

BIOAVAILABILITY OF PROTEIN AND CALCIUM IN INSTANT NOODLE WITH ANCHOVY FISH POWDER MIXED

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Abstract

The Research objectives of bioavailability of protein and calcium in instant noodle with anchovy fish powder mixed are to analyze the improvement of calcium and protein concentration in instant noodle, sensory analysis, nutrition value, and bioavailability of protein and calcium in instant noodle produced.

This research was conducted in two phases which consists of production of anchovy fish powder and the application of anchovy fish powder into instant noodle. Anchovy fish powder analyzed in physicochemical properties in order to determine the formulation of anchovy fish powder in instant noodle. Instant noodle with anchovy fish powder was analyzed in nutrition value and its composition of sensory aspect. The finest instant noodle formulation with anchovy fish powder mixed was further examined of its bioavailability of protein and calcium.

Nutrition value analyses consist of measurement of water, proteins, lipids, minerals, calcium and carbohydrates content in instant noodle. Sensory analysis was divided into color, taste, aroma and texture of instant noodle. Bioavailability of protein n calcium evaluated using in vivo method using casein as a control Net Protein Utilization (NPU), Net Protein Ratio (NPR) and Biological Value (BV) are the aspects which measured in bioavailability of protein. Bioavailability of calcium determined using Atomic Absorption Spectrometer (AAS).

The research result showed instant noodle mixed with 7.5% anchovy fish powder was the best instant noodle form which represented by composition aspect, nutrition, sensory analysis, and bioavailability of protein and calcium (C analysis which 7.5 % anchovy fish powder). The utilization of anchovy fish powder in instant noodle showed enhanced the nutrition value, accepted in sensory analysis, and the highest bioavailability of protein and calcium of the instant noodle.

Keywords

calcium, protein, anchovy fish powder, instant noodle, bioavailability.

INTRODUCTION

Calcium is a mineral that plays important role in human body. Calcium is a major component of bone and teeth. Calcium is required in the process of blood clotting, contraction and relaxation of muscles; nerves send signals to the body tissues and maintain hormone balance (Muchtadi, Astawan Palupi and 1993). Calcium is most abundant mineral in the body that is about 1200 g in adults, where about 99% contained in the bones and skeleton. The highest calcium demand occurs during growth because bone

formation is required for, but human still need calcium until adulthood (Winarno, 1997).

Essential purposes of protein in human body are a substance for body builder, as a regulator substance in the body, replacing damaged tissue and protect the body from microbes and disease. In addition, the protein can also be used as a source of energy (calories) for the body, if the energy comes from carbohydrates (starch and sugar) or fat is not sufficient for human metabolic. Besides, the protein can also function as enzymes, acts as plasma (albumin), and antibodies form complexes with other molecules, and as part of the muscles tissue (Muchtadi, 1989).

Intake of calcium and protein can be done through food such as instant noodle. Instant noodles are one form of popular processed foods and foods that are very familiar to the public. Besides, noodles can be consumed by all ages, from children to adults. In general, people consume instant noodles without the addition of other nutrients. The addition of protein sources in the form of eggs or meat balls is only done at certain times. As for the economically weak communities, instant noodles often are used as substitute of rice, consumed without the addition of protein sources from the outside. In order to improve the above items may be additional sources of meat protein, egg, shrimp and fish, including anchovy fish, which is functioning as a source of protein also serves as a source of calcium.

Anchovy is one of the seafood that contains protein and high calcium. Great potential has not been accompanied by the utilization, which so far only used for *terasi* and fish flour. Optimal utilization from anchovy is possible since the abundant production in the ocean.

Based on the above explanation, this research tried to improve the nutritional value of instant noodles with the addition of anchovy as a source of protein and calcium. Instant noodle product was selected because of popular and preferably by many people, can be consumed by all ages and classes, practical, broad distribution, and has saved the old age and storage handling complex and has a long shelf life. Adding anchovy flour into noodles, will give effects to the physical and chemical properties of instant noodle. Addition of anchovy flour is expected to increase the nutritional value of the resulting noodles.

