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Effect of Soybean Sprout Concentration on The Nutritional Content of Jelly Candy in Different Processing Temperature

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ABSTRACT

Jelly candy is one of the processed foods that is popular among all ages. Generally, Jelly candy produced on the market contains sugar, water, and essence only, without considering its nutritional content. As it is low nutritional content, it needs a great strategy to produce nutritious jelly candy by replacing the raw material with other ingredients that are rich in nutrients such as soybean sprouts. Soybean sprouts contain high protein (127% higher than soybean seeds), which is an important component for support growth, development, and maintenance of the human body tissues. This study provides food diversification in jelly candy that is rich in protein, by analyzing the effect of concentration of soybean sprout juice (0%, 40%, 70%, and 100%) and processing temperature (high temperature using oven (80°C) and low temperature using refrigerator (5°C)) using a 4x2 factorial randomized design. The results showed that there was no significant effect ($P<0.05$) of soybean sprout concentration and processing temperature between treatments in the parameters of moisture and ash content, but a significant difference ($P<0.05$) showed in the parameter of fat, protein, and carbohydrate content. The best treatment was obtained by adding 100% soybean sprouts and processed in the refrigerator (low temperature), with an average of 18.43% moisture content, 0.82% ash content, 7.75% fat content, 9.75% protein content, and 37.09% carbohydrates.

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Introduction

Soybeans are one source of vegetable protein. The protein content in soybeans is around 40% of the total components, with an amino acid composition that is almost close to the composition of animal protein (Aminah, 2010). The protein content makes soybeans superior to other seeds. In fact, there is a higher protein than soybeans, that is soybean sprouts. Hartoyo (2006) stated that 100 grams of sprouts contain 35.64 grams of protein, while ordinary soybeans only contain 28.04 grams of protein, it proves that sprouts contain a higher protein than the seeds.

The formation of sprouts occurs through the Germination process, which is the initial process of plant growth from seeds obtain conditions that are suitable for their growth, such as humidity, temperature, and oxygen. This process begins with the absorption of water by the seeds (imbibition), which then activates enzymes to break down food reserves in the seeds into energy needed for further growth. Several researchers report that simple germination technology can improve nutritional components such as free amino acids, α-tocopherol, vitamin C, fiber, and other components, also increase bioactive components such as polyphenols and isoflavones (Aminah, 2020). For this reason, sprouts have the potential to be developed to increase food diversification in society.

Food diversification focuses on the available resources, in this case soybean sprouts. One of the purposes of food diversification is to improve the nutritional quality of a product. The product that is currently the focus for improving its nutrition is jelly candy. According to Indonesian National Standard (SNI 2008), jelly candy is a soft-textured confectionery made by adding food additives, causes this snack does not contain much nutrition, while jelly candy is very popular among children.

This research provides food diversification by producing jelly candy that is rich in protein with the addition of soybean sprout extract. Soybean sprouts are a source of protein that can increase the nutritional value of jelly candy. Based on the description above, the researcher is interested in conducting research by utilizing soybean sprouts by processing them into jelly candy products.

Method

The research used a 4x2 factorial randomized design, with 2 factors: concentration of soybean sprout juice (0%, 40%, 70%, and 100%) and processing temperature (high temperature using oven (80°C) and low temperature using refrigerator (5°C)). This research was conducted at Laboratory of Food Processing and Laboratory of Food Analysis, Agricultural Products Technology, Universitas Teuku Umar, and Laboratory of Food Analysis, Syiah Kuala University.

Research Stages

Soybean Germination

The germination was conducted using the method by Aminah (2012). Germination started by weighing 500g of soybean, then soaked in water at room temperature for 2 hours. Then separate the seeds from the epidermis. The seed was then washed in running water, drained, and covered with cloth and germinated at room temperature for 48 hours. During germination, watering is carried out every 4 hours.

Extraction of Soybean Sprout Juice

Soybean sprouts were washed in running water and steamed for 5 minutes (Aminah dan Wikanastri, 2012). The sprouts were crushed with the addition of water with a ratio of 1:1, then filtered and squeezed using a filter cloth (Sarah and Erni, 2018).

