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Organoleptic properties evaluation of Ternate Nutmeg (*Myristica fragrans* Houtt)

Baharuddin¹, Maryani¹, Suriani Laga¹, Andi Tenri Fitriyah¹, Nurhayati², Andi Nur Amalia A³, Ratri Retno Utami³, Dwi Indriana³

¹Faculty of Agriculture, Universitas Bosowa, Jl. Urip Sumoharjo Km. 4 Makassar, Sulawesi Selatan 90231, Indonesia

²Agricultural Product Technology Department, Faculty of Agriculture, Universitas Muhammadiyah Mataram, Jl. KH. Ahmad Dahlan, Pagesangan, Mataram, Nusa Tenggara Barat 83115, Indonesia

³Balai Besar Industri Hasil Perkebunan, Ministry of Industry, Jl. Prof. Dr. Abdurahman Basalamah No.28, Makassar, Sulawesi Selatan 90231, Indonesia

Email: andi_nur_amalia@yahoo.com

Abstract. Ternate City, North Maluku Province is a producer of nutmeg. The nutmeg that is cultivated comes from smallholder plantations. So far, post-harvest handling is still traditionally with simple equipment and poor hygienic which results in low-quality nutmeg. Efforts to improve post-harvest handling need to be done to improve the quality and farmer's income. The purpose of this activity is to provide knowledge on good post-harvest handling of nutmeg in Ternate. One of the phases of activity carried out is through a survey to farmers to identify the organoleptic properties of nutmeg, as well as testing the water and vitamin C content of the nutmeg. The test results show that the drying process is not optimal because the resulting water content does not meet Indonesian National Standard (SNI), which is above 10%. The content of vitamin C in the flesh is 22 mg. Meanwhile, the organoleptic properties found that the colour, flavour, and taste were the most preferred by the farmer in the mace, seed, and flesh, respectively. The results of this activity can provide information about the characteristics of nutmeg that have been produced by Ternate farmers as a recommendation for proper post-harvest handling of nutmeg.

1. Introduction

North Maluku Province is one of the regions in Indonesia that produces a lot of spices, including nutmeg (*Myristica fragrans* Houtt). Nutmeg is a plantation crop and is developed through smallholder plantation. Nutmeg is an export commodity where Indonesia produces about 60% of the world's total exports of nutmeg. The area of nutmeg plantations in North Maluku is 55,728 hectares with a total production of 8,567 tons in 2020. This potential is spread especially in Ternate City with an area and total production of nutmeg of 4,161 hectares and 1,006 tons, respectively [1].

Nutmeg farmers generally sell their crops in the form of seeds that are still wrapped in their shell, and mace that have been dried, while the flesh is left alone. Nutmeg flesh fruit is considered to have low economic value, so it has not been used. The benefits of nutmeg (seeds and mace) are as a spices and essential oil which are widely used in the food, beverage, and cosmetic industries. Nutmeg flesh can



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be processed into various food and beverage products such as sweets, syrup, jam, jelly, and chutney [2].

Most of the nutmeg in Indonesia is produced by smallholder plantations, which is around 99%, with traditional post-harvest handling. This traditional processing is done with simple equipment and less hygienic. These produce low quality nutmeg and affect the low price. The low quality of nutmeg is also caused by various types of nutmeg, inappropriate harvest time, poor storage, poor packaging and mixed with forest nutmeg. Incorrect harvest time when the nutmeg is still young causes the fruit to wrinkle. Meanwhile, poor storage and packaging provide opportunities for fungi to grow [3].

Post-harvest handling of nutmeg is done by separating nutmeg seeds from mace and nutmeg flesh. After that, the drying is done by drying. Delayed drying can cause microbial or pest attack so that the nutmeg and mace undergo decaying. Then de-shelled which is the process of breaking the shell and releasing the shell from the flesh of the nutmeg and done by hitting it with wooden bat. Cracking the shell using this method causes damage to the nutmeg flesh so that the quality and price decreases [4].

