

Fortification of Mung bean (*Vigna radiata*) and Ear mushroom (*Auricularia auricula-judae*) in dried sago noodles

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Abstract

This study aimed to obtain a formula dried sago noodles enriched with mung beans and ear mushrooms to produce noodles with high protein and fiber content and favored by the panelist. The experimental design used in this study was a Randomized Block Design (RCBD) with two factorial (3×3). Factor A is the percentage of mung bean flour which consists of three levels: a1 = 12%, a2 = 15%, a3 = 18%. Factor B is the percentage of ear mushroom flour consisting of three levels: b1 = 1%, b2 = 2% and b3 = 3%, with 2 replications. The organoleptic testing was done by 30 untrained panelists. The results showed that the most preferred panelists are dried noodles sago enriched with 12% mung bean flour and 1% ear mushroom flour. The resulting product has an overall value of 14 consisting of an average value of color 3.73 (ordinary-like), aroma preference value 3.3 (ordinary-like), texture preference value 3.47 (ordinary-like), and taste preference value 3.50 (ordinary-like).

Keywords: dried mushroom flour, enriched dried sago noodles, green bean flour

Introduction

Noodles are very popular foods in the world including, in Indonesia. Dried noodles are dry food products made from flour, favored by all ages, and are usually served varied in the daily menu. Noodles are also one of the most popular foods for children as a breakfast menu (Perdana & Hardinsyah 2013). However, the flour which is the basic ingredient in noodles is imported. Therefore, it is necessary to reduce the import of flour by look for other potential sources of flour as ingredients for noodles. One of the sources is sago flour which has a character to support as an ingredient in noodles. The problem with the use of sago flour is that the nutritional content of protein and fiber is still low. The minimum requirement for protein content in wheat flour-based on SNI 01-2987-1992 is 8%. One alternative to increase protein content from sago noodles is to add legume flour which is a source of protein. Mung beans are a type of beans that contain high enough protein so that it is suitable to be used as an additive in making sago starch noodles to increase its protein content.

According to Dahiya *et al.* (2015), mung beans are rich in protein (14.6-33.0 g/100 g) and iron (5.9-7.6 mg/100 g), also high of vitamin B1, vitamin A, and vitamin C. The protein such as isoleucine 6.95%, leucine 12.90%, lysine 7.94%, methionine 0.84%, phenylalanine 7.07%, threonine 4.50%, valine 6.23%, and nonessential amino acids. Some studies suggest

that legume flour such as mung bean flour can be included in making noodles (Chillo *et al.* 2010).

Mushrooms have been known for their nutritional and culinary value for a long time. It is currently recognized as a functional food supplement. Among them, species cultivated from the genus *Auricularia* (*Auricularia auricula-judae*, *Auricularia polytricha*, *Auricularia fuscusuccinea*) are mainly considered as nutritious foods and are widely used for the treatment of various diseases (neutraceutical), especially in Asian countries, as well as a broad spectrum of health properties including antitumor, cholesterol-lowering, anticoagulants, antioxidants, immune modulators, anti-inflammatory, and antimicrobials.

According to Fitriainingsih *et al.* (2015), that the administration of ear mushroom extract at a dose of 60 mg/20 mg body weight had an antihyperglycemic effect (lowering blood sugar levels in mice (rats)). According to Cheng *et al.* (2011), *Auricularia auricula* which is a valuable macro mushroom and fruiting body has been widely used in Chinese cooking and is known for its pharmaceutical effects in traditional Chinese medicine. In recent years, *A. auricula* has been reported to have many biological activities, including anticoagulant activity (Yoon *et al.* 2003), antitumor activity (Mizuno *et al.* 1995), hypoglycemia (Takeuchi *et al.* 2004) and hypocholesterolemia (Cheung 1996). Until now, the attention of *A. auricula* has been focused on dietary fiber and polysaccharide components, especially extracted from the fruiting body.

Considering the many benefits of ear mushrooms and mung beans and the potential for sago starch, this study aims to obtain and look at the panelist preference factor for sago noodle formula enriched with mung beans and ear mushrooms.

Materials and methods

Experiment design and materials

The experimental design used in this study is a complete random design (CRD). Treatment factors consisted of: factor A was the percentage of mung bean flour consisting of three levels: 12%, 15%, and 18%. Factor B is the percentage of ear mushroom flour consisting of three levels: 1%, 2%, and 3%, with 2 replications.

The study was conducted at the Agricultural Production Technology Laboratory, LAPTIAB, The Agency for the Assessment and Application of Technology. Serpong, South Tangerang.

The materials used in this study were Sago starch ANJ brand. Wheat flour of Cakra Kembar mung bean flour, ear fungus (*Auricularia auricula*) obtained from the North Bekasi Market, natural dyes gardenia Yellow color obtained from Zhong Tian Agricultural & Biological Group Limited.

