Natural flavoring formulations of straw mushrooms and quality test with variations in temperature and drying time

SADLI SADLI¹, SITTI SALEHA², RAIYAN RAIYAN¹

¹Department of Pharmacy, Faculty of Mathematics and Natural Sciences, Universitas Syiah Kuala, Banda Aceh, Indonesia
²Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Syiah Kuala, Banda Aceh, Indonesia

Abstract. Mushrooms contain a substance known as glutamic acid, that produce a savory taste which has the potential to be developed into a natural flavoring. The research began with the determination of amino acid levels in three phases of harvesting straw mushrooms, namely: the egg phase, the bud phase, and the adult phase, by using High Performance Liquid Chromatography which aims to determine the harvesting phase with the highest glutamic acid content. The test results of amino acid levels showed the adult phase contained the highest glutamic acid levels of 49.08 mg/g. Furthermore, the manufacture of straw mushroom flour was performed with temperature variations of 60° C and 70° C and drying times of 6, 7 and 8 hours. Then the flavoring formulation was completed by mixing mushroom flour and other dry additives namely shallots, garlic, white pepper, tapioca flour, salt, and sugar. The resulting flavoring test is conducted using a description test by assessing the sensory properties of natural flavorings, namely color, aroma, taste, and texture. Based on a panelist rating, F2 (60°C, 7 hours) has the best score for color (3.88) and aroma (3.32), F5 (70°C, 7 hours) has the best score for taste (3.24) and F1 (60°C, 6 hours) has the best score for texture (2.08). The conclusion of this study is that mushrooms have a very high potential to be deformedalized into natural flavorings, as well as the natural flavoring quality parameters of mushrooms is influenced significantly by temperature parameters and drying time.

Keywords: flavorings mushrooms, test description

INTRODUCTION

The delicacy of different foods is typically judged by the taste of the food itself. The taste of food is generally produced from a combination of natural and synthetic compounds. The safe use of flavorings from synthetic compounds was called into question after the events of the Chinese Restaurant Syndrome, which was linked to the use of artificial flavors. Monosodium glutamate (MSG) is commonly used in synthetic flavoring. On the one hand, the use of MSG can provide a very enjoyable taste to food and is a high source of sodium, sodium produced by MSG can provide 20-30% of the recommended intake of salt. Therefore, excessive use of MSG can increase the concentration of salt in the blood and is a known carcinogenic, so synthetic flavorings if consumed often can have a negative effect on health.

Monosodium glutamate (MSG) is a substance that gives a specific taste of "umami" or savory to food or drink [1]. Although the addition of MSG to food provides benefits for consumers, the administration of MSG in food needs to be minimized, because of the many studies that suggest that excessive and continuous administration of MSG in food, will cause certain symptoms and diseases such as nausea, which occurs with an administration of only 1.5 g / day MSG [2]. The results [3] showed that overdosing on MSG in male and female mice would lead to the formation of micronucleus in red blood cells of the femur bone marrow. The administration of MSG to albino rats is also known to cause an increase in heart weight [4]. In addition, other studies have proven that the administration of MSG in mice causes spermatogenesis disorders by lowering the number of pakiten and spermatid spermatocytes through a testicular mechanism. On this basis,

*Corresponding Author: sadli_zhafara@unsyiah.ac.id
Received: September 2021 | Revised: September 2022 | Accepted: October 2022
it is necessary to take an innovation step to reduce or even eliminate the use of synthetic flavorings, by presenting natural flavorings that are safe to consume and have enticing properties for consumers.

Straw mushrooms can be used as natural flavoring agent ingredient in food. Because straw mushrooms contain high amounts of glutamic acid. They contain 4.0428 g / 100 g dry weight [5]. In Aceh, mushroom business are increasing but the research that relates to mushroom is very limited.

