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Physico-chemical Properties and Sensory Evaluation of Fish Seasoning Powder

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Abstract Seasoning powder is a form of flavor enhancer, which is commonly prepared from various kinds of meat, fish, and vegetables. The main purpose of this research work is to produce natural seasoning powder instead of mono sodium glutamate (MSG) to reduce health problem. This research was focused on the preparation of fish seasoning powder from Ngar-myint-chin (*Labeo rohita*) and other ingredients such as carrot, white radish, chayote, Chinese cabbage, cabbage, cauliflower, lactose, sugar, salt, fresh ginger juice, garlic and water were used. This study used hot air oven for maintaining constant air flow and constant temperature during drying or dehydration stage. Optimum conditions for the fish seasoning powder were determined by varying drying temperature (55, 60, 65, 70, 75°C), varying sugar content (0.2, 0.4, 0.6, 0.8, 1%) and varying salt content (1, 2, 3, 4, 5%). The optimum conditions for prepared fish seasoning powder were drying temperature 70°C, drying time 9 hours, 0.8 (% w/w) sugar content and 3 (% w/w) salt content, respectively. The physico-chemical properties such as moisture content, ash content, protein content, fat content, crude fiber content, carbohydrate content, energy value, pH, water activity and microbiology test of the prepared fish seasoning powder were analyzed to study the quality improvement and shelf life of this product storage at room temperature. The results of nutritional value, microbial tests, low moisture content and water activity (a_w) content of the prepared fish seasoning powder show the quality, safety and stability of this product. The physico-chemical properties and sensory properties of fish seasoning powder were statistically analyzed using one way ANOVA (Analysis of Variance) and the significant difference between the samples was determined using LSD and Tukey test at $p<0.05$ respectively. Commercialization of this value-added fish product can contribute to diversification in the fish processing industry through better utilization of this fish species.

Keywords: *fish seasoning powder, hot air oven drying method, drying temperature, sensory properties*

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1. Introduction

Both synthetic and natural flavor as food additive are needed to enhance sensory characteristics. Flavor enhancer in form of seasoning powder is defined as food additive which can add, enhance and establish taste and flavor and commonly made from meat or poultry, seldom found from fish [1]. Seasoning powder product contained enough amounts of I, Fe and cobalamin and that was contributed positive effect on human health. Seasoning powder produced had low water content and it might show the stability of product during storage [2].

Fish is one of the most important sources of animal protein and has been widely accepted as a good protein source and other elements for the maintenance of healthy body [3]. *Labeo rohita* is the most important species of major craps, commonly known as rohu or dumbra [4]. The rohu occurs in India, Pakistan, Bangladesh, Nepal, Myanmar, Peninsular and Sri Lanka. Rohu is very commonly eaten in Bangladesh, Nepal, India and Myanmar [5]. Rohu are heavily consumed throughout all areas in which they are found and prepared in variety of ways. It is economically important due to its food value. The texture of the fish is white, non-oily and the bigger the size of the fish; the tastier it is [6]. Rohu fish is rich in source of vitamin C, vitamin D, niacin and protein. Vitamin C is essential for maintaining a good health. It keeps diseases like cold and coughs at bay and prevents other diseases related to it. Fish protein is one of the best forms of protein available [7].

Plants are often used as raw materials to produce condiments or seasonings and plant-based condiments are produced from a variety of plant components like leaves, seeds, or barks, and are used either in fresh or dried forms [8]. Conventional production of plant-based condiments and seasonings implicate losses of volatile compounds as well as hygienic and quality problems, which may bring relevant safety risks for the population [9,10]. In the case of spices, several factors influence their shelf life, including bacterial contamination and changes in metabolic activity, especially enzyme activation [11-16] Grinding, for example, may cause discoloration and losses of essential oils due to evaporation and oxidative reactions [17,18].