In general, this research aims to study the increased levels of calcium and protein through the addition of anchovy powder on instant noodle. While specific objectives of this research is : identified the formula of instant noodle with anchovy powder mixed, evaluate the sensory aspects of instant noodles produced by the addition of anchovy powder, evaluate physical and chemical properties that produce instant noodles, bioavailability study of calcium and protein , bioavailability instant noodles produced.

MATERIALS AND METHOD

Material

Materials and Equipment Research can be divided into 2 groups. The first was anchovy powder production, second was the addition of anchovy powder into instant noodle. The main materials used in the manufacture of instant noodles are wheat flour; anchovy fish powder, salt, alkali salt and water. It also used calcium lactate (standard), and gum Arabic as emulsifiers. Chemicals material is used for the analysis of content and nutritional value of instant noodle. For the analysis of protein and calcium bioavailability, this research used white rats.

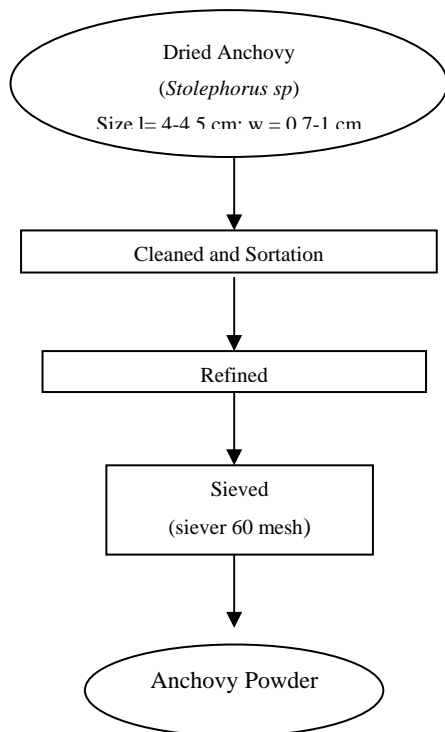


Figure 1. Procedures of Powder Dried Anchovy

The tools which were used in instant noodle production include the equipment as following : mixing machine, pressing machine (sheet-forming), ampia, steamed tools , wok pan, bowl, spoon, blender, 60 mesh sieve and tools for the analysis of raw materials, nutrients

and sensory test and analysis of protein and calcium bioavailability of instant noodle produced.

Method

The design of experiments conducted in this study are Complete Random Design with fourth repeating. Addition of fish meal will be done on instant noodle dough with the provisions treatment:

A (0%, 100%) = Without the addition of anchovy powder (control)

B (5%, 95%) = 5% anchovy powder and wheat flour 95%

C (7.5%; 92.5%) = 7.5% anchovy powder and wheat flour 92.5%

D (10%; 90%) = 10% anchovy powder and 90% wheat flour

E (12.5%; 87.5%) = 12.5% anchovy powder and wheat flour 87.5%

F (15%; 85%) = 15% anchovy powder and 85% wheat flour

Table 1. Formula in Instant Noodle Manufacture

Material	Quantity (%)					
	A	B	C	D	E	F
Wheat flour	100	95	92,5	90	87,5	85
Anchovy powder	-	5	7,5	10	12,5	15
Water	34	34	34	34	34	34
Salt	1	1	1	1	1	1
Alkali salt	2	2	2	2	2	2
Gum Arabic	0,2	0,2	0,2	0,2	0,2	0,2