**METHODOLOGY**

**Determination of straw mushrooms**
Determination of straw mushrooms was conducted at the Bogoriense Herbarium in the Botanical Field of the Center for Biological Research LIPI Bogor. The purpose of determining is to identify the species of fungi that will be used.

**Rendemen and characterization of simplisia**
Mushrooms are harvested in three phases, namely eggs, buds, and adults. At each of these phases 1 kg of each sample is taken, then cleaned from the impactor and chopped thinly. Mushrooms are then dried in the sun for 2 hours then dried at room temperature for 14 days, and then dried again with an oven at 60°C for 6 hours. The characterization that is measured is the moisture content and ash content of the straw mushroom simplisia.

**Glutamic acid analysis**
Analysis of the glutamic acid content will be conducted at the laboratory of Organic Chemistry Gadjah Mada University (UGM) using High Performance Liquid Chromatography (HPLC). Analysis of glutamic acid in mushrooms varies between the three different harvesting phases namely: the egg phase, bud phase and adult phase. Furthermore, the harvesting phase of straw mushrooms with the highest levels of glutamic acid will be used as the basis to be formulated for mushroom flour.

**Preparation of mushroom flour**
Mushroom moans are used as the main ingredient in the manufacture of natural flavorings which are then processed into mushroom flour. Fresh straw mushrooms were washed thoroughly using running water, then cut thinly and dried at room temperature about 3-4 hours and then chopped. Mushrooms are then dried for 2 hours in the sun. Furthermore, the mushrooms are dried at room temperature for 14 days. Then the mushrooms are dried again by oven using a temperature variation of 60°C and 70°C and a drying length of 6, 7 and 8 hours. Dried straw mushrooms are then mashed by in a blender until they become flour [6].

**Flavoring Formulations**
Mushroom flour that is ready is then formulated into flavorings. The flavoring of mushrooms is formulated by modifying the formula once [6] and combined with tapioca flour 2.47%, white pepper 6.18%, shallots 1.11%, salt 8.65%, granulated sugar 1.24%, garlic 20.21% and mushroom flour straw 60.14%. All ingredients are used in a dry form. Flavoring begins with roasting tapioca flour for 20 minutes, then mixing mushroom flour, tapioca flour, salt and granulated sugar until the mixture is homogeneous. The blended ingredients are mashed using a blender and sifted using a 60-mesh sieve. The next stage is mixing the above ingredients with spices namely garlic, shallots, and white pepper until homogeneous. The mixed material is then blended and sifted with 60 mesh sieves. Flavorings are then characterized by testing moisture content and ash content.

**Flavoring evaluation**
Six variants of the mixture resulted in flavors that were evaluated with organoleptic tests. The selected organoleptic test is a description test. The description test was conducted by assessing the important sensory properties of the color, aroma, taste, and texture of the flavoring of the mushrooms. The color description test is determined by a light brown color, dark brown color, and a blackish brown color. The description test of the aroma is determined through fragrant (aroma of the ingredients are strong), somewhat fragrant (the aroma of the ingredients is not too strong), unpleasant (typical smell of mushrooms) and rancid. The taste description test is determined by the taste (umami is strong), quite tasty (umami tastes balanced), rather pleasant (umami is weak) and unpleasant (umami is not tasted). The texture description test is determined by a very smooth, smooth, rough and very rough texture. Panelists were presented with natural flavoring samples from the mushrooms and assessed the samples, and then wrote down their responses to the questionnaires that had been provided [7]. The criteria to choose the panelists was a random sample of 25 people.
Figure 1. Egg Phase Chromatogram. The amino acid elution order is as follows: (1). Aspartic acid, (2). Glutamic acid, (3). Serine, (4). Histidine, (5). Glycine, (6). Threonine, (7). Arginine, (8). Alanine, (9).- (10). Tyrosine, (11). Methionine, (12).- (13).- (14). Phenylalanine, (15). Isoleucine, (16). Leucin, (17). Lysine, (18).-

Figure 2. The amino acid elution order is as follows: 1. Aspartic acid, (2). Glutamic acid, (3). Serine, (4). Histidine, (5). Glycine, (6). Threonine, (7). Arginine, (8). Alanine, (9).- (10). Tyrosine, (11). Methionine, (12).- (13).- (14). Phenylalanine, (15). Isoleucine, (16). Leucine, (17). Lysine, (18).