Drying is a method of food preservation by removing water from the food, which inhibits the growth of microorganisms [19] and also is a key processing step for maintaining the shelf life of the finished product by slowing microbial growth and preventing biochemical reactions that may alter sensory characteristics [20]. The process starts by drying the plant raw material using various methods, such as sun drying or drying using stoves, open fires, or heated iron pipes, until reaching a hygienically safe moisture level of about 10% [20-24]. In industrialized countries, drying using mechanical equipment allows for control of drying temperatures (45–60°C), minimizing the loss of volatile oils and discoloration of the plant material and, additionally, achieving better hygienic conditions [20, 25]. The effect on shelf life is due to the link between moisture content and a property called water activity, a measure of the availability of water to take part in chemical reactions [26].

2. Materials and Methods

2.1. Raw Materials

The fresh rohu fish (*Labeo rohita*), carrot, white radish, chayote, cabbage, Chinese cabbage, cauliflower, garlic, ginger, sugar and salt were purchased from Hlaing market, Hlaing Township, Yangon Region. Lactose (Commercial Grade) was purchased from Super Shell Chemical Shop, Pabeldan Township, Yangon, Myanmar.

2.2. Preparation of Fish Seasoning Powder

Firstly, the raw fish was prepared by dressing (scaling, gutting, removal of gills, removal of slimes, removal of head and tail) and then washed with potable water. Carrot, white radish, chayote, cabbage, Chinese cabbage and cauliflower were peeled, chopped and washed with potable water.

The prepared raw fish, vegetables and other ingredients such as salt, lactose, sugar, garlic, fresh ginger juice, were added to the pressure cooker with 2 L of water. These ingredients were cooked in the pressure cooker at 121°C, 15psi for two and half hours.

After pressurized cooking, the resultant fish and vegetables paste was blended by using a domestic blender.

The blended paste was spread on the tray and dried by hot air oven at various drying temperature (55, 60, 65, 70, 75°C). At the end of drying, the dried products were scrapped and cooled at room temperature for 10 minutes.

After drying, the dried product was ground by using a domestic blender. Finally, the fish seasoning powder was obtained, weighed and stored in an air tight container.

2.3. Methods of Analysis

Physico-chemical properties of fish seasoning powder such as moisture content, ash content, protein content, fiber content, fat content, and carbohydrate content (AOAC-Method, 2000) [27] were determined. The microorganisms were determined by Aerobic Plant Counts by petrifilm method (AOAC-990.12), *Staphylococcus aureus* by AOAC-2003.07 method and Yeast & Mould by FDA-BAM (Food and Drug Administration-Bacteriological Analytical Manual) (Online Manual April 2001) method, respectively.

2.3.1. Determination of Moisture Content

3 g of sample was weighed in a petri dish and dried for 4 hours at 110°C in hot air oven and it was cooled in desiccators and weighed. The process of heating, cooling and weighing was repeated. Moisture content was calculated as follows: [27]

$$\text{Moisture (\%)} = \frac{W_1 - W_2}{W_1}$$

Where, W_1= weight (g) of sample before drying,
W_2= weight (g) of sample after drying.

2.3.2. Determination of Ash Content

Accurately weighed 1 g of sample was introduced into the porcelain crucible. The crucible and sample were carefully ignited over hot plate and heated until the sample was thoroughly charred. Then, it was placed in the muffle furnace at 550°C for 5 hours until residue was free from carbon. The crucible and ash were then cooled in the desiccator and weighed. The weighing, heating in the furnace and cooling were repeated until the constant weight was obtained. The ash content of sample was calculated as follows: [27]

$$\text{Ash}(\%) = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100.$$

2.3.3. Determination of Protein Content

2 g of sample was transferred to a digestion flask followed by the addition of 3 g of catalyst mixture (K_2SO_4:$CuSO_4$:SeO_2 in 100:20:2.5) and 20 ml of concentrated sulfuric acid. The content was then digested till transparent liquid was obtained. The volume of digested material was made up to 100 ml with distilled water. Carry out a blank digestion without the sample and make the digested to 100 ml. Measured a liquor of digested material was distilled with excess of 40% NaOH solution and the liberated ammonia was collected in 20 ml of 2% boric acid solution containing 2-3 drops of mixed indicator (10 ml of 0.1 percent bromocresol green + 2 ml of 0.1 percent methyl red indicator in 95 percent alcohol). The entrapped ammonia was titrated against 0.01 N of hydrochloric acid. A reagent blank was similarly digested and distilled. Nitrogen content in the sample was calculated as follows and a factor of 6.25 was used to convert nitrogen to protein [27].

