Sensory Quality Attributes of Crab Analogue and Squid Balls from Bighead Carp (*Aristchthys Nobilis* Richardson)*

* An excerpt from a dissertation for Ph.D major in Food Science "Utilization of bighead carp (*Aristichthys nobilis* Richardson) for surimi production" presented to the UPLB Graduate School, October 1995.

DALISAY DG. FERNANDEZ[1] AND LINDA B. MABESA[2]

[1]Philippine Council for Aquatic and Marine Research & Development
Department of Science and Technology, Los Banos, Philippines
[2]University of Philippines, Los Banos, Philippines

Abstract

Surimi from bighead carp was used in the production of crab analogue and squid balls. Crab analogue using sweet potato starch and crab flavour powder resulted in better flavour, odour, texture and general acceptability than those using potato starch.

Squid balls were also produced from bighead carp surimi and compared with commercial squid balls. Sensory evaluation showed that the formulated squid balls were comparable with the commercial sample in terms of odour, texture and flavour. The commercial squid balls exhibited better colour and general acceptability than the formulated squid balls.

Introduction

Comminuted products prepared from minced meat and surimi are produced and consumed in many countries. These include fish jelly products, fish and prawn sausages, and burgers, among others.

Ideally, surimi should be processed from white fish with good gel forming ability to achieve an elastic texture, good taste and a white appearance. Surimi is usually prepared from Alaska pollock and other species like threadfin bream, blue whiting, hoki and hake. Arrowtooth, flounder and several species of small pelagics are also used. Surimi is usually kept frozen for the manufacture of fabricated food products.

Freshness of the raw material is a critical factor in determining the quality of the final product. The proximity of the source of the raw material may favour the use of freshwater fishes which are readily harvested from ponds, pens and cages.

In the Philippines, developed culture techniques of freshwater fishes resulted in increased production of bighead carp in Rizal, Laguna, Bulacan, Cagayan, Batangas and other neighboring provinces.

Like most fish species, bighead carp is a good protein source. Its protein content is comparable with beef, pork and poultry. It can also be processed like big fishes in many ways, thus making it a suitable raw material for the development of various fish products.

Therefore, this study was conducted to explore the possibility of using bighead carp as a raw material for the processing of surimi, crab analogue and squid balls.

Materials And Methods

Bighead carp (*Aristichthys nobilis* Richardson) was procured from markets in Los Baños and nearby towns. Fish was cleaned thoroughly, scales were removed and then deheaded, degutted, and washed several times in water. Samples were passed through meat grinder. The resulting product was used as the raw material for the production of surimi.

1. Production of Surimi

A 1% sodium chloride (NaCl) washing solution was used in the preparation of surimi from bighead carp. The fish meat was soaked in 1% NaCl at the rate of 5:1 (solution:fish) for 15 min with occasional stirring. The temperature during soaking was maintained at 2-5°C. After soaking, the liquid was removed from the fish meat by squeezing the mixture through a nylon net. Sodium pyrophosphate and sodium bicarbonate were added to the washed fish residue at the rate of 0.1% each and then mixed thoroughly. The samples were packed in polyethylene bags (0.003 mm thickness) and frozen at -18°C. This product will be referred to as surimi in the rest of the text.

2. Processing of Crab Analogue

Table 1 shows the different formulations for crab analogue used in the study. The ingredients for each surimi formulation were mixed well, portioned into a crab moulder and then steamed for 30 min, cooled and then frozen. The crab analogue was re-heated in steam prior to sensory evaluation.

Table 1. Formulation for crab analogue using bighead carp surimi.

Ingredient	Formulation			
	A	B	C	D
Surimi (g)	100.00	100.00	100.00	100.00
Raw egg white (g)	16.00	16.00	16.00	16.00
Starch (g)				
Potato	8.00	8.00	-	-
Sweet potato	-	-	8.00	8.00
Salt (g)	2.80	2.80	2.80	2.80
MSG (g)	1.60	1.60	1.60	1.60
Flavour :				
Crab liquid (ml)	0.007	-	0.007	-
Crab powder (g)	-	0.02	-	0.02
Flavour enhancer (g)	1.50	1.50	1.50	1.50
Chilled water (ml)	50.00	50.00	50.00	50.00

Table 2. Formulation for squid balls using bighead carp.

