

PREPARATION AND CHARACTERIZATION OF DRY CAT FOOD FROM FACTORY WASTES FISH MIXING WITH DIFFERENT CEREALS

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Abstract

The aim of this research is to prepare the dry cat food using factory wastes fish and cereals. Pyi-taw-thar and Nga-khaung-pwa were collected as the rejected low grade fish from Ngwe Pin Lae fish factory, Hlaingthayar Township, Yangon Region. The ingredients were dried by using hot air oven. Dry cat food was prepared from fish by mixing with each cereal namely wheat, corn and soybean. The respective conditions were investigated for varying ingredient compositions and steaming time. The nutritive values, pH, water activity, size stability, metabolizable energy and cat feeding of dry cat food with different cereals were also determined. It was observed that the optimum parameters were 3:7 ratio of fish powder and wheat flour with steaming time of 25 min., 1:1 ratio of fish powder and corn flour with steaming time of 25 min. and 2:8 ratio of fish powder and soybean flour with steaming time of 20 min.. The optimum dry cat food (fish and soybean) was also selected based on the comparison of nutritive values of dry cat food (fish and wheat, fish and corn, and fish and soybean). It was found that the dry cat food prepared from fish and soybean had the highest protein content of 41.5 % and metabolizable energy of 3277.5 kcal/kg.

Keywords: Dry cat food, fish, cereals, nutritive value, protein content

Introduction

Dry cat food is usually the extruded product. Dry cat food (8-10 % moisture) is manufactured using extrusion cooking under the condition of high heat and pressure. Dry cat food has a long shelf-life on account of its low moisture content. Several types of cat food are graded depend on their ingredients and nutritive value especially the protein content. There are three types of commercial cat foods. They are dry cat food, semimoist cat food, and canned cat food. These products vary in moisture content, protein content and energy value. Proteins, fats and carbohydrates are the three major groups of nutrients in any cat food. Protein is necessary for the cat to grow (Rivera, 1998). Meat, meat byproducts, fish, poultry, cereals, fruits, and bones are used as the ingredients for the production of cat food. Cereals are used to supply energy, a proportion of protein and other nutrients such as thiamine and niacin. Cereals including corn, rice, wheat, barley or sorghum are good sources of carbohydrates in the cat food (Amir and Mona, 2013). And soybean which is a source of protein and energy, omega 6, B vitamins, fibre and minerals is also used as the ingredient (Potter, 1996). A favourable source of high quality protein in the cat food is fish. The soft tissue of fatty fish comprises vitamin A, D and omega 3 (Pet Food Manufacturers Association, 2010). The protein content in cat food recommended by AAFCO is 30-45 % (AAFCO, 2003).

The objectives of the study are:

- (1) to develop dry cat food from fish and cereals namely wheat, corn and soybean using an extruder, and
- (2) to evaluate the physico-chemical properties and the cat feeding of dry cat food by varying the ingredients composition.

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Materials and Methods

Raw Materials

Torpedo scad (Pyi-taw-thar) and White mouth croaker (Nga-khaung-pwa) were collected as rejected fish from Ngwe Pin Lae Fish Factory, Ngwe Pin Lae Marine Industrial Zone, Hlaingthayar Township, Yangon Region. Wheat powder and table salt were also purchased from Ocean Supermarket, Mayangone Township, Yangon Region. Corn flour was purchased from Orange Supermarket, Kyeemyindaing Township, Yangon Region. Soybean was purchased from Nyaungpinlay Market, Lanmadaw Township, Yangon Region. Citric acid (Analar grade, BDH) was purchased from Academy Chemical Shop, 28th Street, Pabedan Township, Yangon Region.

Methods

Preparation of Fish Powder Using Hot Air Oven Drying

The (1:1) ratio of Pyi-taw-thar and Nga-khaung-pwa fish was cut into 1cm to 2 cm length. The cut fish was dried in a hot air oven at 60°C for 4 hr and the dried fish was ground into fish meal using meat grinder. Then the fish meal was dried again in a hot air oven at 60°C for 2.5 hr. After that the dried fish meal was ground into powder using grinder. Finally, the powder was screened with sieve (-14+20).