This problem for nutmeg farmers also occurs in the Ternate Island District, where the harvest does not provide many benefits both in terms of quality and price. The low income of farmers is mainly due to the limited knowledge and skills of farmers. The program for developing a nutmeg production center in Ternate Island District has become the goal of the smallholders through post-harvest processing. This program is carried out to help farmers improve their skills and knowledge of post-harvest processing of nutmeg. One of the stages of this program is a post-harvest survey of nutmeg in the Ternate Island District. The purpose of this activity is to provide knowledge on good post-harvest handling of nutmeg in Ternate with the benefit of giving information for the smallholder plantation regarding post-harvest handling of nutmeg.

2. Methodology

The survey was carried out in three places, namely the smallholder plantations of Kastela, Rua, and Loto Villages, Ternate Island District. The analysis of water and vitamin C content was carried out at the Khairun University Laboratory, Ternate City.

2.1. Tools and Materials

The main ingredient used in this research is nutmeg obtained from smallholder plantations. While the materials for analysis in the laboratory include distilled water, iodine solution, and 1% starch. The tools used in fruit picking are bamboo poles, knives, sacks, and ropes. While the tools for laboratory analyses include the Wess Martin oven, analytical balance, Erlenmeyer, stirring rod, dropper, glass funnel, burette, measuring pipette, beaker glass, measuring cup, and glassware.

2.2. Research Method

This research was carried out using survey methods and laboratory analysis.

2.2.1. Survey. Survey was carried out in smallholders plantations which included fruit picking, fruit collection, seed release from fruit pulp, drying, breaking of nutmeg shells, packing, storage. Furthermore, data collection was carried out by giving questions through questionnaires to nutmeg plantation owners. Panelists from the three areas totaled 8 people.

2.2.2. Laboratory Analysis. Laboratory analysis includes water content analysis by oven method, measuring vitamin C content by titration method, and sensory testing of colour, texture, and flavors of nutmeg.

2.3. Parameters

Parameters to be observed for nutmeg flesh consist of water content, vitamin C, and organoleptic tests, while for seeds and mace are water content and organoleptic tests.

2.3.1. *Moisture Content* [5].

Determination of moisture content is calculated by the difference between the weight of the material before and after drying. The sample is weighed as much as 1-2 grams and put in an oven at a temperature of 105°C for 6 hours or until a constant weight is obtained. Then weighed to know the weight and calculated by the formula (dry basis).

2.3.2. *Vitamin C* [5].

The vitamin C present in nutmeg was tested using a titration method. A total of 10 grams of the material was put into a 100 mL volumetric flask and diluted. 10 mL of filtrate was poured into an Erlenmeyer, added 5 drops of indicator, and then titrated with 0.01 N iodine solution until there was a change.

2.3.3. *Organoleptic test* [6].

This organoleptic test was carried out using a hedonic scale consisting of flavor, colour and texture of nutmeg. Panellists are farmers who are asked to fill out table sheets according to their level of preference.

2.4. *Data Analysis*

The data obtained are secondary data from literature and primary data from surveys, then data processing is carried out descriptively.

3. **Result and Discussion**

3.1. *Nutmeg Harvesting*

The nutmeg plant that is widely cultivated in Maluku is *Myristica fragrans* Houtt, because this type of nutmeg has a very high economic value than other types of nutmeg. In the Ternate city, there are 2 ways of harvesting nutmeg, the first is done with a bamboo pole with a hook or a basket at the end. This method is generally done for fruit that is easily accessible by farmers. The second way is done by climbing a tree and selecting and picking ripe nutmeg. Good quality nutmeg is produced from ripe nutmeg, which can be seen from the colour of the nutmeg skin. The brownish-yellow skin of the nutmeg indicates the fruit is ready to be picked/harvested.

One nutmeg tree produces a minimum of 200 nutmeg. Nutmeg harvesting for six months can be done two to three times on the same tree or place. Post-harvest handling is carried out at the home of the nutmeg farmer. Nutmeg that have been harvested are subjected to several treatments, such as separating the flesh from the seeds using a knife. The separation of mace from nutmeg seeds is done to facilitate the drying process. This drying process is done to facilitate the breaking process of nutmeg shell.