Production of Jelly Candy

The procedures refer to the method of Iswahyudi *et al*. (2022) and Alridho et al. (2017). Soybean sprout juice (0; 100; 175; 250 ml) was mixed with sugar (150g), plain agar (5g), and citric acid (1g), into water (250; 150; 75; and 0 ml, respectively) then 18.75g carrageenan was added while continuing to stir for 18 minutes under the temperature of 80°C. The mixture was then poured into the mold and cooled at room temperature for 30 minutes. The jelly candy was then given further treatment processing temperature (oven (80°C) and refrigerator (5°C)).

Determination of chemical characteristics of jelly candy enriched with soybean sprout

The chemical properties of jelly candy enriched with soybean sprout were analyzed further. The proximate composition analyzed was moisture content using the oven method (AOAC, 2005), protein content using the Kjeldahl method (AOAC 955.04 2012), fat content using the Soxhlet extraction method (AOAC 2003.06 2012), ash content using the dry ashing method (AOAC, 2005), and carbohydrate content using by-difference method.

Statistical analysis

This study used factorial randomized design, and all analyses were performed in triplicate. Data was analysed by using ANOVA and the significance of differences between selected parameters was examined using Duncan's multiple range test (DMRT), with a 5% level of probability regarded as statistically significant.

Results

The proximate composition of jelly candy enriched with soybean sprout extract with various processing temperature is shown in Table 1.

Table 1. Proximate composition of jelly candy enriched with soybean sprout extract with various processing temperature

Proximate composition (%)	Concentration of Soybean Sprout (%)							
	0%		40%		70%		100%	
	5°C	60°C	5°C	60°C	5°C	60°C	5°C	60°C
Moisture (wb)	19.82±0.15	19.04±0.36	19.20±0.69	17.21±3.08	19.41±0.48	19.03±0.28	18.43±0.68	17.92±1.09
Ash (db)	0.72±0.29	0.59±0.26	0.84±0.76	0.64±0.41	0.86±0.46	0.77±0.56	0.82±0.23	0.88±0.33
Fat (db)	$3.62±0.22^{a}$	$3.65±0.22^{a}$	$5.80±1.65^{b}$	$4.81±0.49^{b}$	$7.62±0.6^{c}$	$6.50±0.9^{c}$	$7.75±1.07^{c}$	$7.81±1.93^{c}$
Protein (db)	$5.51±0.5^{aB}$	$3.48±0.0^{aA}$	$6.38±0.5^{bB}$	$4.35±0.0^{bA}$	$7.12±0.28^{cB}$	$5.22±0.0^{cA}$	$9.57±0.0^{dB}$	$6.96±0.0^{dA}$
Carbohydrate (db)	$29.4±0.06^{B}$	$73.2±0.6^{A}$	$31.93±1.9^{B}$	$72.9±2.9^{A}$	$34.8±0.6^{B}$	$68.5±1.2^{A}$	$37.1±1.2^{B}$	$66.4±2.7^{A}$

($^{a-c}$Different lowercase superscript indicate significant different in proximate composition between means for soybean sprout concentration, $^{A-C}$different uppercase superscript indicate significant for processing temperature (P<0.05).

The sample showed there was no significant (P<0.05) between treatments in the parameters of moisture and ash content, but a significant difference (P<0.05) showed in the parameter of fat, protein, and carbohydrate content. The moisture content of jelly candy ranged from 17.21 to 19.82%, and ash content of jelly candy ranged from 0.59% to 0.88%. The test results of all samples have met the quality requirements of Indonesian National Standard for jelly candy (SNI 3547-2-2008), the moisture content of jelly candy is a maximum of 20%, and the ash content of jelly candy is a maximum of 3%. The highest fat content results were found in the concentration of soybean sprout 100%. The fat content at high temperature (60°C) is 7.81% and at low temperature (5°C) is 7.75%. The lowest fat content was in the treatment without additional of soybean sprout, namely 3.65 and 3.62% at high temperature and low temperature, respectively. The protein content results ranged from 3.48 to 9.57% along with increasing soybean sprout concentration. Processing temperature treatment also has a significant effect on protein content, where low temperature processing produces higher results of protein content compared to high temperature processing. The carbohydrate content obtained ranged from 29.4 to 73.2%, where the processing temperature treatment had a significant effect, while the concentration of soybean sprout did not have a significant effect on carbohydrate content.