Nutritive Value of Fish Powder

The nutritive value of fish powder such as moisture content, ash content, protein content, crude fibre content, crude fat content, carbohydrate and energy value were determined.

Preparation of Dry Cat Food

Effect of Steaming Time on the Characteristics of Dry Cat Food (Fish and Wheat)

Dry ingredients such as 50 g of fish powder and 50 g of wheat powder were mixed together in a steel tray. Then 1 g of salt and 0.5 g of citric acid were added into the mixture and mixed thoroughly. And the mixture was pre-steamed at 90-95°C for 20 min. to gelatinize the starch. The mixture was thoroughly mixed with 50 ml. of distilled water to form a moist mixture for cooking. The moist mixture was cooked with steam at 90-95°C by varying the steaming time 10 min., 15 min., 20 min., 25 min., 30 min. and 35 min., respectively. After that the cooked mixture was dried in a hot air oven at 60°C for 3 hr. The dried mixture was ground into powder and screened with sieve (-30+40). The moisture content, pH and yield percent of sample were determined.

Effect of Ingredients Composition Ratio on the Characteristics of Dry Cat Food (Fish and Wheat)

In order to get the proper ratio for the preparation of wheat mixed dry cat food, fish powder and wheat powder were firstly mixed together in a steel tray by varying the weight ratio of 10:90, 20:80, 30:70, 40:60, 50:50, 60:40 and 70:30. Then 1 g of salt and 0.5 g of citric acid were added into the mixture and mixed thoroughly. And then the mixture was pre-steamed at 90-95°C for 20 min. to gelatinize the starch and it was thoroughly mixed with 50 ml. of distilled water to form a moist mixture for cooking. The moist mixture was then cooked with steam at 90-95°C at the suitable steaming time of 25 min.. After that the cooked mixture was extruded by

using a meat grinder/extruder. Finally, the extrudates were dried at 60°C for 3.5 hr. The protein content, moisture content, ash content, pH, yield percent and the cat feeding of wheat mixed dry cat food were determined. From these results, the most suitable sample was selected and the nutritive value of it was investigated.

Similarly, the effect of steaming time on the characteristics of dry cat food (fish and corn), (fish and soybean) was analyzed. The effect of ingredients composition ratio on the characteristics of these samples was also investigated.

Determination of Characteristics of Dry Cat Food

The nutritive value of dry cat food such as moisture content, ash content, protein content, crude fibre content, crude fat content, carbohydrate and energy value, and pH, metabolizable energy, water activity, size stability and cat feeding were determined.

Determination of Metabolizable Energy

$$ME \text{ (kcal/kg)} = 10 [(3.5 \times CP) + (8.5 \times CF) + (3.5 \times NFE)]$$

Where ME= Metabolizable Energy

CP= % crude protein

CF= % crude fat

NFE = % nitrogen-free extract (carbohydrate)

(Asaro, Guevara and Berendt, 2017)

Determination of Feline Body Mass Index of Experimental Cats

Feline Body Mass Index is a simple measure of body fat content in cats.

$$FBMI = \frac{\left(\frac{\text{rib cage}}{0.7062} \right) - LIM}{0.9156} - LIM$$

where, LIM = Lower Hind limb Measurement (cm)

rib cage = rib cage Measurement (cm)

(WALTHAM, 2003)