3.2. *Drying*

Drying is a process to remove the water from a material with heat energy sources from natural (sunlight) or artificial (dryers) [7]. The purpose of drying is to reduce the moisture content to the limit of the development of microorganisms and the activity of enzymes that can cause spoilage. Thus, the dried material can have a long shelf life [8].

After separating the flesh, mace, and seeds, then mace and seeds are dried separately under the sunlight. From field observations, farmers generally carry out drying that has been inherited from

generation to generation. The drying process which has been carried out is still maintained considering that the market does not question the quality of the product.

After drying, then proceed with breaking the nutmeg shell. To get the seed of the nutmeg, the shell must be broken by hitting it with wooden bat. The way to break the nutmeg shell requires special skills, because it can be damaged or broken the seed and produce the low quality. The seeds that have been separated from the nutmeg shell are then stored.

3.3. Storage

Storage is the activity of delaying the transfer by placing the material in one place. Storage of agricultural materials usually aims to wait for the right time to move and wait for increasing the selling prices [9]. During storage, the quality of agricultural products will continue to change over time. Storage activities determine the quality of the product. The storage of mace and nutmeg is usually done simply. Nutmeg that has been sorted is packed using two layers of burlap sacks, with the average weight per pack as follows, de-shelled bald nutmeg per bag contains about 90 kg, de-shelled nutmeg wrinkled per bag contains about 80 kg, and de-shelled nutmeg crushed per bag contains about 75 kg. Especially for mace storage, it is usually done in wooden crates, but farmers in the Ternate Island sub-district use rice sacks. This storage is done to simplify the sales process to producers. Nutmeg and mace that have been packaged are then sold at special sales places, if there is a decrease in prices, farmers prefer to keep their harvests until the selling price of nutmeg rises.

3.4. Nutmeg Seed Quality

Quality standards for nutmeg flesh, seeds and mace in Indonesia are based on SNI 01-0006-2004, as listed in Table 1.

Table 1. Nutmeg quality requirements

No	Type of Test	Unit	Requirements
1	Moisture content (mass fraction)	%	Max. 10
2	Moldy seeds / mace	%	0
3	Death insects	-	-
4	Live insects	-	-
5	Others	%	0,5

Source: [10]

However, this quality requirement is not applied in the sub-district of the island of Ternate. The market of nutmeg at the farmer level are determined based on the dry weight.

3.5. Water Content Properties

The water content will determine the shelf life of a product, high water content will shorten the shelf life of the product because microbes grow fast [11]. The water content analysis is intended to determine the water content in flesh, seeds, and mace. Water is an important component in food ingredients because it can affect the appearance of the texture and taste of food [12]. The higher the water content in the flesh, seeds, and mace the lower the quality of the product [13].

The high-water content in nutmeg has the potential to occur due to the fast-drying process [14]. This is because nutmeg farmers only know that the nutmeg seeds are dry by looking at the separation of the seeds from the nutmeg shell [15]. The results showed that the water content in flesh was 10.15%, seeds was 33%, and mace was 17.5%. The value of the moisture content of seeds and mace is higher than the value of the water content specified in SNI. The high-water content in both samples was due to the drying process being too fast. To avoid high water content in the accompaniment process, it is better if the seeds and mace are dried until they are completely dry and following SNI.

3.6. Organoleptic Properties

Organoleptic test or sensory test is a test method using the human senses as the main tool for measuring product acceptance. Organoleptic testing has an important role in the application of quality and can indicate spoilage, deterioration, and other defects of the product [16].

The preference test is also known as the hedonic test, where the panellists are asked for their responses about their likes or dislikes of the sample being tested. In addition to the panellists expressed a like response, or the opposite, they also expressed a level of preference called the hedonic scale. These representations include very much like, like, and, somewhat like. Vice versa, if the response does not like it can have a hedonic scale such as likes and somewhat likes, there is also a response that is referred to as neutral, which is neither like nor dislike [17, 18].