Figure 3. Adult Phase Chromatogram. The amino acid elution order is as follows: 1. Aspartic acid, (2). Glutamic acid, (3). Serine, (4). Histidine, (5). Glycine, (6). Threonine, (7). Arginine, (8). Alanine, (9).- (10). Tyrosine, (11).- (12). Methionine, (13).- (14).- (15). Phenylalanine, (16). Isoleucine, (17). Leucin, (18). Lysine, (19).-
RESULTS AND DISCUSSION

Determination
The results of the determination showed that the straw mushroom (Volvariella volvacea) used in this study was Volvariella volvacea (Bull.) from the family Pluteaceae.

Rendemen and characterization of simplisia
The rendemen of straw mushroom simplisia in the egg phase was 5.3036%; the bud phase was 8.2679%; and the adult phase was 6.1937%.

Table 1. Simplisia characterization results

| Characterization | Moisture Content (%) | Ash Content (%) |
|------------------|----------------------|-----------------|
| Harvesting       | Egg Phase            | Bud Phase       | Adult Phase   |
|                  | 2.58                 | 2.85            | 3.85          |
|                  | 9.50                 | 8.95            | 11.11         |

Determination of moisture content is also measured in simplisia straw mushroom. High moisture content in simplisia can be caused by a drying process that is not optimal [8]. If the moisture content of simplisia is too high, it can cause the growth of mold. Mold can damage the tissues of the mushroom and also alter the composition of chemicals contained in simplisia. In addition, the mold also emits toxins that negatively affect human health. According to the quality requirements simplisia the moisture content in a mushroom flour can only reach a maximum of 12% (SNI 01-4476-1998). Based on the results of the study, the moisture content of fungal simplisia straw egg phase is 2.577%, bud phase is 2.8457% and adult phase is 3.846%.

Determination of ash content is closely related to the mineral content contained in a foodstuff, as well as the purity and cleanliness of a food produced. Ash content measurement aims to determine the amount of mineral content contained in a foodstuff. The amount of ash from the straw mmushroom simplicia egg phase is 9.5%, the bud phase is 8.945% and the adult phase is 11.105%.

Testing of amino acids and glutamic acids
Testing of amino fungal acid using High Performance Liquid Chromatography (HPLC). In the case of straw mushroom, analysis is carried out in three (3) harvesting phases, namely the egg phase, bud phase, and adult phase. The purpose of the phase difference is to look at the phases that contain the highest levels of glutamic acid. The phase that contains high glutamic acid levels will be formulated into natural flavorings. The content of amino acids and glutamic acid of straw mushrooms can be seen in Table 2.

Table 2. Amino Acid Levels of Straw Mushrooms

| Amino Acids | Egg Phase (mg/g) | Bud Phase (mg/g) | Adult Phase (mg/g) |
|------------|------------------|------------------|--------------------|
| Aspartic acid | 21.66            | 20.03            | 22.36              |
| Glutamic acid | 38.36            | 29.21            | 49.08              |
| Serine      | 10.76            | 11.53            | 10.68              |
| Histidine   | 4.03             | 4.01             | 4.51               |
| Glycine     | 26.51            | 23.43            | 49.61              |
| Threonine   | 12.16            | 12.33            | 13.01              |
| Arginine    | 9.44             | 9.07             | 10.62              |
| Alanine     | 6.58             | 6.81             | 7.01               |
| Tyrosine    | 39.35            | 39.06            | 40.73              |
| Methionine  | 6.83             | 6.41             | 7.48               |
| Phenylalanine | 19.61           | 18.98            | 20.53              |
| Isoleucine  | 8.23             | 7.60             | 8.06               |
| Leucine     | 10.93            | 10.58            | 11.06              |
| Lysine      | 13.25            | 13.08            | 12.50              |

Based on Table 2, the highest content of glutamic acid is present in the adult phase, hence the mushrooms in the adult phase are formulated as flavorings.