Ingredients	Formulation	
	A	B
Surimi (g)	100.00	100.00
Raw egg white (g)	16.00	16.00
Starch (g)		
Sweet potato	8.00	-
Potato	-	8.00
Salt (g)	2.80	2.80
MSG (g)	1.60	1.60
Flavour		
Freshly prepared squid flavour extract (ml)	0.007	0.007
Flavour enhancer (g)	1.50	1.50
Chilled water (ml)	50.00	50.00

3. Processing of Squid Balls

Table 2 presents the formulation for squid balls used in the study. Surimi from bighead carp was mixed with starch and freshly prepared squid flavour extract. The extract was prepared by squeezing out the liquid from the fresh squid mantle/meat by hand. The mixtures were portioned and formed into balls, deep fried in vegetable oil for 5 min or until light brown in colour, and subjected to sensory evaluation. A popular commercial squid ball sample was used as the control.

4. Sensory Evaluation

The samples were coded with three-digit random numbers and randomly served to each panelist. The evaluation of the sample was carried out in individually separated booths. A glass of water was given to each panelist for rinsing their mouths in between samples. Quality scoring was employed to assess sensory quality attributes of each sample.

5. Statistical Analyses

Data obtained were subjected to analysis of variance (Snedecor and Cochran, 1967) to evaluate treatment effects. Where treatment effects were found significant, Duncan's Multiple Range Test (Duncan, 1955) was used to locate significant means.

6. Cost and Return Implications

The cost implications of the production of the formulated crab analogue and squid balls from bighead carp surimi were calculated.

Results And Discussion

1. Crab Analogue

To determine the best formulation for the production of crab analogue, different ratios of crab flavour and starch were added to surimi made from bighead carp muscle. Formulations were abbreviated as: A (liquid crab flavour and potato starch), B (crab flavour powder and potato starch), C (liquid crab flavour and sweet potato starch) and D (powder crab flavour and sweet potato starch). These abbreviations were adapted in the succeeding studies, where applicable.

In the formulation, egg-white was added to improve the texture of the product. According to Chang-Lee *et al.* (1989), the use of egg-white produced acceptable gel strengths of surimi prepared from pacific whiting. This also provided a sulfhydryl enrichment which intensified the sulfhydryl disulfide interchange in surimi. Egg-white also inhibited the proteases in whiting (Haga, 1980; Nagahisa *et al.*, 1983).

To complement the action of egg-white on the final texture of the product, starch was added. Commercial potato starch is usually used in the preparation of crab analogue. The high cost of this starch, however, became a consideration in its utilization.

To lower the production cost, use of locally available starchy materials was explored. Potato (*Solanum tuberosum* Linn) and sweet potato (*Ipomea batatas* (Linn Poir) were used as source of starch. Based on the yield of the extracted starch, sweet potato starch cost less than potato starch. Due to its high yield during extraction and low cost, utilization of sweet potato starch was compared with potato starch. Chang-Lee *et al.* (1989), however, observed that the action of egg-white was complemented by potato starch in improving the hardness and elasticity of heat-set gels of surimi from whiting.

Synthetic food colours were not used in the formulation of crab analogue. This was done to retain the original colour of the product. Soup (1977) stated that in many food systems, the use of synthetic colors are limited by heat, light and other factors.

Commercial crab flavour, however, was used in product formulation. The quantity of use of crab flavor used was based on the recommended level of use by the local manufacturer. About 0.7% liquid crab flavour and 2.0% crab flavour powder were used in the study.

To further enhance the crab flavour of the product, flavour enhancer, disodium 5-inosinate commercially labelled as IMP was added.