$$N_2(\%) = \frac{\dfrac{\text{Sample titre} - \text{Blank titre} \times \text{Normality of HCl} \times 14}{\text{vol. made of digest} \times 100}}{\text{Aliquot of the digest taken} \times \text{Weight of sample} \times 1000}$$

$$\text{Protein content} = \%\ \text{Nitrogen} \times 6.25.$$

2.3.4. Determination of Crude Fiber Content

2 g of sample was weighed into 500 ml of beaker and 200 ml of boiling 0.255 N of sulfuric acid (1.25 percent w/v) was added. The mixture was boiled for 30 min keeping the volume constant by the addition of hot water at frequent intervals (a glass rod stirred in the beaker helps smooth boiling). At the end of this period, the mixture was filtered through a muslin cloth and the residue washed with hot water till free from acid. The material was then transferred to the same beaker and 200 ml of boiling 0.313 N of NaOH (1.25 percent w/v) was added. After boiling for 30 min., the mixture was filtered to a crucible, dried overnight at 80-100°C and weighed (W_2). The crucible was kept at in a muffle furnace at 550°C for 3 hours. Then it was cooled in desiccators and weighed again (W_3). The difference in residue weights and ash represents the weight of crude fiber [27].

$$\text{Crude fiber content } (\%) = \frac{(W_2 - W_3)}{W_1} \times 100$$

where, W_1= Weight of sample, (g), W_2= Weight of insoluble matter, (g) and W_3= Weight of ash, (g).

2.3.5. Determination of Fat Content

Accurately weighed 5 g of sample was introduced inside the thimble and a piece of cotton was placed at the open and of the thimble. The thimble containing the sample was kept inside Soxhlet apparatus fixed with round bottom flask (500 ml) containing petroleum ether (B. P 40-60°C) 250 ml. The extraction flask was heated on the heating mantle for 14 hours at the boiling point of petroleum ether. After the extraction was completed, the ether dissolving oil was transferred into the beaker. Then, the ether was removed by evaporation. Fat content was calculated as follows: [27]

$$\text{Fat } (\%) = \frac{\text{Fat weight}}{\text{Sample weight}} \times 100.$$

2.3.6. Determination of Carbohydrate Content

Carbohydrate value of the sample was determined by using the following formula:

$$Carbohydrate(\%) = 100 - \left(\begin{matrix} moisture + ash \\ + protein + fiber + \text{fat} \end{matrix} \right).$$

2.3.7. Statistical Analysis

All measurements were made in triplicate for each sample; statistical analysis for physico-chemical properties of all samples were calculated using a one way ANOVA and the significant difference between the samples were determined using LSD test at $p < 0.05$.

The organoleptic properties namely color, flavor and aroma were determined on the basic of 9 point Hedonic scale by 10 panelists. For sensory evaluation, the organoleptic properties of product were determined on the basis of 9 point Hedonic scale-rating, where 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) by a panel of 10 semi-trained judges. The results were analyzed using Analysis of Variance (ANOVA). The results of the overall acceptability were compared using Turkey's test. All tests were conducted at the 5% significance level.

3. Results and Discussion

3.1. Proximate Composition of Raw Materials

Proximate composition of raw fish, raw carrot, raw white radish, raw chayote, raw cabbage, raw Chinese cabbage, and raw cauliflower were determined and presented in Table 1 and Table 2. From this table, the moisture content of cauliflower is the highest, so that this vegetable is more perishable than others. Carrot, white radish, cabbage and Chinese cabbage are rich in ash content so that they contain a lot of mineral contents. The fiber content of vegetables gave health benefits such as helping to maintain a healthy weight, lowering risk of diabetes, heart disease and aid in digestion. Complex carbohydrate breaks down into glucose (simple carbohydrate). Carbohydrate is the main source of energy help fuel for brain, kidney, muscle, heart and central nervous system. Extra carbohydrate can store in the liver as fat. Carbohydrate deficiency can cause headaches, difficulty concentration, weakness, nausea and fatigue. The carbohydrate content of fish and vegetables were fulfilled the necessary amount of energy for human body.

