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THE EFFECT OF DIFFERENT SUBSTITUTION MEALS TO PHYSICAL AND CHEMICAL QUALITY OF INSTANT NOODLES

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ABSTRACT

Fishery resources including scad fish (Restrelliger sp.), Small Shrimp (Acetes sp.), and Swimming crab (Portunus pelagicus) have a high nutritional value. It can be processed into meal through several procedures, so the product can be used as a substituted material to create a nutritious instant noodle. The objectives of this research were to study the effect of fish meals as substituted material with different concentration to the physical and chemical quality of instant noodle produced and to find out what the optimal composition also whether there are any interaction of both factors. This research used factorial experimental design based on group random design, consisted of 2 factors: factor A (different fish meals): Scad fish meal (A1), Small shrimp meal (A2) and Swimming crab (Portunus pelagicus) meal (A3); and factor B (different concentration) consisted of 5 level: 0%, 5%, 10%, 15% and 20%. The analysis used was analysis of variance (ANOVA) followed by HSD 5%. The results of this research showed that there was significant effect (P<0.05) of different fishmeals and concentration to the physical and chemical quality of the product. The type of meal has a significant effect (P<0,05) to the tensile strength, moisture, ash, protein, fat, and calcium content. Concentration treatment has a significant effect (P<0,005) to the physical (brightness) and chemical quality, but there was no interaction of treatment to tensile strength, brightness, fat, and color of instant noodles (P>0,005). The optimal compositions of protein rate (19,77%) were achieved by 20% scad fishmeal; fat rate (19,93%) by 20% Small Shrimp meal, and calcium rate (42,525%) by 20% swimming crab meal. The favorite composition for instant noodle was achieved by 10% swimming crab meal.

Key words: Instant noodles, fishmeals, physical quality, chemical quality

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INTRODUCTION

Fisheries product processing is post harvest activity that take an important role in agribusiness and agroindustry. By processing activity, fisheries product which has characteristic of perishable can be retard from deterioration and improve shelf-life of the product. Post harvest processing technology can be carried out by diversification product to improve nutritional value especially for protein and calcium. By using fish products as a whole (scad fish, small shrimp and swimming crab) that consist of flesh, bone, head, while

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gut should be removed to produce fish meals. So that fish meal produced by this materials will have high nutritional value and the product can be used as substituted material in producing instant noodle.

According to Hadiwiyoto (1993) fisheries products have some substances valueable for human being such as protein, calcium, fat, small amount of carbohydrate, vitamin, salt mineral. Generally fish, small shrimp and swimming crab are considered as source of food protein and calcium, therefore it is necessary to modify some food based on those materials. Instant noddle is the most favorite food by children and adults (Sriboga ratu raya, 2002). However, instant noodle is obviously contain more cahbohydrate whereas it is lack of protein and calcium. Substitution of wheat by some meals made from different fish product may improve the nutritional value and organoleptic value of instant noodle. Modification of instant noodle processing by making different shape and taste can probably increase its consumption for example by making into snack food.

MATERIALS AND METHODS

This experiment was conducted from March to July 2005 at laboratory of Fish Product Processing Technology – Fisheries Department, Diponegoro University and Laboratory of Agriculture and Animal Husbandry Technology – Semarang University for fish meal production. Chemical and physical analysis of the product were conducted at Inter University Centre Laboratory – Gajah Mada University and Laboratory of Chemistry – MIPA, Diponegoro University.

Raw material used for this experiment consist of wheat flour, cassava flour, and fishmeals resulted from the experiment (scad fish meal, small shrimp meal and swimming crab meal), sodium carbonate, water. Some chemicalia used for the analysis includes: aquadest, $KHSO_4$, $CuSO_4$, H_2SO_4, NaOH 33%, indicator Methyl Red, Methyl Blue, NaOH 0,3.

