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Effect of The Addition of Glucomannan to the Quality of Composite Noodle Prepared from Wheat and Fermented Cassava Flours

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ABSTRACT

This study aimed to improve the quality of cooked noodle by adding glucomannan, a dietary fiber, in order to increase its nutritional value. Glucomannan was added to the noodle dough, comprised of wheat and fermented cassava flours (with ratio of 80:20, respectively), with varying quantity, from 0.5 to 5.0 %w/w. The addition of glucomannan to the noodle dough was not only to increase the fiber content, but also to reduce the caloric value and to improve the physical properties of the resultant noodle. The addition of glucomannan in the range of 2.0 and 2.5 %w/w tended to reduce the caloric value of the produced noodle, at the same time increased its tensile strength, elongation, hardness, and cohesiveness. A higher addition of glucomannan (5.0 %w/w) did not give any improvement to the cooked noodle quality.
Keywords: cooked noodles, glucomannan, fermented cassava flour, texture, fiber.

INTRODUCTION

Noodle is a popular food in Indonesia throughout all society and economy levels. It is affordable and easy to be distributed. The raw material is wheat flour, which is supplied in Indonesia through import trading. Thus, study aimed to substitute a part of wheat flour with native Indonesian carbohydrate sources, i.e., cassava, yum, and sagoo, should be conducted. This experiment is an effort to improve the quality of cooked noodle by adding glucomannan to noodle dough, prepared from wheat and fermented cassava flours. The disadvantage of adding cassava flour to noodle dough is the low quality of the resultant cooked noodle as shown by increased cohesiveness, adhesiveness, and viscosity [1]. Fermented cassava flour was chosen to partly substitute wheat flour in noodle manufacturing as the limited application of cassava to convenient foods. A study on quality improvement of fermented cassava flour by Oboh and Akindahunsi [2] showed that there was a significant increase of protein content as well as better properties and taste. The addition of fermented cassava flour to substitute wheat flour in noodle production ranged from 25 to 50 %w/w [3].

Previous study showed the potential of glucomannan, contained approximately 1.2 %w/w in cassava [4]. Due to its low content, glucomannan powder was added into the noodle dough. An organoleptic evaluation using scoring method on cooked noodles, prepared from wheat and fermented cassava flour (ratio 80:20), fortified with glucomannan 0.5–3.0 %w/w, has been conducted by Husniati and Medikasari [5] with trained panelist, aged between 20 and 24 years old. There was not any significant differences found in terms of taste, colour, chewiness, and overall acceptability. Proximate analysis, however, exhibited increased of soluble dietary fiber (SDF). Since texture is another important parameter besides colour, which influences consumers in selecting cooked noodles [6], the quality evaluation of glucomannan fortified noodles covered mechanical test, i.e., texture analysis. The caloric value was also determined. Both results were compared to those of unfortified wheat and wheat-cassava noodles.

MATERIALS AND METHODS

Materials

Wheat flour with protein content of 12–14 %w/w was purchased from local supermarket. Fermented cassava flour was obtained from local producer in Kabupaten Pesawaran, Lampung. This cassava flour was manufactured from cassava flour which had been fermented by yeast for 18 hours prior to milling and passing through 100 Mesh screen. Bottled mineral water was used for noodle preparation. Egg yolk instead of whole egg was used as well as cooking oil (olein RBO). Iodied salt was added to noodle dough to give a taste (to avoid bland test). Commercial glucomannan flour from konjac was used.

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Methods

Cooked Noodle Preparation

Wheat and fermented cassava flours were blended with a ratio of 80:20 (based on organoleptic study by Husniati and Medikasari [5]), to achieve a total of 100 grams of mixed flours. Salt (2 grams), beaten egg yolks (10 grams), and 100 mL of water were added to the flour. Mixing was done by hands. Once the dough was no longer stick to the hands, it was passed through a pastamaker using a thickness no. 1, folded, and then repassed. This process was done stage wise, from thickness no.1, 2, 3, and finally 4. Each stage was done twice. Flour was added on the surface of the dough to prevent it from sticking to the pasta maker. The dough layer was immediately sliced using a cutter, installed in the pasta maker. The sliced dough was boiled for 3 minutes in boiling water which had beed added with a spoon of cooking oil to prevent sticking.

Quality Evaluation

Caloric Value Determination

The caloric value was determined using Bomb Calorimeter (6200 Parr Instrument, Illinois, United States). Approximately 1 gram of cooked noodle was analysed with 1 gram of benzoid acid pellet as the standard. The caloric value of the benzoid acid pellet equaled to 6318 I.T. cal/g. The analysis was done in duplicates.

Texture analysis

Texture analysis covered tensile strength, elongation, hardness, cohesiveness, and adhesiveness. Texture Analyser TA.XT2 (Stable Micro Systems Ltd., Surrey, United Kingdom). The tensile strength and elongation tests used this followong protocol: pre-test speed 1.0 mm/s, test speed 3.0 mm/s, post-test speed 10.0 mm/s, distance 100 mm, and trigger force 5 g. One thread of noodle was placed in each test. The rest parameters were determined using this following protocol: test speed 0.17 mm/s, post-test speed 10.0 mm/s, and distance 5 mm. Five threads of noodle were placed for each compression [7]. Each test was performed in duplicates.

RESULTS AND DISCUSSION

Caloric Values of Cooked Noodles

All percentages of glucomannan addition to wheat-cassava noodles in this study showed reduced caloric values (Table 1). The largest reduction was obtained at 2.0 %w/w of glucomannan with 3.2433 kcal/g of cooked noodle whilst the caloric value of wheat-cassava noodle without glucomannan fortification was 4.6900 kcal/g. It means a reduction of 1.4467 kcal/g of cooked noodle.