Figure 1 Pyi-taw-thar



Figure 2 Nga-khaung-pwa



Figure 3 Meat grinder/Extruder

Results and Discussion

The ingredients used in the production of dry cat food are usually powder form and therefore 1:1 ratio of both fish were firstly converted into fish powder by drying in hot air oven. The investigated nutritive value of prepared fish powder was compared with the prepared fish powder from tuna trimmings and the results are shown in Table (1). It was found that the moisture content and ash content were markedly higher than that of Tuna trimmings, although, the protein content was found slightly lower. The effect of steaming time on physico-chemical characteristics of dry cat food (fish and wheat) was studied and shown in Table (2). Although the yield percent of WST₁ to WST₅ were the same, the attractable fishy smell was observed in WST₄ to WST₆. Therefore WST₄ was selected as the suitable condition based on the odour, moisture content and short steaming time. Table (3) shows the effect of ingredient composition ratio on physico-chemical characteristics and cat feeding of extruded dry cat food (fish and wheat). Among the different composition ratio, HFW₃ was selected as the suitable sample because of the moisture content and yield percent. Although HFW₅ with the ratio of 50 g : 50 g had the highest consumption of cat, the ratio used in HFW₃ was chosen as the optimum ratio based on the protein content.

In this research work, the preparation of dry cat food was also prepared by mixing fish with other cereals such as corn and soybean. Table (4) and (6) pointed out the comparison of steaming time for corn and soybean. The optimum steaming time used for corn and soybean was found 25 min. and 20 min. because of the odour, moisture content and short steaming time. The physico-chemical characteristics obtained in Table (5) and (7) represented the value obtained for corn and soybean. The effect of ingredients composition ratio on cat feeding of dry cat food (fish and corn) and (fish and soybean) were also tasted with the domestic cat. It was found that all the samples were consumed by the domestic cat and HFC₅ and HFS₂ were found the highest consumption of dry cat food. According to the results of Table (5), HFC₅ was chosen as the suitable sample because of the moisture content and protein content. According to the results of Table (7), HFS₂ was chosen as the suitable sample based on the moisture content, protein content and nutrition of fish.

The comparison of the nutritive values of the suitable dry cat food containing fish mixed with wheat (HFW₃), corn (HFC₅) and soybean (HFS₂) is shown in Table (8). According to this Table, HFS₂ (fish and soybean) was chosen as the most suitable sample for the preparation of dry

cat food because of the highest protein content and metabolizable energy. The effect of different ingredients and recipes on water activity and size stability of the suitable dry cat food containing fish mixed with wheat (HFW₃), corn (HFC₅) and soybean (HFS₂) was studied and shown in Table (9). According to this Table, the water activity of all of dry cat food was around the value of 0.3. Bacteria, molds and yeast require water for growth and every microorganism has a minimum water activity below $a_w = 0.61$. Size stability of dry cat food was determined by using drop test and it was found that they were not easily breakable. The feline body mass index (FBMI) of experimental cats were also determined and shown in Table (10). The kibbles with different ingredients and recipes were simultaneously fed to the neighbour's cats in the evening and the results are shown in Table (11) and it was observed that all of dry cat food were consumed by the cats.

Table 1 The Nutritive Value of Prepared Fish Powder

Sr. No.	Value of Sample	Fish Powder	Literature Value* (Prepared fish powder from Tuna Trimmings)
1	Moisture Content (% w/w)	11.37±0.2	4.8
2	Ash (% w/w)	9.51±0.1	3.4
3	Protein (% w/w)	72.33	80.71
4	Crude Fat (% w/w)	0.09	-
5	Crude Fibre (% w/w)	4.08	5.7
6	Carbohydrates	2.31	5.39
7	Energy Value (kcal/100 g)	299.37	344.4

(*) Abbey et al., (2016)

Table 2 Effect of Steaming Time on the Characteristics of Dry Cat Food (Fish and Wheat)

Sr. No.	Sample	Steaming Time (min.)	Moisture Content (% w/w)	pH	Yield (%)	Observations
1	WST ₁	10	5.75±0.25	6	93.5	Relatively weak fishy smell, brown colour
2	WST ₂	15	6.55±0.25	6	93.5	Moderately strong fishy smell, brown colour
3	WST ₃	20	7.5±0.3	6	93.5	Moderately strong fishy smell, brown colour
4	WST ₄	25*	8.25±0.25	6	93.5	Attractable fishy smell, brown colour
5	WST ₅	30	8.88±0.2	6	93.5	Attractable fishy smell, brown colour
6	WST ₆	35	11.5±0.1	6	88.1	Attractable fishy smell, brown colour