The apparatus used for the experiment includes: analitic scale, slicer/knife, mixer, scissor, spoon, laddle, plastic pan, bamboo, roll press, mechanical drier, thermometer, exstractor, muffel furnace, desicator, Chromameter, Kjeltec apparatus, Soxhlet apparatus, oven. The experiment was conducted using Block random design, with factorial different fishmeals (scad fishmeal, small crab meal and swimming crab meal) and different concentration that consist of 5 levels (0%, 5%, 10%, 15 % dan 20 %). Each treatment was done in duplo (Sastosupardi. A, 1995).

Factor I (A) :
Different fish meals (scad fish meal , small shrimp meal and swimming crab meal)

Factor II (B) :
Different concentration of fish meals (0%, 5%, 10%, 15%, 20%).

RESULTS AND DISCUSSION

Tensile Strength

Based on ANOVA results with α = 5%, it was found that there is significant effect of different type of fishmeals to tensile strength (P <0,05). Further analysis of mean using HSD 5% showed that scad fish meal give significant different to small shrimp meal and swimming crab meal, whereas between small shrimp meal and swimming crab meal showed no significant different. In addition, the tensile strength of instant noodle made from scad fish meal was 8,455% (the highest), small shrimp meal was 5,241 % and swimming crab meal was 3,394 %. Combination treatment showing highest tensile strength was A1B0 with value of 18.15% and combination treatment having lowest tensile strength was A3B4 with the value of 0,775% means that

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the product can be broken easily when there is stress on the sample.

The occurence of lowest tensile strength on instant noodle made of swimming crab meal is considered due to more waste substances (shell) in the product so that protein content especially glutenin is smaller compared to that of other meals, but it has high calsium instead. Stickyness of noodle depend on protein (glutenin) which has elasticity and can improve tensile strength of noodle. (Sriboga Raturaya, 2002). Tensil strength is related to protein content, where higher protein will give higher tensile strength. Higer protein content will consequently results in longer peptide bond, so that more energy required to breaking down thus peptide bonds (Horseney,1994). Gluten in wheat flour has viscosity, which is formed by glutenin with its elasticity. Elasticity of gluten is determined by glutenin, and its extansibility is determined by gliadin (Indah,1992). The tensile strength of food is determined by type of flour containing gluten and its concentration. In fishmeals products, there are no gluten contained so that the instant noodle resulted from this was relatively low in elasticity, but more nutritious.

Color

Based on ANOVA results with α 5%, it was found that different type of fishmeals and concentration give significant effect to the color of instant noodle ($P<0,05$). But there is no significant interaction between type and concentration of fish meal to the color of instant noodle. Based on mean analysis using HSD 5%, it was found that there was significant different means that increasing concentration from 0 – 20% for different fishmeals resulted in decreasing color (become darker) with the value of 56,243 decreased to 33,05. This result showed that the instant noodle tend to be darker (dark brown) by increasing concentration of fish meals. According to Tranggono (1989), smaller brightness value will give darker brown color to black and higher brightness value will give yellow color to white.

All combination treatments can be summarised as follow:

Concentration of fish meals (%)	Type of fish meals		
	Scad fish meal (A1)	Small shrimp meal (A2)	Swimming crab meal (A3)
0% (B0)	A1B0	A2B0	A3B0
5% (B1)	A1B1	A2B1	A3B1
10% (B2)	A1B2	A2B2	A3B2
15% (B3)	A1B3	A2B3	A3B3
20% (B4)	A1B4	A2B4	A3B4

Variables observed were included:

Physical analysis : tensil strenght, color

Chemical analysis : moisture, ash, protein, fat content

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Table 1. Average of Tensile Strength of Instant Noodle made from different fishmeals and different concentrations

Type of fish meals	Concentration					Average
	0%(B0)	5%(B1)	10%(B2)	15%(B3)	20%(B4)	
A1	18,15 [a]	8,515 [a]	4,255 [a]	6,22 [a]	5,13 [a]	8,454 [B]
A2	3,885 [a]	5,72 [a]	8,42 [a]	6,42 [a]	1,69 a	5,241 [A]
A3	2,47[a]	8,555 [a]	1,875 [a]	3,295 [a]	0,775 [a]	3,394 [A]
Average	8,168 [A]	7,595 [A]	4,85 [A]	5,335 [A]	2,532 [A]	