Crab analogue of different formulations were steamed at the same time and temperature before subjecting to sensory evaluation.

2. Sensory Evaluation of Crab Analogue from Bighead Carp Surimi

The mean sensory scores of crab analogue developed from bighead carp surimi using different formulations subjected to -18°C is presented in Table 3.

Based on colour intensity, it was noted that the degree of whiteness of samples (A & B) using potato starch increased as storage time progressed. Samples using sweet potato starch (formulations C and D) decreased in whiteness when stored at -18°C for 30 days. This showed that potato starch improved the whiteness of the crab analogue more than sweet potato starch. The whiteness of the crab analogue may be attributed to the leaching and grinding processes during surimi preparation. According to Hsu (1990), the whiteness of the fish sausage from whiting was affected by leaching and the interaction of leaching and grinding processes. Furthermore, the difference in colour between the surimi using of potato and sweet potato starch is partly attributed to the presence of yellow pigment known as beta-carotene in sweet potato. This result was significantly influenced by using different formulations but not affected by storage time.

The flavour intensity of crab analogue using formulations C and D increased, while formulations A and B decreased it, when stored at -18°C for 30 days. As expected, the use of liquid and powdered crab flavours evidently intensified the flavour of crab analogue. Though all formulations were added with monosodium glutamate (MSG) and disodium 5-inosinate (commercially labeled as IMP) as flavour enhancer, differences in flavour intensity were observed. Differences in flavour intensities of crab analogue may be attributed to the differences in the formulation. Lagua (1984) observed that the quality of surimi is affected by the method of processing. Distinct flavour of crab analogue, however, was better perceived in samples using sweet potato than potato starch. These differences, however, were not significant.

As perceived by the panelists, the fishy odour of crab analogue using formulations A and B became more evident when stored at -18°C for 30 days. The use of sweet potato starch and liquid crab flavour decreased the fishy odour of the crab analogue samples. Fishy odour differences in crab analogue may again be due to the method of preparation of the surimi. The washing or leaching process removes undesirable or off-odours in surimi (SEAFDEC,

1987). Improperly washed surimi, when used in the fabrication of food products, may affect the odour of the final product. Differences in the odour intensity of the crab analogue, however, were not significantly affected by using different formulations and storage time.

Table 3. Mean[1] sensory scores[2] of crab analogue from bighead carp surimi developed using different formulations subjected to -18°C.

Quality attribute	Storage time at -18°C (day)	Formulation[3]			
		A	B	C	D
Colour	0	5.3[a]	4.0[a]	5.4[a]	4.7[a]
	3	5.9[a]	4.1[a]	3.8[a]	2.9[a]
Flavour	0	4.7[a]	5.1[a]	4.4[a]	5.0[a]
	30	3.8[a]	4.7[a]	4.9[a]	5.6[a]
Odour	0	4.2[a]	4.9[a]	3.4[a]	4.7[a]
	30	3.3[a]	3.8[a]	4.6[a]	4.2[a]
Texture	0	4.5[bc]	5.6[ab]	4.3[bc]	4.6[bc]
	30	3.3[c]	3.6[c]	5.1[ab]	6.0[a]
General acceptability	0	4.4[a]	5.8[a]	4.3[a]	5.2[a]
	30	4.4[a]	5.2[a]	5.2[a]	5.2[a]

[1] N = 10. Means followed with the same letter within a sensory attribute are not significantly ($P<0.05$) different from each other.
[2] Range of scores : Colour : 7, white; 1, off-white. Flavour : 7, very strong crab flavour; 1, absence of crab flavour. Odour : 7, absence of fishy odour; 1, fishy odour. Texture : 7, firm; 1, soft. General acceptability : 7, acceptable; 1, unacceptable.
[3] Formulation : A (0.7% liquid crab flavour + potato starch); B (2.0% crab flavour powder + potato starch); C (0.7% liquid crab flavour + sweet potato starch; D (2.0% crab flavour powder + sweet potato starch).