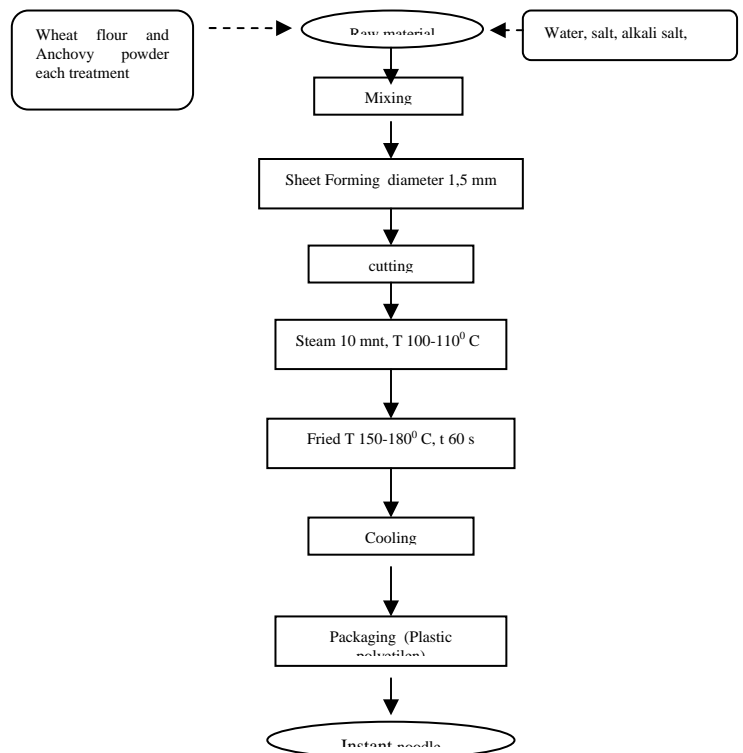


Figure 2. Instant Noodle Process in this Research (source: Bogasari Baking Center Padang)

OBSERVATION

Observations of Raw Materials

Analysis of raw materials made of flour fish and wheat powder which was used in this research. Anchovy powder made from *stelophorus sp* from West Sumatera Ocean. Analysis of raw materials includes calculations water content, protein content and levels of calcium.

Analysis of Instant Noodles Nutrition Substances

Nutrient analysis of instant noodle which produced consists of determining the water content, ash content, protein content, fat, and carbohydrates, also calcium levels.

Sensory Test

Sensory test which was used is Hedonic Test consist of color, smell, taste and texture analysis with hedonic scale of 1-5. Scale 1 indicates the value of the lowest preference level (very unpopular), the value of 2 is not preferred, the value of 3 is average, the value of 4 is desirable and values of 5 the highest preference that is highly desirable.

Analysis of Protein and Calcium Bioavailability

A total of 3 noodles formula that meets the sensory value, which is the highest rank in sensory test (Formula B, C, and D), carried out further analysis of the analysis of protein and calcium bioavailability. For protein bioavailability compared with standard proteins (Casein), while the bioavailability of calcium compared with calcium lactate and casein. Each formula was tested with 5 repeating using mice. Mice which used were "albino Norway rats (*Rattus norvegicus*) Sparague Dawley strain. Measurement of protein and calcium bioavailability by using a method carried out in vivo, where rats were given rations at the end of the test will be measuring the amount of protein and calcium in the feces and urine, and compared with the levels of protein and calcium in the rations.

RESULT AND DISCUSSION

Making of Anchovy Powder

Anchovy Powder which is produced have smooth textures and feels soft in touch, light, and brown. This brown color probably derived from fish meat which is yellow to light brown, but it is thought also as Millard reaction. Millard reaction, according to Winarno (1997) is due to reaction between the primary amine group and groups of amino acids from proteins, with the carbonyl (reducing sugar) into melanoida (brown compounds). Millard reaction heat caused by bacteria experienced during the drying process and sieving

Table 3. Physical properties and chemical components of Anchovy Powder

Components	Description
Color	Yellow Color grayish
Aroma	Anchovy Typical
Taste	Amis and a little taste salty
Performance	Smooth
Moisture	20,13 %
Ash	20,22 %
Protein content	53,15 %
Fat content	4,3-5,2 %
Calcium content	2632 mg/100 gr

Wheat flour which is used for this research is production of Cakra Bogasari Twins. Physical properties and Chemical Components of Wheat Flour in Research (from flour labels Cakra Twins)

Instant Noodle Production

Good noodle dough is influenced by several factors such as; amount of water which was added to the dough, dough mixing time, and temperature of mixing. The recommended time for mixing is 2-10 minutes, while stirring in temperature 24-450 C. The amount of water added to is maximal 38% and a minimum 28%. If water is added too much, it will cause the dough diluted, and if the amount of water is not enough, it will cause defective development gluten fibers and the resulting noodles become brittle (Winarno, 1991).