Note : 1. Data followed by the same superscript have no significant different (P>0,05).
2. Average in the same column followed by different superscript have significant different (P<0,05).
3. Average in the same row followed by same superscript have no significant different (P>0,05)

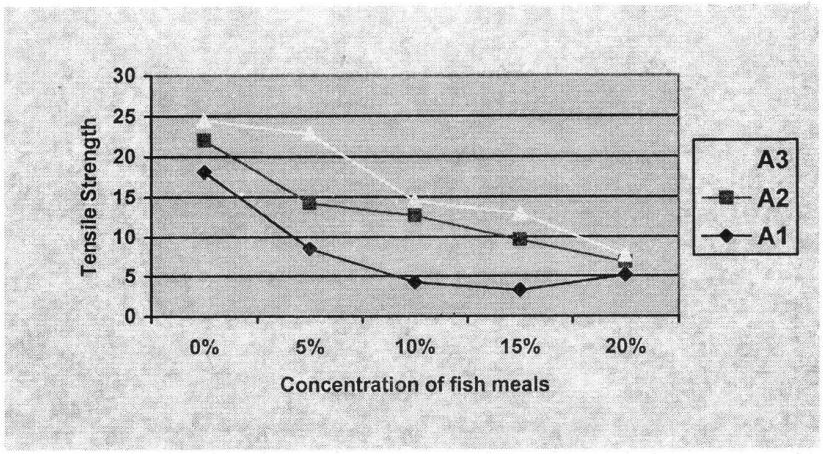

Fig 1. The effect of treatment on Tensile Strength of Instant Noodle

Table 2 showed the highest brightness value occured in combination treatment of A1B1 (scad fish meal at 5%) with value = 55,075 L* with yellowish color. The smallest brightness value occured at A2B4 (small shrimp meal at 20%) with value = 33,005 L* with dark color.

Brightness (color) of instant noodle was affected by different treatment (see Figure 2). This is because generally almost all food made from cereal flour will take browning reaction when it is heated to more than 35°C due to the reaction between protein and carbohydrate (i.e Maillard reaction). The initial color of flour used to produce instant noodle will determine the color of instant noodle resulted. (Miskelly in Kruger *et.al*,1994). The color of instant noodle is affected by water absorbtion and ash content occured in scadfish meal, small crab meal and swimming crab meal. The more water absorbed, the color will be darker (Miskelly in Kruger *et.al*,1994). This is in line with the experiment results that swimming crab meal containing higest moisture content (11,2%), showed darker color in the product, whereas for small shrimp meal and swimming crab meal is (9,15% and 10,4%, respectivelly)

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showed brighter color of the products. In addition, instant noodle resulted from swimming crab meal relativelly darker because the meal contain more ash (9.4%) than other meals. Instant noodle resulted from small crab meal and scad fish meal relativelly brighter. The brightness of instant noodle without adding fish meals for A1B0, A2B0 and A3B0 was : 50,735 L", 56,245L", 54,875L". High value of brightness in this case because it was used 80% wheat flour and 20% cassava flour. The later flour was considered to have white color compared to that of fish meals.

From this results it can be concluded that the color of instant noodle is affected by water and ash content of fish meals used in processing.

Table 2. The average of instant noodle color resulted from different treatments

Type of meals	Concentration					Average
	0%(B0)	5%(B1)	10%(B2)	15%(B3)	20%(B4)	
A1	$50,735^{f}$	$55,071^{gh}$	$36,53^{c}$	$38,54^{b}$	$35,33^{a}$	$43,241^{A}$
A2	$56,245^{h}$	$44,87^{e}$	$40,235^{bc}$	$35,16^{a}$	$33,005^{a}$	$41,903^{A}$
A3	$54,875^{g}$	$50,635^{f}$	$42,955^{d}$	$41,22^{cb}$	$34,15^{a}$	$53,95^{A}$
Average	$53,95^{E}$	$50,19^{D}$	$39,91^{C}$	$38,31^{B}$	$34,16^{A}$	