Flavoring formulations
Flavoring mushroom charcoal is formulated by modifying the formula by the [9] tapioca flour 2.47%, white pepper 6.18%, shallots 1.11%, salt 8.65%, halur sugar 1.24%, garlic 20.21% and straw mushroom simplisia powder 60.14%. Ingredients for flavoring formulations have different benefits; for instance, tapioca flour serves as a binder and prevents clumping in flavoring ingredients [10]. Garlic contains allisin compounds that function as fragrances and preservatives. [11]. Salt and sugar serve as natural preservatives. Salt can effectively inhibit microorganisms and increase the value of WHC [12]. Sugar has a high soluble property and bindsto water so that it can be used as a preservative [13].

Testing the moisture content in flavorings aims to determine the range of water content in the flavoring. The higher the moisture content, the higher the chances of microbial contamination [14]. Moisture content can affect the aroma, taste, color and texture of flavorings. Based on the results listed in Table 3, the six flavoring formulas in accordance with the quality requirements of water content of seasoning flour is a maximum of 12% (SNI 01-4476-1998).

| Ingredient | Egg phase (mg/g) | Bud phase (mg/g) | Adult phase (mg/g) |
|------------|------------------|------------------|--------------------|
| Aspartic acid | 21.66            | 20.03            | 22.36              |
| Glutamic acid | 38.36            | 29.21            | 49.08              |
| Serine      | 10.76            | 11.53            | 10.68              |
| Histidine   | 4.03             | 4.01             | 4.51               |
| Glycine     | 26.51            | 23.43            | 49.61              |
| Threonine   | 12.16            | 12.33            | 13.01              |
| Arginine    | 9.44             | 9.07             | 10.62              |
| Alanine     | 6.58             | 6.81             | 7.01               |
| Tyrosine    | 39.35            | 39.06            | 40.73              |
| Methionine  | 6.83             | 6.41             | 7.48               |
| Phenylalanine | 19.61           | 18.98            | 20.53              |
| Isoleucine  | 8.23             | 7.60             | 8.06               |
| Leucine     | 10.93            | 10.58            | 11.06              |
| Lysine      | 13.25            | 13.08            | 12.50              |
Table 3. Moisture content and flavoring ash content

| Temperature and Drying Time | Moisture Content (%) | Ash Content (%) |
|-----------------------------|----------------------|-----------------|
| FI (60°C, 6 hr)             | 8.05 ± 0.70          | 14.05 ± 0.07    |
| FII (60°C, 7 hr)            | 7.55 ± 0.89          | 13.55 ± 0.10    |
| FIII (60°C, 8 hr)           | 7.24 ± 0.67          | 14.09 ± 0.32    |
| FIV (70°C, 6 hr)            | 5.84 ± 0.18          | 14.53 ± 0.10    |
| FV (70°C, 7 hr)             | 3.82 ± 1.81          | 13.96 ± 0.47    |
| FVI (70°C, 8 hr)            | 2.04 ± 0.27          | 14.24 ± 0.41    |

Ash content testing aims to determine the mineral content of flavorings. Based on the results of Table 1 and Table 3, it gives an idea that the ash content in flavorings is higher than that of fresh mushrooms. Increased ash content in the total of mushroom flavorings and can be refined by additional ingredient factors in flavoring formulations. One of the additional ingredients that can affect the percentage increase in flavoring ash content is salt. Because salt is a food ingredient that gives taste to food and contains various types of minerals. The dominant types of minerals contained in salt are Na, Cl, and I. So that from some additional ingredients used, the addition of salt affects the percentage of minerals in the total ash content of flavorings [15].