Addition of certain ingredients and additives such as anchovy powder will affect the texture (crispy), the level of noodle gelatinizes, hydration time and the resulting textures noodles.

Table 4. Composition of Instant Noodles Nutrition Substances

Instant noodle Formula	Water Content (%)	Protein content (%)	Fat content (%)	Ash content (%)	Carbohydrate content (%)	Calcium content (mg)
A	4.87	14.32 ^a	19.65 ^a	1.09 ^a	60.30 ^a	162.54 ^a
B	4.59	17.11 ^b	19.98 ^a	1.19 ^{ab}	55.45 ^b	269.01 ^b
C	4.94	18.24 ^{bc}	21.36 ^b	1.26 ^b	55.79 ^b	379.39 ^c
D	4.64	18.76 ^c	22.12 ^c	1.53 ^c	52.61 ^c	544.47 ^d
E	3.46	20.97 ^d	21.95 ^c	1.57 ^c	52.88 ^c	585.24 ^d
F	4.30	20.80 ^d	23.50 ^d	2.52 ^d	50.11 ^d	598.35 ^d
S						

Remarks: The numbers followed the same letter, are not significantly different in Duncan's test at the level of advanced real 5% (p > 0.05)

Sensory Test

The factors that determine the quality of a food product is sensory value. Sensory tests can be done through sensory evaluation, by smell, taste, and colors and texture of products.

Table 5. Average Score Sensory Test of Instant Noodles

Parameters	Formula Instant Noodles					
	A	B	C	D	E	F
Color	3.77 ^a	2.57 ^b	2.40 ^b	2.50 ^b	1.73 ^c	1.70 ^c
Flavor	3.37	2.77	2.63	2.63	2.23	2.33
Taste	3.83 ^a	2.97 ^b	2.70 ^b	2.87 ^b	2.67 ^b	2.77 ^b
Texture	3.53 ^a	2.63 ^b	2.87 ^b	2.87 ^b	2.27 ^c	2.10 ^c

Remarks: The numbers followed the same letter, are not significantly different in Duncan's test at the level of advanced real 5% ($p > 0.05$)

Protein and calcium bioavailability

a. Protein Bioavailability

Table 6. Results Analysis of Biological Value, True Power Cerna, NPU and NPR

Ration	Biological Value	Digestibility	NPU	NPR
A	84.0534 ^a	93.0430 ^a	78.2056 ^a	8.438921 ^a
B	95.2437 ^a	92.9709 ^a	88.6562 ^b	6.365632 ^b
C	93.8638 ^a	95.7687 ^b	89.8665 ^b	5.935433 ^c
F	90.4304 ^a	98.5809 ^c	89.1729 ^b	7.401327 ^a

Remarks: The numbers followed the same letter, are not significantly different in Duncan's test at the level of advanced real 5% ($p > 0.05$)

From the analysis of protein bioavailability through in vivo method, we may concluded that for the biological value of instant noodles that add the anchovy powder was not significantly different with the biological value of casein protein controls. This showed that the addition of anchovy powder on instant noodles can increase the biological value of instant noodle. This is because anchovy powder is added to increase the biological value of wheat flour so that the resulting instant noodles have the same biological value with the control protein (casein).

Biological value of a protein used as a measure of protein quality. Biological value can be defined as the percentage of protein is converted into body proteins. Biological value is not related to digestibility food proteins. Not all proteins that enter the body absorbed by the intestine.