Note :

1. Data of combination treatment followed by superscript of different letter means there is a significant (P<0,05).
2. Average on the same column followed by the same superscript means there is no significant different (P>0,05).
3. Avergae on the same row followed by different superscript means there is a significant different (P<0,05)

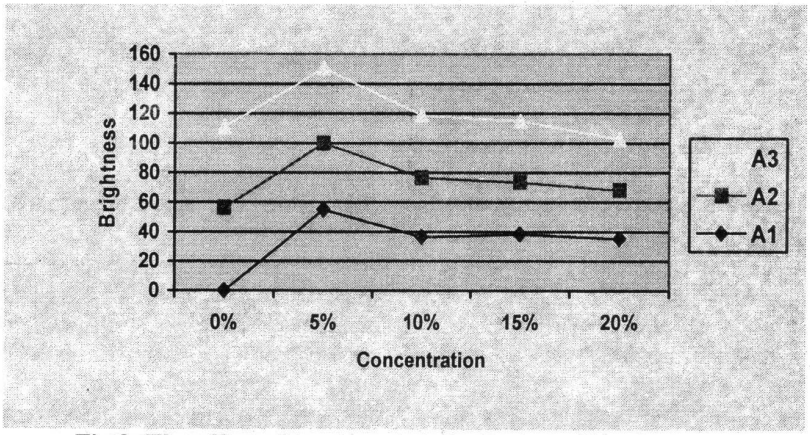

Fig 2. The effect of treatments to instant noodle color

Moisture Content

Based on Analysis of varian, combination treatment of fishmeal type and its concentration give significant different to water content of instant noodle (P<0.05). This occurence was considered due to increase in concentration of fish meals

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resulted in higher water content of fishmeals and vice versa.

Table 3 showed that there were a different of moisture content of fishmeals between treatments. Highest water content of instant noodle was found on A3B4 treatment (swimming crab meal 20%) and the lowest was found on A2B1 treatment (small shrimp meal 5% with the value of 3,19 %). However, it can be concluded that water content of instant noodle resulted from scad fish meal with different concentration tend to produce higher water content compared to other fishmeals of swimming crab and small shrimp meals. Based on sensory analysis on crispiness after instant noodle was frying, it was observed that instant noodle made of scad fish meal tend to have lower crispiness compared to the two other fishmeals. Higher water content of scad fish meals bring about the longer processing time for making the meal, showing by longer time of drying (7 hours) with compression using hidroulic press, which is different to swimming crab and small shrimp meals processing.

Table 3. The average of moisture content of instant noodle with different treatment

Type of meals	Concentration					Average
	0%(B0)	5%(B1)	10%(B2)	15%(B3)	20%(B4)	
A1	4.325^{cd}	6.17^{f}	7.53^{g}	$8,105^{gh}$	$8,565^{h}$	$6,939^{C}$
A2	$2,4^{a}$	$3,19^{b}$	$4,16^{c}$	$5,26^{d}$	$5,875^{de}$	$4,177^{A}$
A3	$4,34^{cd}$	$5,265^{e}$	$5,545^{de}$	$6,43^{fg}$	$8,585^{h}$	$4,316^{B}$
Average	$3,688^{A}$	$4,875^{B}$	$5,745^{C}$	$6,598^{D}$	$7,675^{E}$	

Note : 1 Data of combination treatment followed by different superscript means there is significant different (P< 0,05 or Fhit > F .0.05)
2 Average on the same column followed by different superscript means there is Significant different P< 0.05
3. Average on the same rows followed by different superscript means there is significant different P< 0.05