The firmness of crab analogue using formulations C and D increased when stored at -18°C for 30 days. Formulations A and B, however, reduced the firmness of crab analogue when subjected to the same condition. The texture of crab analogue may have been affected by cooking time and/or temperature. According to Raj (1986), improper cooking affect the quality of the final product. Patashnik *et al.* (1982) reported that rapid heating of the flesh to 70°C (158°F) for 10 min completely inactivated the protease and preserved its textural properties. Results further showed that sweet potato starch improved the texture of crab analogue more than using potato starch. Significant differences in the textural quality were influenced by the interaction of formulations and storage time.

A more acceptable crab analogue using formulation C was obtained than using other formulations as storage time progressed at -18°C. The use of potato starch, however, decreased the general acceptability of crab analogue under the same conditions. The use of different formulations and storage time did not influence the general acceptability of crab analogue.

Sensory evaluation showed that crab analogue using formulation C resulted in better flavour, odour, texture and general acceptability than using other formulations. Sensory evaluation of crab analogue from bighead carp surimi showed that the method of processing/preparation of surimi may affect the final quality of the crab analogue. The leaching, grinding, setting, heating processes and their two-way interactions affect the quality of surimi (Hsu, 1990). Lagua (1984) also stated that the quality of surimi is affected by species, season of harvest, handling and method of processing.

Crab analogue using formulation C resulted in better flavour, odour and general acceptability as storage time progressed at -18°C, but was not significantly different from samples using potato starch. A better textured crab analogue was noted in samples using sweet potato starch. The appropriate method of preparation and the nutrients present in sweet potato showed an improved quality of crab analogue. The presence of the yellow pigment, beta-carotene, in sweet potato may partly contribute to the improved flavour, odour, texture and general acceptability of the crab analogue.

3. Economic Potential of Crab Analogue from Bighead Carp Surimi

At present, Japan is still the major producer, consumer and exporter of surimi-based seafoods. Alaska pollock, a marine fish, is still the major fish used in the preparation of surimi, which is being used in the manufacture of imitation crab sticks, shrimp and lobster products.

With the reduced supply of this fish in the country and the decline in the production of marine fish, possibilities exist in the exploitation of cultured fishes.

The Philippines, a noted aquaculture producing country in the world, has increased the production of freshwater fishes due to the availability of improved aquaculture techniques. Global expansion of the fish processing industry may be possible with the use of freshwater fishes like bighead carp.

Carps are abundant in Binangonan, Cardona, Jalajala and Tanay, Rizal; Mandaluyong and Alabang, Metro Manila; Bay, Calauan, Pila, Mabitac and Sta. Maria, Laguna; San Miguel, Bulacan; Cagayan; Batangas; and in nearby areas. Due to advanced aquaculture techniques, carp is abundant all year round.

Based on a previous study, characterization of the bighead carp muscle proved its viability for the production of surimi and crab analogue.

Following the law of supply and demand, bighead carp costs less. The continuous production of bighead carp coming from the lakes, rivers and ponds all year round make them a potential substitute for marine fish in surimi and crab analogue production.

Table 4 presents the cost and return analysis of crab analogue from bighead carp muscle.

It is expected that this type of product will be sold daily. The capital investment on the production of crab analogue can be used over again within a week or a month. On a laboratory scale, a fish processor can operate with less than 30,000 as a revolving budget. The capital investment for the purchase of utensils and equipment is P26,815 but these will last for many years (Table 5).

To operate on a larger economic scale, technical adjustments will be required. The number of equipment will be increased, size of equipment has to be enlarged to meet the target production, and labour and other inputs have to be increased.

Bighead carp proved to be a potential raw material for the production of surimi and crab analogue. Profitability is ensured from the manufacture of surimi from bighead carp. Better or additional earnings, however, are expected if crab analogue will also be produced. The import of intermediate products for local consumption can also be reduced.

4. Formulation of Squid Balls from Bighead Carp Surimi

Squid balls were prepared and compared with the commercial squid balls to test the viability of bighead carp surimi for the production of "ready to serve foods" or "fabricated food products".