Net Protein Utilization (NPU) is another way used to measure the protein quality that takes into account also digestibility protein (Gaman and Sherrington, 1992). The higher the addition of anchovy powder in instant noodle will increase the NPU and equivalent to NPU casein. This take place because more protein from animal contained in the food, will lead to increased NPU.

b. Calcium Bioavailability

Table 7. Analysis Results on Calcium Bioavailability

Rations	Calcium Bioavailabili-ty
A	74,35 ^a
B	75,03 ^a
C	89,14 ^b
D	81,62 ^c
F	63,75 ^d

Remarks: The numbers followed the same letter, are not significantly different in the test information Duncan on the real level of 5% ($p > 0.05$)

Total calcium that is available shows the amount of calcium that can be absorbed by the body and influenced by the total bioavailability of calcium and calcium products. Calcium absorption is also influenced by the ratio of calcium and phosphor contained in food. Ratio of calcium and the recommended phosphor is 1:1. Calcium metabolism regulated by parathyroid hormone, calcitonin, and the active form of vitamin D is vitamin D 1.25 dihydroksi (Muhilal et al, 1998).

Meanwhile, according to Gaman and Sherrington (1992), less than half the absorption calcium consumed by the intestine, factors that determine the actual amount of calcium that is absorbed vitamin D (helps absorption) and oxalic acid and fitat (disturbing absorption). Cooking factor does not have a major influence on calcium content in the material and the body absorption.

CONCLUSION

Conclusion

Anchovy powder which was produced has a distinctive character, in terms of taste, aroma and color nutritious. Anchovy powder can be added only a maximum of 15% into the making of instant noodle. Addition of anchovy powder exceeds the amount of 15% will cause instant noodles that are not compact, disjointed and less attractive color.

Analysis of nutrient content of instant noodles showed that the addition of anchovy powder will raise the levels of protein, fat and ash content, and increased levels of calcium produced instant noodle. Along with the increased nutrient content of instant noodles, adding fish meal to decrease carbohydrate levels instant noodle.

In terms of sensory, the increasing number of total anchovy fish in instant noodle will decrease the level of panelist's preferences. This occurred because the increasing number of anchovy powder will affect the color, smell, taste and texture of instant noodles produced. Increased addition of anchovy powder will make instant noodle color

becomes darker, resulting in instant noodle smell becomes more fishy odor (typical anchovy), resulting in a sense of instant noodles taste of fish, and the resulting textures less elasticity.

Of the test has been done on protein bioavailability can be concluded that the use of anchovy powder in the instant noodles can increase the nutritional value of instant noodle. Where the addition of anchovy can increase the biological value of instant noodles, improve digestion and increase the true Net Protein Utilization (NPU) instant noodle. To Net Protein Ratio, increased addition of fish into flour, instant noodle instead will lower NPR, because it reduced the number of rations consumed by the rats.

To Bioavailability of calcium, calcium absorption was derived from animal sources of calcium (small fish) would be better than synthetic sources of calcium (calcium lactate). Besides increasing the addition of fish meal can increase the absorption of calcium by the body.

From the whole research, it can be concluded that the addition of fish flour into instant noodles can increase the nutritional value of instant noodles, and can increase its availability in the body. Absorption of protein derived from anchovy powder had no significant difference with the control protein (casein) that is equally derived from animal protein sources. While the absorption of calcium in instant noodles with anchovy powder mixed is better than synthetic sources of calcium.

Suggestions

In the manufacture of instant noodles with the addition of anchovy powder is constrained in terms of acceptance of instant noodles panelists generated. Therefore, it is necessary to improve the performance of anchovy flour to be used. Things can be done is eliminate the fat contained in fish flour used, because the fats found in fish flour can result when stored in rancidity period, and may influence anchovy aroma. The most likely thing to do is to use protein concentrate anchovy.

Besides flour color is brown fish should be eliminated or reduced the intensity of color, which can produce instant noodles with a color that is still preferred by consumers.

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