The tools used include the equipment used to make sago dried noodles are plastic basins, gloves, stainless pans, gas stoves, steaming tools, mixers, analytical scales, filters and extruder machines type EXTC-02 SC, single-tiered threaded with a production capacity of 10 kg/hour to print noodles.

Composite flour production

This research was conducted in several stages, namely produced of composite flour consisting of sago starch and wheat flour, making mushroom ear flour, and mung bean flour. Composites consist of a ratio of sago starch: wheat flour = 80%: 20%; 70%: 30%; and 60%: 40%. The composite used was the one selected after the physical elasticity test in the making of noodles. The next step is making mushroom ear flour using a blender. Each sago starch, mung bean flour, and ear mushroom sifted with a 100 mesh sieve to obtain sago starch, mung bean flour and ear mushroom flour with uniform granules. The selected composite flour is the ratio between sago starch: wheat flour = 60%: 40%.

Table 1. The formula for sago noodles with the addition of mung bean flour and ear mushroom flour and composite flour (sago 60% and wheat flour 40%).

Composite flour (%)	Mung bean flour (%)	Ear mushroom flour (%)
87	12	1
86	12	2
85	12	3
84	15	1
83	15	2
82	15	3
81	18	1
80	18	2
79	18	3

Table 1 shows the comparison between mung bean flour, ear mushroom flour and composite flour (sago and flour) with three multiplications for each treatment based on the level of mungbean flour and ear mushrooms flour.

Sensory test

Sensory tests (Soekarto 1985) were conducted to determine the level of consumer acceptance of the color, texture, flavor and preference of sago starch noodles. This test was conducted by 30 untrained panelists. The parameters tested were a taste, color, texture, and overall value. Boiled noodles without mixing with herbs for the scoring test method. This test provides a quantitative value with a score (number) that has been previously agreed that is between range 1 (lowest) to range 4 (highest).

Data analysis

Data were analyzed using analysis of variance or the Fischer test (F test) at the level of 95%, and if there was a real influence continued with Duncan's Multiple Range Test (DMRT) at the level of 5%.

Results

Figure 1 shows the panelist values of color for dried sago noodles. The highest score (3,97) for noodles contain 12% of mung bean and 3% of ear mushroom. The lowest score (2,47) for the color of noodles goes to the noodles contain 18% of mung bean and 3% of ear mushroom. The figure showed that color preferred by panelists, in general, contains ear mushroom flour with a low concentration. The higher concentration of ear mushroom flour added to the formula the darker the color of noodles.

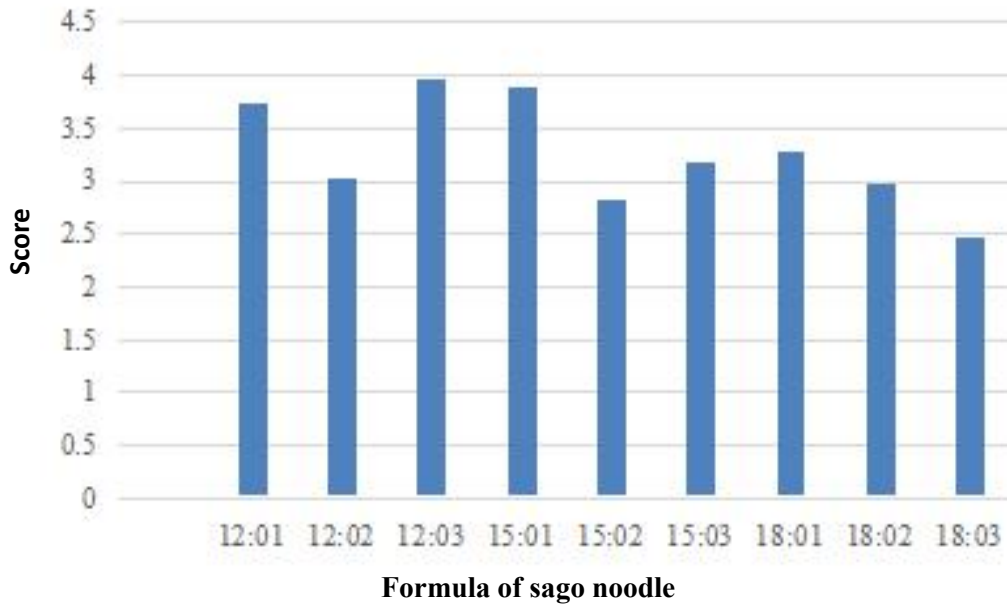


Figure 1. The value of the color of noodles by the panelist in the sensory test

On the other hand, Figure 2 shows the panelist agreed that the values of aroma for dried noodles reached the highest concentration of 15% of mung bean and 1% of ear mushrooms. The prominent aroma in the combination of composite flour enriched with 15% mung bean flour and 1% ear mushroom flour indicated that the higher of the ear mushroom added, the more unpleasant the aroma of noodles. The results also indicated that the result of the Analysis of Variance (F Test) and DMRT at the level of 5% significantly different.