In the formulation of squid balls from bighead carp surimi, the formulation for crab analogue was used but modified. Crab flavour used in crab analogue preparation was changed to squid flavour.

Squid flavour extract was prepared from fresh squid unlike the crab flavours (liquid and powder) which are both commercially available. Other ingredients were also used in squid ball preparation.

Treatments applied were designated as: A (freshly prepared squid flavour extract and potato starch); B (freshly prepared squid flavour extract and sweet potato starch); and C (control or commercial squid balls).

5. Sensory Evaluation of Squid Balls

Sensory evaluation was conducted to determine the quality differences between the formulated and commercial squid balls. The mean sensory scores of formulated and commercial squid balls are presented in Table 6.

Based on colour intensity, the commercial squid balls had whiter colour than formulated samples. Samples using formulation B, however, had better colour than samples using formulation A. These differences may be attributed to the species differences of the raw material, degree of freshness, added ingredients, and the processing method employed in the product preparation. The differences in the colour intensity of the formulated samples, however, were not statistically significant. Significant differences were noted between the bighead carp products and the commercial samples. Hsu (1990) observed the effect of leaching and the interaction of leaching and

grinding on the whiteness of the fish sausage from whiting. The processing methods employed in both formulations were the same, thus differences in the colour intensity of the formulated samples were not significant. Since the processing methods employed in commercial samples were already standardized, significant differences of the formulated samples were noted with the commercial ones. There was difficulty in comparing the samples since the history of the commercial squid balls was unknown.

Absence of fishy odour was noted in formulated and commercial squid balls. Though squid balls using formulation B had lower sensory scores for odour, these were not significant. The differences in the starch used, the degree of freshness of the surimi and the process of preparation did not affect the odour intensity of the samples. This showed that leaching or washing process for the squid balls preparation was good. Leaching improved the odour of the final product (SEAFDEC, 1987).

Noting the differences in the raw material used (i.e., bighead carp for samples A and B, and marine fish of unknown species for sample C), the textural qualities of the products were assessed. Texture of the products was noted to be neither soft nor firm. No significant differences in the textural qualities among samples were noted. Though there was variation in the raw materials used, their textural qualities were not affected. Results showed that the cooking time and temperature of squid balls were appropriate. Patashnik *et al.* (1982) and Raj (1986) stated the effect of cooking on the textural properties of the final product.

Samples A and B used freshly prepared squid flavour extract while sample C had the commercial ones. Sample C had more evident squid flavour than the formulated samples. These, however, resulted in insignificant differences in the flavour of samples. The intensity of use or level of flavour and flavour enhancers differed but was not found to affect the flavour intensity of the samples. Results further showed that the method of preparation of squid flavour did not affect the quality of the final product.

The general acceptability of squid balls showed significant differences among samples. Sample C had better acceptability than samples A and B. Differences in the colour of the samples seemed to affect the general acceptability of samples. Differences in species composition of raw material, degree of freshness, quantity of flavour and flavour enhancers, and processing method employed, which were unknown in the commercial samples, also seemed to affect the general acceptability of samples. Lagua (1984) stated that the quality of the final product is affected by species, season of harvest, handling and method of processing.

6. Cost and Return Analysis of Formulated Squid Balls from Bighead Carp Surimi

Table 7 presents the cost and return analysis of formulated squid balls from bighead carp surimi. Based on computations, squid balls from bighead carp surimi seemed not to be a profitable business. A loss was incurred due to the ratio of raw material (surimi) to the final product, unlike the commercial squid balls, where more ingredients like starch and flavourings could have been added to reduce the amount of fish. Fish could be substituted by other ingredients like starch or flour. This showed that the formulations of squid balls from bighead carp surimi should be further modified to be competitive with the commercial ones. The processing site should be close to the production areas. The formulation should also be further improved to generate better profit and encourage a technology user.