Table 1. Proximate Composition of Raw Materials

Composition (Dry Basis) (% w/w)	Raw Fish	Raw Carrot	Raw White Radish	Raw Chayote
Moisture content	78.1 ±0.06	85.8 ±0.06	85 ±0.2	90.7±0.06
Ash content	1.2 ±0.06	1 ±0.03	1.1 ±0.06	0.5 ±0.06
Protein content	16.2 ±0.06	0.96 ±0.006	0.6 ±0.05	0.8 ±0.05
Fiber content	0	1 ±0.03	1.6±0.01	5.58 ±0.006
Fat content	0.7 ±0.06	0.52 ±0.01	0.1 ±0.06	1 ±0.03
Carbohydrate	3.8 ±0.06	10.72 ±0.02	4.1 ±0.06	1.42 ±0.006

Table 2. Proximate Composition of Raw Materials

Composition (Dry Basis) (% w/w)	Raw Cabbage	Raw Chinese cabbage	Raw Cauliflower
Moisture content	87.9±0.06	87 ±0.1	92.1 ±0.1
Ash content	1.06 ±0.006	1 ±0.03	0.6 ±0.06
Protein content	1.93 ±0.006	1.3 ±0.06	1.7 ±0.06
Fiber content	3.75 ±0.01	1.1 ±0.06	2.2 ±0.1
Fat content	0.30 ±0.06	0.3 ±0.06	0.3 ±0.06
Carbohydrate	5.06 ±0.01	2.2 ±0.06	3.1 ±0.06

3.2. Effect of Drying Temperature on Drying Time and Yield Percent of the Fish Seasoning Powder

Table 3 shows the effect of drying temperature on yield percent of the fish seasoning powder. The moisture contents of the samples are constant at 6.8 (% w/w). Drying temperature 70°C was chosen as the most suitable condition because of high yield percent.

Table 3. Effect of Drying Temperature on Drying Time and Yield Percent of the Fish Seasoning Powder

Drying Temperature (°C)	Drying Time (hours)	Yield (% w/w)
55	12	31.33
60	11	32.83
65	10	32.17
70*	9	33.88
75	8	33.67

*the most suitable condition.

3.3. Effect of Sugar Content on Sensory Evaluation (Overall Acceptability) of the Fish Seasoning Powder

Table 4 shows the effect of sugar content on sensory evaluation (overall acceptability) of the fish seasoning powder. Sample no.4 is the most suitable condition for fish seasoning powder because of the highest sensory score.

Table 4. Effect of Sugar Content on Sensory Evaluation (Overall Acceptability) of the Fish Seasoning Powder

Sample No.	Drying Temperature (°C)	Drying Time (hours)	Sugar (% w/w)	Overall Acceptability
I	70	9	0.2	4.5
II	70	9	0.4	5.2
III	70	9	0.6	4.8
IV*	70	9	0.8	7.2
V	70	9	1	5.4

*the most suitable condition

3.4. Effect of Salt Content on Sensory Evaluation (Overall Acceptability) of the Fish Seasoning Powder

Table 5 shows the effect of salt content on sensory evaluation (overall acceptability) of the fish seasoning powder. Sample no.3 is the most suitable condition because of the highest sensory score.

3.5. Physicochemical Properties and Nutritional Values of Prepared Fish Seasoning Powder

Physico-chemical properties and nutritional values of fish seasoning powder are tabulated in Table 6. From the results in Table, it was found that the water activity (a_w) content is 0.35 of freshly prepared fish seasoning powder. According to the literature, water activity (a_w) content 0.51 and less than 0.51 that is not contaminated to food. And then microorganisms cannot grow at that time. After 2 months, 4 months and 6 months storage, according to the comparison of these experimental values, moisture content (6.8 – 7.12 % w/w) were slightly increased, the same result was found an increase of moisture content during storage in all type of packaging [2]. And water activity content (0.35 – 0.37) were slightly increased and the other values (ash content, protein content, crude fiber content, fat content, carbohydrate content, energy value and pH) were slightly decreased due to the increase of moisture content.