Flavoring evaluation

Descriptor test is a sensory method that covers all parameters of the product and can be limited by 25 semi-trained panelists. This test is expected to help identify variables of additional ingredients (Ingredient) or processes related to certain sensory characteristics of flavorings that are variations in temperature and drying time of mushrooms which are the basis of natural flavoring formulations. The description test assesses the intensity of the product with a decreased scoring system on aroma, taste, color, and increased scoring on texture.

The description test aims to get an overview and measure the intensity of sensory properties on the flavoring of the mushrooms. The sensory properties tested were color, aroma, taste, and texture. The test results of the description of the flavoring of the mushrooms can be seen in Table 4.

Table 4. Description of flavorings

| Temperature and Drying Time | Color | Aroma | Taste | Texture |
|-----------------------------|-------|-------|-------|---------|
| FI (60°C, 6 hr)             | 3.76  | 3.28  | 3.08  | 2.08    |
| FII (60°C, 7 hr)            | 3.88  | 3.32  | 3.12  | 2.20    |
| FIII (60°C, 8 hr)           | 3.08  | 3.08  | 2.92  | 2.44    |
| FIV (70°C, 6 hr)            | 3.84  | 3.08  | 3.16  | 2.20    |
| FV (70°C, 7 hr)             | 3.80  | 3.16  | 3.24  | 2.12    |
| FVI (70°C, 8 hr)            | 3.28  | 2.76  | 2.96  | 2.44    |

Color is the first sensory trait that can be seen by panelists before recognizing other sensory properties. Color is a key component in knowing the quality of a foodstuff. Through color, chemical changes in flavorings can be determined, such as browning and caramelization. The test results of the description show that formulas 1, 2, 4 and 5 have a light brown color while formulas 3 and 6 have a rather light brown color. Formula 3 and 6 have a longer drying time of 8 hours, causing the flavoring color to be browner than formulas 1, 2, 4 and 5.

The aroma of flavorings can determine the delicacy and durability of the flavoring. Aroma comes from ingredients contained in flavorings such as shallots, garlic containing alisin compounds, which play a role in producing fragrant compounds in a dish, as well as white pepper powder add a spicy flavor [16]. The fragrant aroma indicates that the flavoring is still delicious and safe to consume, while the rancid aroma indicates that the flavoring has undergone chemical changes. The results of the description test showed that all six formulas have a rather fragrant aroma (the aroma of the ingredients is not very strong).

Taste is a very important parameter in determining the quality of flavorings. Taste is something that is determined by the tongue. Guyton and Hall (2007) divided the taste that can be tasted by the tongue into five tastes, namely sweet, sour, salty, bitter and umami [17]. The distinctive flavoring of oyster mushrooms is not only influenced by one component, but by certain components that have a distinctive smell. The flavor that appears in flavorings also comes from ingredients contained in ingredients such as shallots, and garlic which contains alisin compounds that play a role in producing fragrant compounds in a dish. Test descriptions of the six formulas have a fairly pleasant taste.

Texture is a sensory trait associated with touch. Drying with a low temperature and a short time can cause the water content of a material to be still high so that the texture result is rough and not dry [18]. Based on the results of the
description test of texture, the six formulas have a smooth intensity based on the value on each sample that is worth 2. The subtle properties of flavorings are in line with the basic properties of straw mushrooms that have a smooth texture, and this is also influenced using a 60 mesh that produces a smooth even result.

CONCLUSION

Based on this study, it can be concluded that the harvesting phase of straw mushrooms with the highest glutamic acid levels is the adult phase. In addition, from the test results the description of the flavoring of the mushrooms known as F2 (60°C, 7 hours) had the best score for color (3.88) and aroma (3.32). F5 (70°C, 7 hours) had the best score for taste (3.24) and F1 (60°C, 6 hours) has the best score for texture (2.08).

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