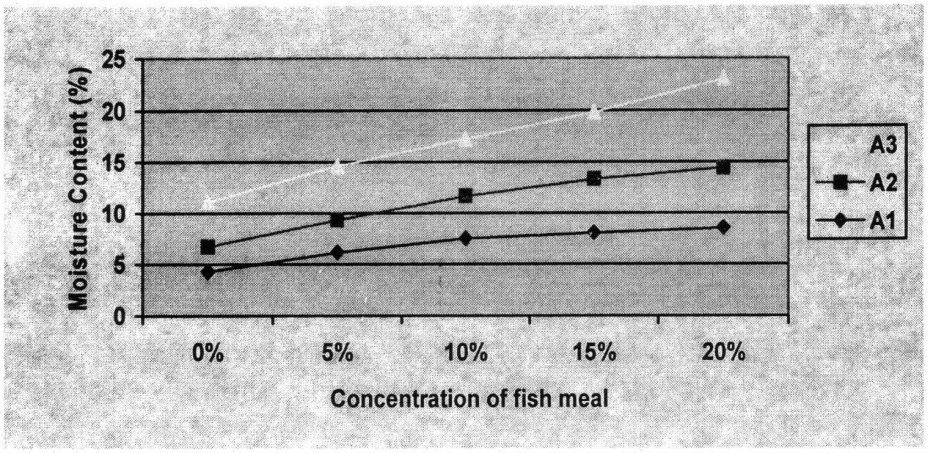

Fig 3. The effect of treatment on moisture content of instant noodle

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Ash content

Table 4. The average of Ash content of instant noodle

Type of fish meals	Concentration					Average
	0%	5%	10%	15%	20%	
A1	1,4493[a]	2,4515[cd]	2,3205[d]	2,881[de]	3,8189[ef]	2,5842[B]
A2	1,526[b]	2,046[c]	3,587[e]	3,9865[fg]	4,5249[g]	2,2291[A]
A3	1,45885[a]	3,9238[f]	5,6811[h]	7,4807[i]	9,4298[j]	5,59485[C]
Average	1,4780 [A]	2,8071 [B]	3,8628 [C]	4,7827 [D]	5,9242[E]	

Note : 1 Data of combination treatment followed by different superscript means there is significant different (P< 0,05 or Fhit > F .0.05)
2 Average on the same column followed by different superscript means there is significant different P< 0.05
3 Average on the same rows followed by different superscript means there is significant different P< 0.05

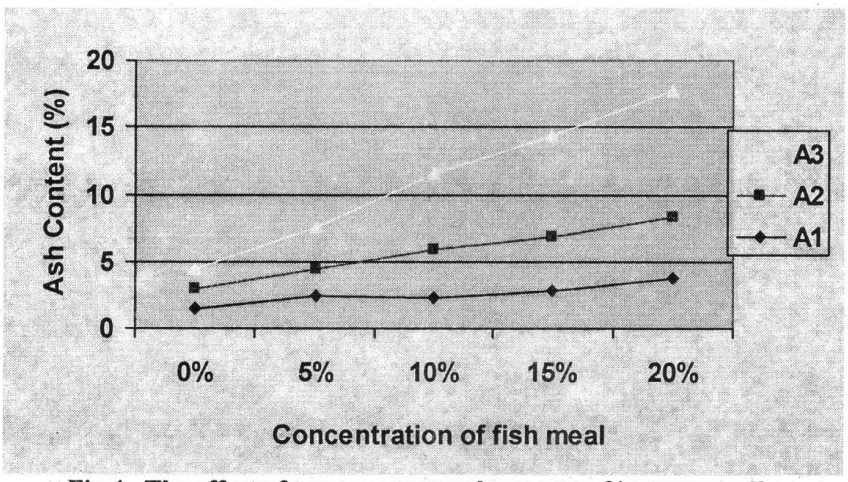

Fig 4 . The effect of treatments on ash content of instant noodle

Based on Analysis of variance using α =5% found P<0,05. Combination treatments give significant effect to ash content of instant noodle and there was significant interaction. After it is analysed using HSD 5% for mean it was found that the highest ash content was found on treatment A3B4 (20% swimming crab meal) with the value of 9,42%. The lowest ash content was found for A1B0 (20% of cassava flour and 80% wheat flour (control) with value of 1,45%.