As studied by Vuksan et al. [8], glucomannan acts as a soluble fiber in water and contains zero calori since its glycocidic *β-1-4* bond is not digestible by humans. As it is not digested by human intestines, it subsequently goes to colon to be fermented by lactic acid bacteria to produce short chain fatty acids [9].

Table 1. Quality data of cooked noodle prepared from wheat and fermented cassava flours, fortified with glucomannan

%w/w of glucomannan added to noodle dough prepared from wheat and fermented cassava flours	%w/w of fiber		Caloric value (kcal/g)
	Insoluble	Soluble	
0.0%	15.08	7.01	4.6900
0.5%	16.35	8.96	3.5600
1.0%	19.03	8.86	3.2800
1.5%	19.84	11.47	3.4270
2.0%	20.59	23.23	3.2433
2.5%	22.74	14.70	3.4810
3.0%	20.22	11.08	3.5163

An increase of SDF was obtained on the addition of 0.5‒3.0 %w/w glucomannan to wheat-cassava noodles (Table 1). The highest increase was achieved at 2.0% w/w of glucomannan, with 23.23 %w/w of SDS, or an increase by 16.22 %w/w to the control wheat-cassava noodle (without glucomannan). The addition of glucomannan also increased the amount of insoluble dietary fiber (IDF), particularly in the range of 2.0‒3.0 %w/w [5]. SDF affects the fermentation process by lactic acid bacteria in human colon, i.e., an increase of SDF quantity will increase the microbial mass [10]. This gives an advantage to human's digestion as the microbes produce short chain fatty acids which help to prevent colonic diseases.

Texture of Cooked Noodles

In general, the addition of glucomannan to wheat-cassava noodles enhanced its tensile strength. This was expected since the control wheat-cassava noodles exhibited a lower tensile strength compared to that of the control wheat noodle (Table 2). The reduced tensile strength in control wheat-cassava noodle is proposed to be caused by the decreased amount of gluten, which is required to create elasticity of noodle dough. Glucomannan was able to improve the quality of wheat-cassava noodles as showed by a maximum elongation (141.99%) at 2.5

%w/w of glucomannan addition compared to those of wheat (135.24%) and wheat-cassava (102.59%) control samples. Glucomannan addition above 2.5 %w/w did not give a good result in term of elongation, even lower than that of the control wheat-cassava noodles. Since glucomannan attracts water and rapidly swells to 138−200% of its original volume [11], its addition above 2.5 %w/w will possibly defeat wheat flour in absorbing water. Thus, gluten network is not developed and noodle dough loses its elasticity, as shown by low values of elongation percentages. This phenomenon was previously observed by Lee et al. [12] in their study on alginate addition to noodles. Alginate also caused an increased force to cut the noodle. In this study, hardness was defined as the maximum force during the first compression to break the noodle sample. The wheat-cassava noodle hardness was enhanced at 2.5 %w/w of glucomannan addition.

Table 2. Textural properties of cooked noodles prepared from wheat and fermented cassava flours (with ratio of 80:20), fortified with glucomannan (G) 0.5−5.0 %w/w, in comparison to control noodles prepared from wheat or wheat-cassava flours without the addition of glucomannan

No	Noodle sample	Textural properties				
		Tensile strength (Gf)	Elongation (%)	Hardness (Gf)	Adhesive-ness (area)	Cohesive-ness
1	Control wheat noodle	13.8	135.24	1904.6	-58.1	0.4002
2	Control wheat-cassava noodle (WCN)	12.2	102.59	2055.2	-100.6	0.3068
3	WCN + 0.5 %w/w of G	14.6	120.21	2010.4	-95.6	0.3257
4	WCN + 1.5 %w/w of G	14.7	104.33	2122.5	-115.9	0.3086
5	WCN + 2.0 %w/w of G	16.7	121.20	2059.3	-107.4	0.3102
6	WCN + 2.5 %w/w of G	17.5	141.99	2629.1	-159.5	0.3035
7	WCN + 3.0 %w/w of G	14.2	95.11	2086.3	-132.7	0.3129
8	WCN + 5.0 %w/w of G	13.6	80.93	2142.6	-151.0	0.2925

The addition of glucomannan did not enhance the cohesiveness of wheat-cassava noodle. A reduction of cohesiveness occured due to the substitution of 20% of wheat flour with fermented cassava flour, which significantly decreased the gluten amount. A study by Tang et al. [13] exhibited a positive effect of gluten to the cohesiveness of noodle. Gluten also binds water which helps to suppress noodle adhesiveness. The replacement of 20% of wheat flour with fermented cassava flour in this study caused an increase of adhesiveness. Besides the inadequate amount of gluten in the control wheat-cassava noodle, the leaching of amylopectin (from fermented cassava flour) from the bulk body of noodle to the noodle surface also contributed to increased adhesiveness. In general, the addition of glucomannan to wheat-cassava noodle did not reduce its adhesiveness.

CONCLUSIONS

Quality improvement of cooked noodle prepared from wheat and fermented cassava flours (with ratio of 80:20) with glucomannan fortification was achieved at 2.0−2.5 %w/w of glucomannan. Enhaced quality was displayed by higher values of tensile strength, elongation percentage, and hardness, accompanied by reduced caloric values. The addition of glucomannan at all percentages, however, did not decrease the adhesevenss of wheat-cassava noodle.

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