Discussion

Table 1. showed that there was no significant effect of soybean sprout concentration and processing temperature between treatments in the parameters of moisture and ash content. Moisture content has a great influence on the shelf life of food, this is due to high moisture content supporting microorganisms to grow. Otherwise, microbial growth can be inhibited under the low level of moisture content (Putri and Yunita 2015). The high temperature processing can relatively reduce the moisture content due to the heat drying process, this is in line with research by Subaryono and Utomo (2006) which states that the moisture content of jelly candy is determined by the drying time of the jelly candy product. On the other hand, in refrigerator processing there is no heat drying process, so the moisture produced tends to be higher.

The results showed that concentration of soybean sprouts had a significant effect on fat content. The highest fat content results were found at the concentration of soybean sprouts 100%. The increase in fat content in each treatment at all processing temperatures was due to the increase in the concentration of soybean sprouts in each treatment. This is in line with the research by Leonita (2021), the fat content is determined by the raw materials used, the higher the fat content of the raw material, the higher the fat content produced, so that the more soybean sprout juice added tends to increase the fat content value, in each treatment. The fat content results also show that the high temperature processing treatment using oven tends to be lower than the refrigerator processing treatment. The decrease in fat content during the high temperature processing process can occur due to an oxidation reaction in the material produced during the oven. This is in line with research by Yuniarti et al, (2013), which states that increasing drying temperature causes a decrease in fat content. Oxidation reactions begin with the formation of free radicals caused by factors that can speed up the reaction.

The sample showed a significant effect of the concentration of soybean sprouts and variations in processing temperature between treatment in protein content. The average protein content increased significantly along with increasing the concentration of sprout juice. This is in line with research by Sarah and Erni (2018) which states that germination causes an increase in several nutritional components, one of which is protein. The lowest average value in the high temperature processing is caused by heating in the oven using high temperatures resulting in denaturation of the protein so that it is broken down and damaged, this is in line with research by Sabariman and Intan (2022), which states that heating can damage the protein resulting in denaturation which can damage albumin and globulin in the structure of protein complexes. A strategy to save and extend the shelf life of food product is to provide low temperature treatment. According to Solikah et al, (2022) low temperatures can maintain the quality of food ingredients, processing jelly candy at low temperatures results in substances that are composed being maintained.

In the parameter of carbohydrate content, the processing temperature treatment had a significant effect, while the concentration of soybean sprouts did not have a significant effect on carbohydrate content. The results showed that high temperature processing tends to result in a decrease in carbohydrate levels as the concentration of sprout juice is added to each treatment. It is suspected that processing at the temperature of 60^{o}C for 5 hours can damage the carbohydrate of soybean sprout in jelly candy. This is in line with the previous research by Elika et al, (2019) and Martunis (2012), which states that the high temperatures used during the processing can damage carbohydrates, causing their nutritional content to decrease. On the other hand, in the low temperature processing, the carbohydrate content increases slowly along with the increase in the concentration of soybean sprout juice. This is due to the absence of the use of high temperatures, so that the carbohydrate content that previously existed in the product can be maintained.

Conclusion

The results showed that there was no significant effect ($P<0.05$) of soybean sprout concentration and processing temperature in the parameters of moisture and ash content, but a significant effect ($P<0.05$) showed in the parameter of fat, protein, and carbohydrate content. The test results of all samples have met the quality requirements of moisture content and ash content of Indonesian National Standard for jelly candy (SNI 3547-2-2008). The best treatment was obtained by adding 100% soybean sprouts and processed in the refrigerator (low temperature), with an average of 18.43% moisture content, 0.82% ash content, 7.75% fat content, 9.75% protein content, and 37.09% carbohydrates. In addition, it is necessary to conduct further study on the effect of soybean sprout concentration on the bioactive components of jelly candy under various processing temperatures.

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