(*) Most suitable condition

Table 3 Effect of Ingredients Composition Ratio on the Characteristics and Cat Feeding of Extruded Dry Cat Food (Fish and Wheat)

Sr. No.	Sample	Weight of fish powder to wheat flour based 100 g	Moisture Content (% w/w)	Ash (% w/w)	Protein (% w/w)	pH	Yield (%)	Cat Feeding (%)
1	HFW ₁	10:90	9.85±0.15	12.5±0.5	ND	6	89	28.1
2	HFW ₂	20:80	9.6±0.3	12.5±0.5	24.65	6	89	69.5
3	HFW ₃ *	30:70	9.6±0.3	13.5±0.5	33.16	6	94	76.6
4	HFW ₄	40:60	9.9±0.1	14.5±0.3	34.27	6	94	64.2
5	HFW ₅	50:50	9.8±0.1	14.5±0.5	39.47	6	94	100
6	HFW ₆	60:40	9.65±0.05	15.5±0.5	48.28	6	89	83.7
7	HFW ₇	70:30	9.45±0.35	15.8±0.2	53.15	6	89	68.4

(*) Most suitable sample

Table 4 Effect of Steaming Time on the Characteristics of Dry Cat Food (Fish and Corn)

Sr. No.	Sample	Steaming Time (min.)	Moisture Content (% w/w)	pH	Yield (%)	Observations
1	CST ₁	10	10.2±0.2	5.8	84	Relatively weak fishy smell, brown colour
2	CST ₂	15	10.5±0.1	5.8	91	Moderately strong fishy smell, brown colour
3	CST ₃	20	10.3±0.2	5.9	91	Moderately strong fishy smell, brown colour
4	CST ₄	25*	10.4±0.1	5.9	93	Attractable fishy smell, brown colour
5	CST ₅	30	11.8±0.4	6.1	94	Attractable fishy smell, brown colour
6	CST ₆	35	12.3±0.9	6.1	89	Attractable fishy smell, brown colour

(*) Most suitable condition

Table 5 Effect of Ingredients Composition Ratio on the Characteristics and Cat Feeding of Extruded Dry Cat Food (Fish and Corn)

Sr. No.	Sample	Weight of fish powder to Corn flour based 100 g	Moisture Content (% w/w)	Ash (% w/w)	Protein (% w/w)	pH	Yield (%)	Cat Feeding (%)
1	HFC ₁	10:90	9.1±0.1	9±0.1	ND	6	95	57
2	HFC ₂	20:80	9.6±0.1	10±0.1	12.46	6	95	98
3	HFC ₃	30:70	9.8±0.2	11.3±0.1	18.93	6	94	94
4	HFC ₄	40:60	9.3±0.2	12.3±0.1	28.23	6	90	93
5	HFC ₅ *	50:50	9.4±0.1	12.7±0.1	33.88	6	90	100

ND = Not determined

(*) Most suitable sample

Table 6 Effect of Steaming Time on the Characteristics of Dry Cat Food (Fish and Soybean)

Sr. No.	Sample	Steaming Time (min.)	Moisture Content (% w/w)	pH	Yield (%)	Observations
1	SST ₁	10	7.5±0.15	6	91	Relatively weak fishy smell, brown colour
2	SST ₂	15	7.8±0.1	6	91	Moderately strong fishy smell, brown colour
3	SST ₃	20*	7.9±0.1	6	95	Attractable fishy smell, brown colour
4	SST ₄	25	8.1±0.13	6	93	Attractable fishy smell, brown colour
5	SST ₅	30	8.3±0.15	6	93	Attractable fishy smell, brown colour
6	SST ₆	35	7.6±0.1	6	93	Attractable fishy smell, brown colour