Conclusion

Bighead carp, *Aristichthys nobilis* Richardson, purchased from Los Baños and nearby markets was used in the preparation of surimi. Surimi was used in the preparation of crab analogue and squid balls which were further subjected to sensory evaluation.

Results showed that crab analogue using sweet potato starch and crab flavour powder had an improved texture. No significant differences in flavour, odour and general acceptability, however, were noted among samples as storage time progressed at -18°C.

Squid balls were also developed from bighead carp surimi. These were subjected to sensory evaluation and compared with the commercial squid balls.

Commercial squid balls resulted in better colour than the formulated squid balls. However, there were no significant differences in odour, texture and flavour of the formulated squid balls from bighead carp surimi and the commercial squid balls. Commercial squid balls had better general acceptability than the formulated ones.

Squid balls using the developed formulation with bighead carp purchased from the market were not competitive with the commercial ones. The formulation has still to be modified to compete with the price of the squid balls in the local market. The processing site should be located close to the production areas to reduce the cost of the raw material.

Given the adequate supply, available aquaculture technology to boost the supply of bighead

Table 4.Cost and return[1] analysis on the preparation of crab analogue from bighead carp muscle.

Item	Quantity	Cost (Peso)
I. Fixed cost (Depreciation cost) :		
A. Utensils		
Steamer	1	18.75
Plastic basin	4	3.67
Chopping board	1	2.92
Knife	1	7.08
Wooden spoon	1	2.08
B. Equipment		
Freezer	1	75.00
Microwave	1	250.00
Electric stove	1	41.67
Meat grinder	1	97.22
Sub-total		498.39

Item	Qty/day	Unit cost (Peso)	Total cost (Peso)
II. Variable cost :			
A. Fresh bighead carp[2]	20 kg	50/kg	20,000.00
B. Sodium pyrophosphate	20 g	800/100g	3,200.00
C. Sodium bicarbonate	20 g	391/500g	312.80
D. Egg	6 pc	2.50/pc	300.00
E. Sweet potato	1 kg	7/kg	140.00
F. Salt	0.2215 kg	6.50/kg	2.80
G. MSG	0.1266 kg	85/kg	21.60
H. Liquid crab flavour (cost = US$40/kg; at US$1=25 Peso)	0.0055 kg	1,025/kg	1.20
I. IMP	0.1167 kg	950/kg	225.60
J. Water	395.55 ml	58/m^3	0.40
K. Electricity	9.13 kwh	2.36/kwh	431.00
L. Plastic bag (P.E.)	10 pc	0.35/bag	70.00
M.Detergent	1 box/month	31.00/box	31.00
N. Labour	-	-	3,000.00
O. Contingencies	-	-	1,411.74
		Sub-total	29,148.14
		TOTAL COST	29,646.53
III.Returns :			
Gross income (from sales) 206.22 pc/d at 8.50 Peso/pc			35,057.40
Less : Total cost			29,646.53
Net Income			5,410.87
Return on investment			18.25%
Payback period			5.48 mo

[1] Based on: 1995 prices; 5 days operation/week = 20 days/month.

[2] Based on 1995 market price. The farm gate price ranges from P10-25/kg, depending on size and season.

Table 5. Life span and cost of utensils and equipment in the preparation of surimi and crab analogue from bighead carp.

Item	Life span (year)	Cost/unit (Peso)	Total cost (Peso)
A. Utensils			
1 steamer	2	450.00	450.00
4 plastic basins	5	55.00	220.00
1 chopping board	1	35.00	35.00
1 knife	1	85.00	85.00
1 wooden spoon	1	25.00	25.00
		Sub-total	815.00
B. Equipment			
1 freezer	10	9,000.00	9,000.00
1 microwave	4	12,000.00	12,000.00
1 meat grinder	3	3,500.00	3,500.00
1 electric stove	3	1,500.00	1,500.00
		Sub-total	26,000.00
		TOTAL	26,815.00

Table 6. Mean[1] sensory scores[2] of the commercial and the formulated squid balls from bighead carp.