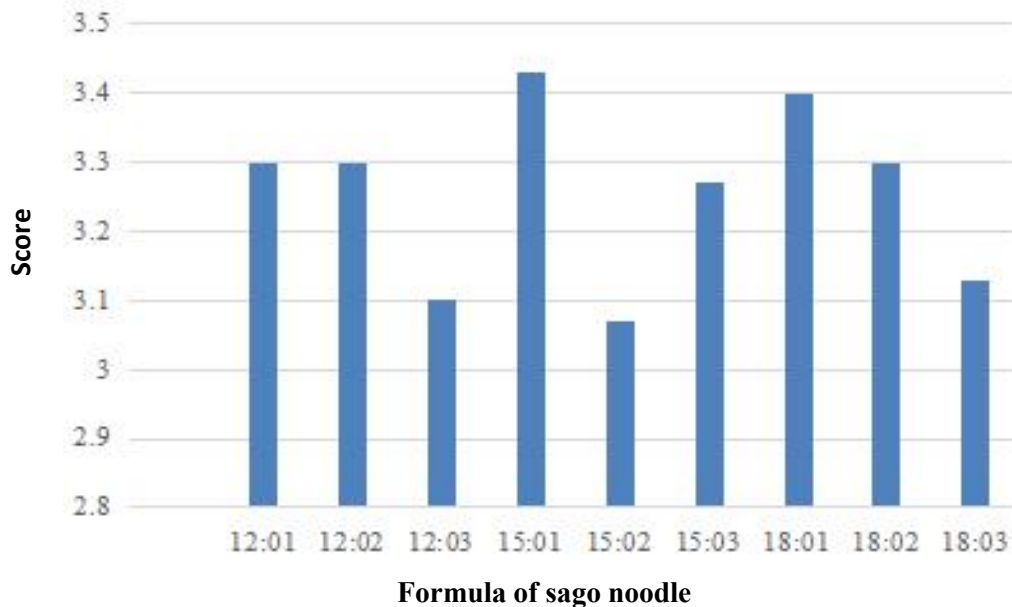


Figure 2. The value of the aroma of noodles by the panelist in the sensory test

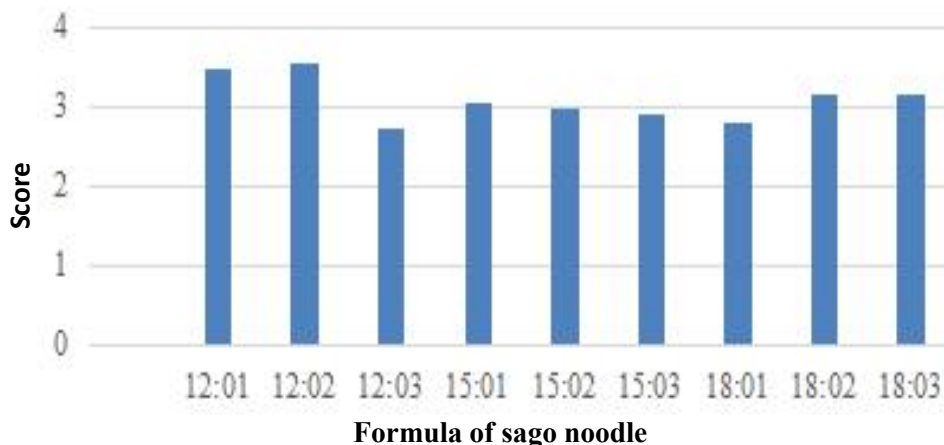


Figure 3. The value of the taste of noodles by the panelist in the sensory test

Figure 3 shows that the highest value of taste for sago noodles formula contained 12% of mung beans flour and 2% of ear mushroom flour. The addition of mung bean flour at an increasing percentage, the panelist preference for sago noodles tends to decrease, in line with an addition of ear mushroom flour with a percentage of 1%, 2%, and 3%.