The test was conducted based on the preference test on the texture, colour, and flavor. This test is used by untrained panellists. Panellists were asked to express their opinion spontaneously, without comparing with the standard sample or samples previously tested [17].

3.6.1. Colour

Food quality generally depends on several factors. These factors include taste, texture, nutritional value, microbiology and colour. Colour is one of the parameters in the main preference test in determining whether a food item will be consumed or not before considering other factors. Visually, the colour factor will appear first [19]. Foodstuffs are considered to contain high nutritional value, taste good and have a good texture, but consumers will not like them if they have a distorted colour [20]. The results of organoleptic tests on the colour of flesh, seeds and mace can be seen in Figure 1.

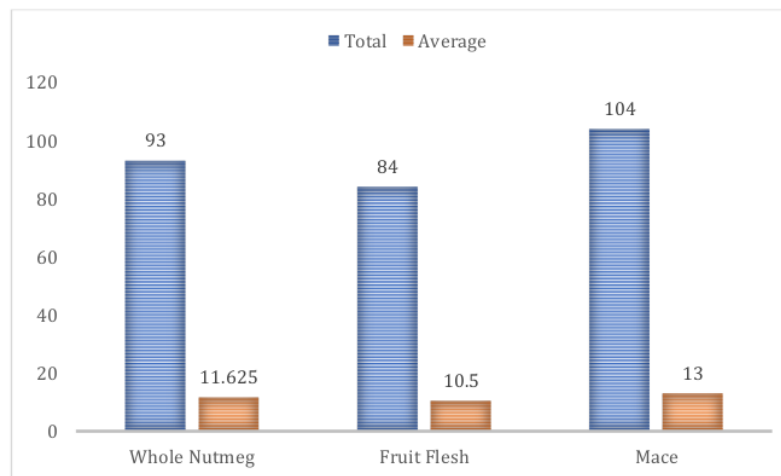


Figure 1. Result of colour properties

The test results show that there is a difference in colour preference where the most preferred sample is mace. Panellists like mace nutmeg because the colour mace is so red in addition to being red mace nutmeg shaped like a net so panellists like the colour mace [21].

3.6.2. Flavor

The delicious taste of food is determined by the smell or flavor of the food itself. Consumers will accept a food product if it has a flavor that does not differ from the normal flavor [22]. Determination of smell is related to the sense of smell. With the sense of smell, a person can recognize the taste of food from a distance without tasting it directly. In general, the smell received by the nose is a mixture of four main odours, namely flavor, sour, rancid, and smoky [19]. This flavor test is important in the food industry because it can provide quick assessment results whether the product is liked or not [19, 22]. The results of organoleptic tests on the flavor of flesh, seeds and mace can be seen in Figure 2.

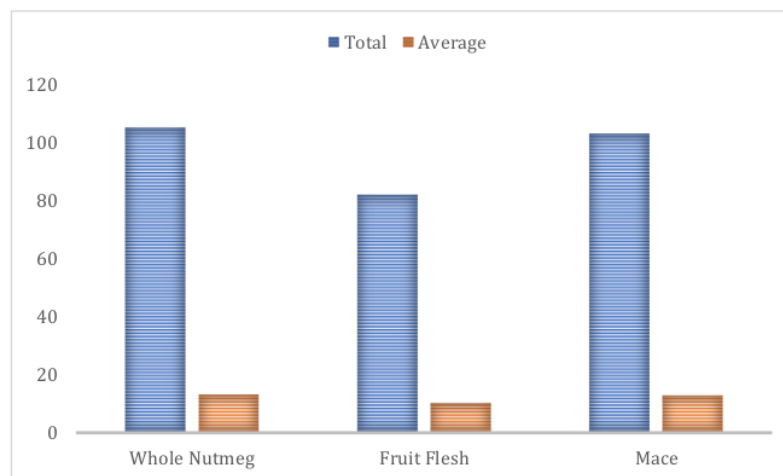


Figure 2. Result of Flavor Properties

The results of organoleptic testing on flavor showed that the panellists preference for the most preferred sample was seeds, because nutmeg seeds have a very fragrant flavor (typical of nutmeg). Although the nutmeg seeds have undergone a drying process, the flavor from the seeds still smells typical of nutmeg. This is not the case for mace and nutmeg flesh, for mace that has undergone a drying process the flavor will begin to decrease, not as fragrant as when it is still fresh, while for nutmeg flesh, the flavor of nutmeg flesh is not as fragrant as seeds and mace due to the flavor of fruit flesh containing high acid.