Quality attribute	Sample[3]		
	A	B	C
Colour	3.70[b]	4.00[b]	5.50[a]
Odour	5.00[a]	4.00[a]	4.90[a]
Texture	4.10[a]	4.00[a]	3.80[a]
Flavour	3.60[a]	3.60[a]	5.00[a]
General acceptability	4.60[b]	4.40b	5.90[a]

[1] N= 10. Means followed with the same letter within a sensory attribute are not significantly ($P<0.05$) different from each other.
[2] Range of scores : Colour : 7, white; 1, off-white. Odour : 7, absence of fishy odour; 1, fishy. Texture : 7, firm; 1, soft. General acceptability : 7, acceptable; 1, unacceptable.
[3] Legend : A = freshly prepared squid flavour extract and potato starch; B = freshly prepared squid flavour extract and sweet potato starch; C = commercial squid balls (manufactured by Yenmei Foods Corporation).

carp and the short payback period to prospective processor, economic returns in the manufacture of crab analogue are bright and encouraging. However, further formulation studies on squid balls and other fabricated food products should be done. Improved processing methods and strict quality control procedures should be enforced to boost the production of processed fish products from freshwater fishes.

In conclusion, the development of surimi and crab analogue from bighead carp showed bright opportunities for the manufacture of fabricated food products. Other value-added products from bighead carp should be further developed to increase the variety of processed fish products in the local market. In the production of a processed product, however, the raw material should be maintained at its freshest stage/condition to develop a good quality processed product. More so, to reduce the cost of the raw material, it should be purchased direct from fish producers.

Table 7. Cost and return analysis[1] on the preparation of squid balls from bighead carp surimi.

Item	Quantity	Cost (Peso)
I. Fixed cost (Depreciation cost) :		
A. Utensils		
Steamer	1	18.75
Plastic basin	4	3.67
Chopping board	1	2.92
Knife	1	7.08
Wooden spoon	1	2.08
B. Equipment		
Freezer	1	75.00
Microwave	1	250.00
Electric stove	1	41.67
Meat grinder	1	97.22
Sub-total	-	498.39

Item	Qty/day	Unit cost (Peso)	Total cost (Peso)
II. Variable cost :			
A. Fresh bighead carp[2]	20 kg	50/kg	20,000.00
B. Sodium pyrophosphate	20 g	800/100g	3,200.00
C. Sodium bicarbonate	20 g	391/500g	312.80
D. Egg	6 pc	2.50/pc	300.00
E. Sweet potato	1 kg	7/kg	140.00
F. Salt	0.2215 kg	6.50/kg	2.80
G. MSG	0.1266 kg	85/kg	21.60
H. Squid	0.0014 kg	60/kg	1.68
I. IMP	0.1167 kg	950/kg	225.60
J. Water	395.55 ml	58/m^3	0.40
K. Electricity	9.13 kwh	2.36/kwh	431.00
L. Plastic bag (P.E.)	10 pc	0.35/bag	70.00
M.Detergent	1 box/month	31.00/box	31.00
N. Labour (2 man-day)	-	-	3,000.00
O. Contingencies	-	-	1,411.74
		Sub-total	29,148.64
		TOTAL COST	29,647.03
III.Returns :			
Gross income (from sales) 206.22 pc/d at 2.00 Peso/pc			8,248.88
Less : Total cost			29,647.03
Net Loss			(21,398.15)

[1] Based on: 1995 prices; 5 days operation/week = 20 days/month.

[2] Based on 1995 market price. The farm gate price ranges from P10-25/kg, depending on size and season.

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Discussion

Dr Fernandez informed the seminar that oil is extracted from bighead carps for use in the manufacturing of food additives and cosmetics. She suggested that the muscle and bone waste should be utilized and processed into other by-products, such as fish meal from the bones. The bighead carp, a reasonably priced fish would then serve well as a raw material in fish processing. She took note of the suggestion that results from the sensory evaluation could be compared with those from texture profile analysis.