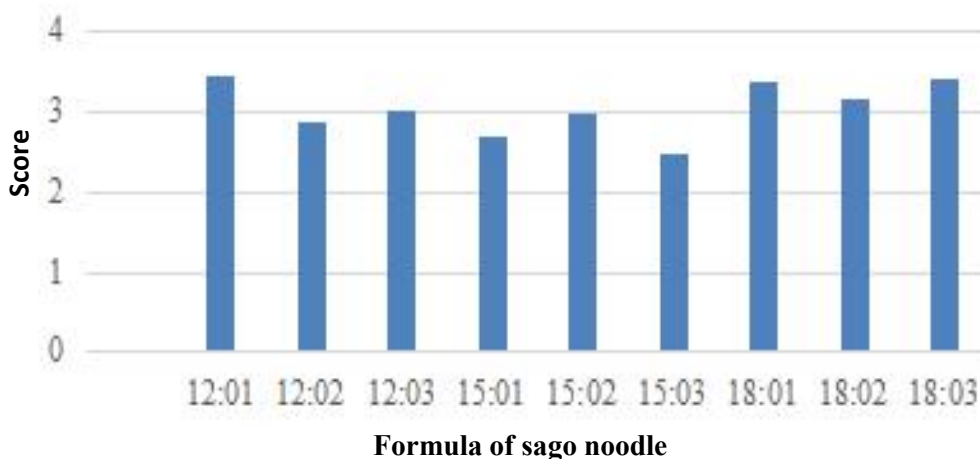


Figure 4. The value of the texture of noodles by the panelist in the sensory test

Figure 4 shows that the panelist's evaluation of the sago noodles texture by the addition of mung bean flour at an increasingly high percentage tends to reduce the level of panelists' preference for the texture of sago noodles, in line with an addition of the percentage of ear mushroom 1%, 2%, and 3%. The increasing addition of mung bean flour, the texture of the noodles was chewier than those of the lower concentration of the mung bean. Based on these results, it was also seen that the addition of higher ear mushroom flour tended to decrease the panelists' preference for the texture of dried sago noodles.

Discussion

The prominent aroma in the combination of composite flour enriched with 15% mung bean flour and 1% ear mushroom flour indicated that the higher of the ear mushroom added, the more unpleasant the aroma of noodles. The score for aroma indicated that the distinctive aroma of ear mushrooms is less preferred. The 1-okten-3-ol compound is known to be the cause of the characteristic aroma of almost all types of fungi (Rajarathanam and Barno 1988). The higher addition of mung beans in the sago noodles formula is not too disturbing for

panelists. It is shown that the addition of mung beans up to 15% get the highest value for the aroma score.

The addition of mung bean flour at an increasing percentage, the panelist preference for sago noodles tends to decrease, both in addition to ear mushroom flour with a percentage of 1%, 2%, and 3%. This can be caused by the activity of the lipoxygenase enzyme found in mung bean flour during the processing of mung beans to produce a stronger aroma in the addition of more mung bean flour to sago noodles, so this mung bean is less favorable by the panelists.

Based on these figures, it was also seen that the addition of ear mushroom flour at a higher percentage tended to decrease the panelists' preference for product taste. This can be caused by the addition of higher mushroom flour, the taste of sago noodles becomes more distinctive, which is less favored by panelists.

In accordance with the increasing addition of mung bean flour, the noodles looked more chewy texture. Based on Liu and Shen (2007) that high amylose content is desirable in making starch noodles because it can reduce violence on sago starch noodles. According to Tan *et al.* (2006) that the amylose content of mung beans ranged from 30.9% to 34.3%, so it is higher than amylose content in sago starch (27%). Therefore, the addition of mung bean flour can reduce the hardness of the noodles so that the noodles will be chewier, but if it more tenderly, the noodles could be easily broken. The high fiber content of mung bean flour (2.79%) causing noodles to break easily (Susanto and Saneto 1994).

Noodles are generally preferred chewy and not easily broken. According to Husna *et al.* (2017), the more non-starch components (fibers) cause the elastic properties of the noodles to be reduced so that it will break easily if there is pressure in the form of traction or strain. The ear mushroom flour contains high levels of fiber. The existence of fiber content in the ear mushrooms inhibits the compactness of the noodles so that the dough is difficult to blend well so that the percentage of broken noodles increases, so the higher the percentage of mushroom flour added, the texture of the noodles will be more resilient but easily broken and this is less favored by panelists.

Overall results based on this research resumed that the best results of dried sago noodles and the most preferred by the panelists were dried sago noodles enriched with 12% mung bean flour and 1% mushroom ear flour. The resulting product has an overall score of 14 consisting of an average value of color 3.73 (ordinary-like), aroma preference value 3.3 (ordinary-like), texture preference value 3.47 (ordinary-like), and taste preference value 3.50 (ordinary-like).

It is concluded that the best results obtained by this study where dried sago noodles most preferred by the panelists were dried sago noodles enriched with 12% mung bean flour and 1% mushroom ear flour. It is also suggested that this study should be developed to improve the best formula for enriched sago noodles with other sources of protein. On the words that mushrooms flour is not the best source of protein for dried sago noodles.

Conflict of Interest

The authors state no conflict of interest from this manuscript.

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