3.6.3. Texture

A surface may be rough, smooth, hard, or soft, rough, or slippery [24]. The texture is a tactile value character that can be felt physically and artificially/imaginary. A rough texture when physically touched does show a rough surface, while a pseudo-texture is only visible, its character is rough but when it is touched it cannot be felt as seen so that this kind of texture only gives an imaginative impression to the feeling. The use of texture is more technical in nature to realize the touch value by the expected character of the object. The results of organoleptic tests on the texture of flesh, seeds and mace can be seen in Figure 3.

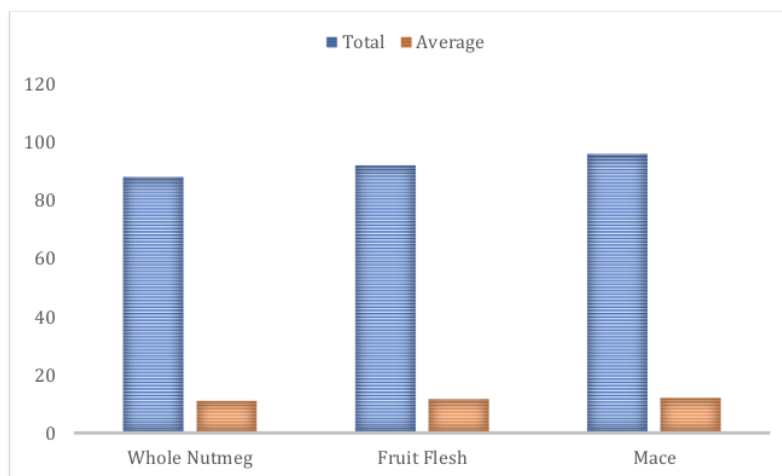


Figure 3. Result of Texture Properties

The results of organoleptic testing on texture showed that the most preferred sample was mace. The panelists level of preference for mace nutmeg is because mace nutmeg has a slippery texture and is easy to separate from nutmeg seeds. Nutmeg flesh has a hard flesh texture that is almost the same as a pear fruit. With a hard texture, some farmers use the flesh of fruit to make sweets, but some nutmeg farmers in the district of Ternate Island let the nutmeg flesh rot because it has no economic value.

3.7. Vitamin C

The active compounds in nutmeg include minerals, Vitamin A, Vitamin B, vitamin C, folic acid, riboflavin, niacin, and flavonoids [25]. Seed or fruit shell usually contain phenolic and potential as cheaper sources of antioxidants [26]. Vitamin C or ascorbic acid is a water-soluble vitamin and has an important role to prevent from various diseases. Vitamin C is an antioxidant that can scavenge extracellular free radicals. Vitamin C has properties as a strong reducing agent and it is easily oxidized which is catalyzed by several metals, especially Cu and Ag [27].

The results showed that the vitamin C content in the fruit flesh was 22 mg, this study is in line with previously research [28].

4. Conclusion dan Suggestion

4.1. Conclusion

Harvesting of Ternate nutmeg is carried out twice a year. Post-harvest handling, namely drying is still done conventionally with the help of sunlight, which results in dry nutmeg that is not meet with the SNI requirement.

4.2. Suggestion

Harvesting of nutmeg should be done in a state of ripe fruit. Drying must be carried out until it meets with the SNI requirement, namely a maximum water content of 10%. This needs to be supported by water content analysis tools and improvement of the drying process to obtain good quality and increase the selling price of nutmeg.

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