3.6. Examination of Microbial Contamination of Prepared Fish Seasoning Powder

Table 7 indicates that the examination of microbial contamination of prepared fish seasoning powder. It was found that the presence of Aerobic Plate Counts (APC) was 3.5×10^4 cfu/gm in fresh fish seasoning powder, after 2 months, 4 months and 6 months were slightly increased to 3.5×10^4 cfu/gm, 3.7×10^4 cfu/gm and 3.8×10^4 cfu/gm, because of the temperature changes of the raw fish from market to processing room, and slightly poor sanitation of the processing area. The presence of *Staphylococcus aureus* was <10 cfu/gm and the presence of Yeast & Mould were <100 cfu/gm. After 2 months, 4 months and 6 months storage, according to the comparison of the presence of *Staphylococcus aureus* and Yeast & Mould of fish seasoning powder are the same each other.

Table 5. Effect of Salt Content on Sensory Evaluation (Overall Acceptability) of the Fish Seasoning Powder

Sample No.	Drying Temperature (°C)	Drying Time (hours)	Salt (% w/w)	Overall Acceptability
I	70	9	1	4.7
II	70	9	2	5
III*	70	9	3	7.5
IV	70	9	4	4.8
V	70	9	5	5.7

*the most suitable condition

Table 6. Physico-chemical Properties and Nutritional Values of the Prepared Fish Seasoning Powder

Sr. No.	Characteristic	Fish Seasoning Powder			
		Fresh	2 month storage	4 month storage	6 month storage
1.	Moisture Content (% w/w)	6.8 ± 0.06	6.9 ± 0.06	7.1 ± 0.08	7.12 ± 0.005
2.	Ash Content (% w/w)	12.60 ± 0.01	12.60 ± 0.1	12.30 ± 0.06	12.00 ± 0.08
3.	Protein (% w/w)	42.22 ± 0.005	42.20 ± 0.01	42.15 ± 0.02	42.09 ± 0.005
4.	Crude Fiber Content (% w/w)	1.42 ± 0.006	1.40 ± 0.006	1.40 ± 0.006	1.38 ± 0.006
5.	Fat Content (% w/w)	17.34 ± 0.006	17.30 ± 0.006	16.90 ± 0.01	16.88 ± 0.01
6.	Carbohydrate (% w/w)	19.62 ± 0.01	19.60 ± 0.01	19.30 ± 0.01	19.20 ± 0.01
7.	Energy (kcal)	401± 0.6	401± 0.6	397± 0.6	397± 0.6
8.	pH	5.8 ± 0.06	5.9 ± 0.06	5.85 ± 0.006	5.8 ± 0.06
9.	Water Activity	0.35 ± 0.006	0.35 ± 0.006	0.36 ± 0.006	0.37 ± 0.006

Table 7. Examination of Microbial Contamination of the Prepared Fish Seasoning Powder

Sr. No.	Characteristic	Fish Seasoning Powder				Standard Limits* (Codex Alimentarius Commission) [28]
		Fresh	2 month storage	4 month storage	6 month storage	
1.	Aerobic Plate Counts (APC) (cfu/g)	3.5×10^4	3.5×10^4	3.7×10^4	3.8×10^4	10^3 to 10^4
2.	*Staphylococcus aureus* (cfu/g)	<10	<10	<10	<10	10^2 to 10^3
3.	Yeast and Mould (cfu/g)	<100	<100	<100	<100	10^2 to 10^3

4. Conclusions

The most suitable compositions for prepared fish seasoning powder is 100 (% w/w) of fish, 33.33 (% w/w) of carrot, 33.33 (% w/w) of white radish, 33.33 (% w/w) of chayote, 33.33 (% w/w) of Chinese cabbage, 16.67 (% w/w) of cabbage, 16.67 (% w/w) of cauliflower, 3 (% w/w) of salt, 0.8 (% w/w) of sugar, 2.5 (% w/w) of lactose, 0.8 (% w/v) of fresh ginger juice and 1.67 (% w/w) of garlic. The most suitable condition for prepared fish seasoning powder is drying temperature 70°C for 9 hours. The fish seasoning powder contained enough amounts of protein, fat, fiber and carbohydrate due to provide the human health. The prepared seasoning powder had low moisture content and water activity (a_w) content, so it might show the stability of the product during storage.

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