High ash content for A3B4 was considered due to swimming crab meal used which contain 20% and 80% of wheat flour. According to Wijaya (1977), minerals are

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belong to anorganic nutrition. When food is burned, organic compounds will loss and anorganic compounds (ash) will remain as minerals. Ash content will increase with increasing concentration of fishmeals, and the most highest ash content was found in swimming crab meal because more carapac containing calcium was observed.

Ash content on food is also affected by alkali solution added for noodle processing (Kim,1996). In addition Sudarmadji (1994) stated that ash compound will easily decompose at high temperature, and it depend on material containing on food, the temperature of ashing will be determined.

Based on analysis of variance there was interaction between type of fishmeal and its concentration. Increase in concentration for each fishmeals will bring about higher ash content of instant noodle.

Based on analysis of variance with α =5% it was found Fhit (74,66)> F0,05(2,4) means Hipothesis 1 was accepted, combination treatments of fishmeals and concentration give significant effect to protein content of instant noodle resulted. Table 5 and Figure 6 showed the effect of different fishmeals to protein content of instant noodle. Scad fish meal with concentration of 20% (A1B4) has protein content of 19.77%. Small shrimp meal with the same concentration give protein content of 16.54% and swimming crab meal 13.73%. The same fishmeals with different concentration will increase protein content of all type of fishmeals. And all instant noodle resulted from fishmelas has higher protein content comparing to control (only 7.7% protein content). From this results it can be considered that by substitution of fish meals to wheat flour with different type and concentration of fish meals can increase the protein content of instant noodle. Highest protein content was found on instant noodle made from scad fish meal. Hadiwiyoto, S (19939 stated that initial protein content of food materials will affect the protein content of product resulted.

Protein Content

Table 5. The average of protein content of instant noodle

Type of fishmeals	Concentration					Average
	0%(B0)	5%(B1)	10%(B2)	15%(B3)	20%(B4)	
A1	$7,72079^{a}$	$12,0053^{cd}$	$13,0546^{d}$	$16,1609^{f}$	$19,7773^{g}$	$13,743^{c}$
A2	$7,71887^{a}$	$10,5284^{b}$	$12,4019^{cd}$	$14,4363^{e}$	$16,5477^{f}$	$12,32^{b}$
A3	$7,4321^{a}$	$10,471^{b}$	$11,651^{bc}$	$12,2943^{cd}$	$13,7301^{d}$	$11,115^{a}$
Average	$7,623^{A}$	$11,0015^{B}$	$12,369^{C}$	$14,297^{D}$	$16,685^{E}$	

Note : 1. Data of combination treatment followed by different superscript means there is significant different (P< 0,05 or Fhit > F .0.05)
2. Average on the same column followed by different superscript means there is Significant different P< 0.05
3. Average on the same rows followed by different superscript means there is significant different P< 0.05

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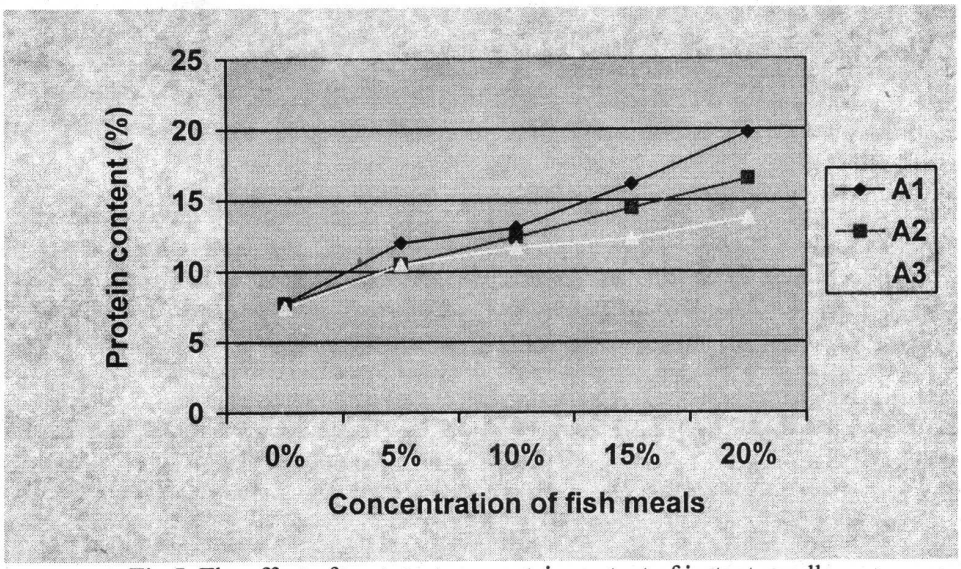

