Storage Period = 8 months)

Sr. No	Type of Sample	Type of Container	Calcium (%) w/w	Iron (ppm)	Lead (ppm)
1	tablet	aluminum foil	8.26	612.98	ND
2	powder	plastic container	8.53	635.87	ND
3	paste	plastic container	5.80	430.49	ND
4	paste	glass bottle	5.57	410.45	ND
5	paste	glazed earthen pot	6.26	708.87	ND
6	paste	plastic bag	5.43	422.61	ND

Sr. No	Type of Sample	Type of Container	Calcium (%) w/w	Iron (ppm)	Lead (ppm)
7	block (Malaysia)	wax paper & plastic bag	6.95	957.60	ND
8	paste (Thailand)	plastic container	3.72	416.62	ND

The parameters were determined at Department of Chemical and |Petroleum Engineering, Curtin University, Sarawak, Malaysia. Among the total plate count of all samples, the TPC of shrimp paste in tablet form is 300 cfu/g and it is the smallest amount of all other stored samples. The coliform content of most of the samples are <3 in MPN/g, according to the 3 tube MPN table except for sample 9 (23 MPN/g). The values are 95 percent conference intervals for 3 tubes. E.coli has not been found in all samples. Salmonella was also absent in all tested shrimp paste samples.

Table 4. Microbiological Analysis of Stored Shrimp Paste

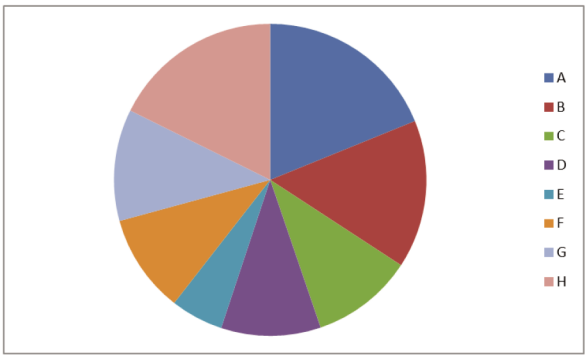
Sample	Types of shrimp paste	Packing Material	TPC	Coliform	*E.Coli*	*Salmonella*
			cfu/g	MPN/g	MPN/g	In 25 g
A	tablet	plastic container	300	<3	<3	ND
B	dried powder	plastic container	1300	<3	<3	ND
C	paste	plastic container	2900	<3	<3	ND
D	paste	glass bottle	1100	<3	<3	ND
E	paste	glazed earthen pot	700	<3	<3	ND
F	paste	plastic bag	2300	<3	<3	ND
G	block (Malaysia)	wax paper & plastic bag	3500	<3	<3	ND
H	paste (Thailand)	plastic container	1450	<3	<3	ND

TPC = Total plate count TVB-N = Total volatile basic nitrogen

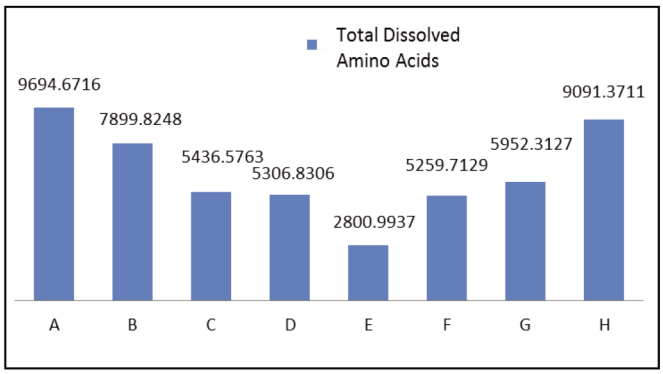
ND = Not detected cfu = Colony forming unit MPN=Most probable number

Quantitative analysis for the different shrimp paste samples was determined at respective retention time by using the peak area of each sample in HPLC chromatogram. It can be observed that there were dissolved amino acids in eight samples of shrimp paste, (A to H). Referring to the Hand Book on “Analysis of Amino Acid by HPLC”, shrimp paste samples would be consists of glutamic acid, asparagine, serine, glutamine, arginine and phenylanaline.

Figure (6) shows the pie graph for total dissolved amino acids in shrimp paste samples. The total dissolved amino acid in shrimp paste tablet (A) is more than three times of the sample in paste form stored in glazed earthen pot (H). It can be concluded that shrimp paste tablets and powder can retain the amino acids to the highest level for the least denaturing of protein during storage.



(a)



(b)

Figure (6) (a) (b) Amount of Total Amino Acids in Different Shrimp Paste Samples

A= shrimp paste tablet
B = shrimp paste powder
C=sample stored in plastic bottle
D= sample stored in glass bottle
E=sample stored in glazed earthen pot
F=sample stored in perforated plastic bag
G=sample from Malaysia
H=sample from Thailand

Conclusions

The main objective of this research work is to investigate the quality improvement of Myanmar shrimp paste and to prepare shrimp paste powder and tablets for best storage condition. The amount of TVB-N, microorganism and total dissolved amino acid in the stored shrimp paste were determined and compared the quality of Myanmar shrimp paste with the quality of Thailand and Malaysia. The HPLC patterns of the dissolved amino acids in the shrimp paste tablet and powder match to those of Thailand and Malaysia commercial products. This means that the prepared shrimp paste tablet and powder were good and safe for human consumption.

Acknowledgements

I am grateful to supervisor, Professor Dr Khin Thet Ni, Head of the Department of Industrial Chemistry (Retd.), University of Yangon, for giving permission to perform this research, and advice throughout this research work.

I would like to express my gratitude to Co-supervisor, Professor Dr Cho Cho Oo, Head of the Department of Industrial Chemistry, University of Yangon, for her helpful suggestion, supervision and encouragement.

I would like to mention my gratitude to Professor Dr Awang Bono, Deputy Dean (Research and Innovation), University Malaysia Sabah, Kota Kinabalu who gave me a chance to utilize the laboratory instruments for quantitative and qualitative analyses.

I feel heartily a deep sense of gratitude to Dr Zeya Oo, who gave me a chance to contact Professors from Malaysia Universities and performed as a program coordinator for my research trip.

I would like to convey my special thanks to Dr. Khin Hla Mon, Associate Professor and Head of Department of Industrial Chemistry, Dagon University, and Dr. Thin Thin Khing, Associate Professor of Department of Industrial Chemistry, Dagon University for kind encouragement throughout doing my thesis.

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Online Materials

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