(*) Most suitable condition

Table 7 Effect of Ingredients Composition Ratio on the Characteristics and Cat Feeding of Extruded Dry Cat Food (Fish and Soybean)

Sr. No.	Sample	Weight of fish powder to Soybean flour based 100 g	Moisture Content (% w/w)	Ash (% w/w)	Protein (% w/w)	pH	Yield (%)	Cat Feeding (%)
1	HFS ₁	10:90	8.8±0.8	14±0.1	38.18	6	90	92
2	HFS ₂ *	20:80	10± 0.05	13± 0.1	41.50	6	92	94
3	HFS ₃	30:70	10.2±0.02	13±0.1	45.51	6	92	54
4	HFS ₄	40:60	10.9±0.05	12±0.07	47.33	6	93	54
5	HFS ₅	50:50	9.8±0.2	11±0.05	51.01	6	93	89

(*) Most suitable sample

Table 8 Comparison of the Nutritive Value of Suitable Dry Cat Food (Fish and Cereals)

Sr. No.	Value of Sample	Fish + Wheat (HFW ₃)	Fish + Corn (HFC ₅)	Fish + Soybean* (HFS ₂)
		30 g : 70 g	50 g : 50 g	20 g : 80 g
1	Moisture (% w/w)	9.6± 0.3	9.4±0.1	10± 0.05
2	Ash (% w/w)	13.5±0.5	12.7±0.1	13± 0.1
3	Protein (% w/w)	33.16	33.88	41.50
4	Crude Fat (% w/w)	1.3	3.15	14.89
5	Crude Fibre (% w/w)	0.35	0.17	3.13
6	Carbohydrates	37.69	34.4	15.98
7	Energy Value (kcal/100g)	295.1	301.47	363.93
8	pH	6.0	5.9	6.0
9	Metabolizable Energy (ME) (kcal/kg)	2590.3	2657.6	3277.5

(*) Most suitable sample

Table 9 Effect of Different Ingredients and Recipes on Water Activity, Size Stability of the Most Suitable Dry Cat Food Using Hot Air Oven Drying

Sr.No.	Sample	Water Activity	Size Stability Percent (Drop Test)
1	HFW ₃	0.32	95
2	HFC ₅	0.31	98
3	HFS ₂	0.30	98

Table 10 The Feline Body Mass Index (FBMI) of Experimental Cats

Sr. No.	Cats	Gender	Age (yr)	Weight of Cat (lb)	Rib Cage (cm)	Lower Hind limb Measurement (cm)	Feline Body Mass Index (Percentage Body Fat)
1	C ₁	Male	4	15	43	20	24.66
2	C ₂	Male	7	15	44	22	22.02
3	C ₃	Male	1	10	26	14	10.92

C₁= Ahlone TownshipC₂= North Dagon TownshipC₃= Kamaryut Township**Table 11 Effect of Different Ingredients and Recipes on Neighbour's Cats Feeding of the Most Suitable Dry Cat Food Using Hot Air Oven Drying**

Sr. No.	Sample	Cat Feeding (%)	
		C ₂	C ₃
1	HFW ₃	100	100
2	HFC ₅	100	100
3	HFS ₂	100	100

C₂= North Dagon TownshipC₃= Kamaryut Township**Figure 4** Dry Cat Food (Fish and Wheat)**Figure 5** Dry Cat Food (Fish and Corn)**Figure 6** Dry Cat Food (Fish and Soybean)

Conclusion

The aim of this research was to investigate the process development on the production of dry cat food based on factory wastes fish by converting to acceptable products for cat consumption and import substitution. This research gave practically how various low grade fish resources could be processed to high grade protein fish powder and dry cat food. In Myanmar, the cat owners usually feed home-made diets. Hence, dry cat food was intended to produce from fish by incorporating cereals such as wheat, corn and soybean. The protein content of dry cat food was 33.16 % from fish and wheat, 33.88% from fish and corn, 41.5 % from fish and soybean. It can be concluded that soybean was the suitable cereal for the preparation of dry cat food because it gave the highest protein content.

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