Fig 5. The effect of treatments on protein content of instant noodle

Fat Content

Table 6. The average of fat content of instant noodle

Type of fishmeals	Concentration					Average
	0%(B0)	5%(B1)	10%(B2)	15%(B3)	20%(B4)	
A1	17,535^{a}	17,825^{a}	18,115^{b}	18,565^{bc}	19,005^{cd}	18,209^{A}
A2	18,225^{b}	18,55^{bc}	19,065^{c}	19,53^{de}	19,93^{e}	19,06^{C}
A3	17,85^{a}	18,005^{b}	18,27^{b}	18,875^{bc}	19,27^{d}	18,454^{B}
Average	17,87^{A}	18,126^{B}	18,483^{C}	18,99^{D}	19,401^{E}	

Note :
1. Data of combination treatment followed by different superscript means there is significant different (P< 0,05 or Fhit > F .0.05)
2. Average on the same column followed by different superscript means there is significantdifferent P< 0.05
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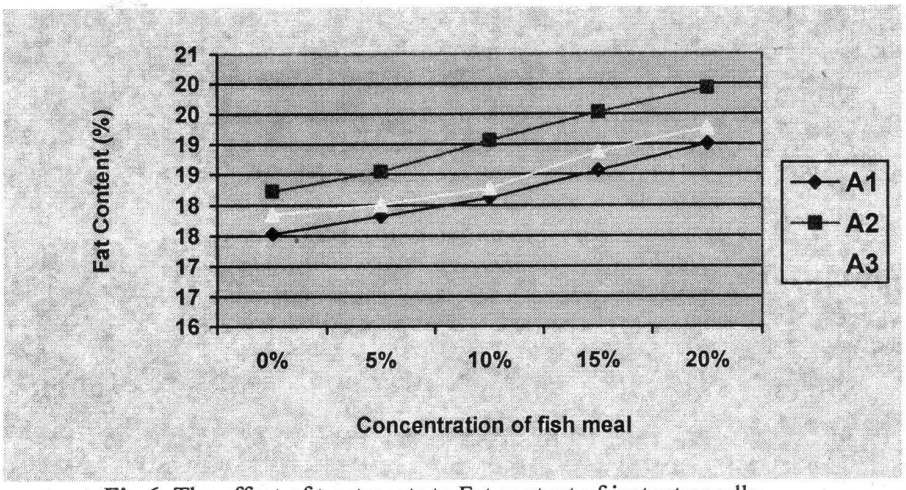

Fig 6. The effect of treatments to Fat content of instant noodle

CONCLUSION

Based on the research results it can be concluded that:

1. Type of fishmeals (treatment A) give significant effect to tensile strenght, moisture content, ash content, protein content and fat content of instant noodle
2. Different concentration of each type of fishmeals give significant effect ($P<0,05$) to physical parameter (brightness), and chemical parameters (water, ash, protein, fat content) of instant noodle.
3. There is an interaction between treatment to moisture, protein, ash and calcium content
4. Combination treatment give significant effect to physical and chemical parameters of instant noodle
5. Best treatment for instant noodle resulted from treatment A3B2 (10% swimming crab meal) which comply with physical and chemical requirement.

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