Conference Paper

Organoleptic Characteristics of Cookies from Sorghum Composites Flour

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Abstract

Application of wheat flour in various food products has increased the import of wheat flour over years. The use of domestically grown crops like Sorghum (*Sorghum bicolor* L. Moench) could reduce the demand of wheat. Sorghum flour can be used in partial substitution with wheat flour for many food products, like *cookies*. The use of sorghum as *cookies* ingredient could be combined with other flours to get a composite flour. The purpose of this research was to obtain proportion of sorghum flour, sweet potato flour and soyabean flour that produce cookies with good organoleptic characteristics. The proportion of composite flour adequacy was calculated using a list of foodstuffs (DKBM).The research method was based on *Experimental Method* with Randomized Block Design (RBD) in twelve treatments and two repetitions. The treatments were proportion of sorghum flour (6 minutes, 8 minutes, 10 minutes of dehulling time), sweet potato flour, and soyabean flour. The results showed that *cookies* made with proportion of sorghum flour, sweet potato flour, and soyabean flour gave no significant difference in organoleptic characteristics (Overall, color, taste, aroma, and hardness). The result also showed that the characteristics of the cookies were not affected by dehulling of sorghum grains but influenced by other ingredient than flour.

Keywords: Sorghum, Sweet Potato Flour, Soyabean Flour, Cookies, Sensory Properties.

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1. Introduction

Wheat is one of the largest imported commodities that are processed into wheat flour. A large number of wheat-based products such as noodle, bread, cookies, etc cause Indonesia to be addicted to wheat. The import of wheat as the raw material of wheat flour is increasing from year to year, minimum at 8%. In 2013, the import of wheat from various countries reached 6, 2 million tons [1].

An effort that could be done to press the consumption of wheat flour is by giving alternative flours from local resources, one of them is sorghum. Sorghum (*Sorghum bicolor* L. Moench) is a cereal commodity that is not very popular among Indonesian

people. Sorghum contains nutrition as much as that of rice, wheat, and corn. Sorghum is one source of carbohydrate that is easily cultivated. In every 100 gram of sorghum's seed, there are 73.0 gram of carbohydrate, 332 cal., 3.3 gram of fat, 11 gram of protein, and another types of nutrition [2]. One kind of sorghum that is used in this research is a Bandung local variety of white sorghum that can produce flour that resembles wheat flour. In principle, the aim of milling is to eliminate the pericarp that can produce a rough texture to food products produced [3].

Sorghum seeds can be processed into flour and useful as a flour substitute material. Therefore, the development of sorghum is quite prospective in order to fulfil the needs of local flour [4]. Utilization of sorghum flour as a raw material in the manufacture of cookies can be combined with flour derived from other materials so it becomes composite flour. Shortage of quality protein in sorghum flour can be supplemented by other flour that has a protein rich of amino acids, such as flour derived from nuts. Nuts have long been known in Indonesia as a source of protein about two to three times greater than cereals. One local food sources of protein that can be used are soybean because it is relatively inexpensive compared to animal protein sources. Soybeans have a high protein value (35-38%) with the lysine amino acid content of 6.25%, so it is important to complement the content of the nutritional value of protein deficiency materials. Sweet potato is one of the local commodity in Indonesia which is abundant at around 2.4 million tonnes / year [5]. So far, sweet potato is fried, steamed or baked, so it has a fairly low economic value. Diversified utilization and increase the added value of sweet potato can be done through processing into semi-finished products, such as sweet potato flour which can then be used as a substitute for wheat flour in making cookies. In this research, the flour that will be combined with sorghum flour is soy flour and sweet potato flour. Sorghum seeds that do not contain enough gluten in the protein cause sorghum flour to be more suitable for making cookies where in the making of cookies the dough development is not expected. Cookies is one kind of snack that attracted many people.

The use of sorghum flour as an ingredient for food products is not common in Indonesia. To improve the usefulness of sorghum as processed food products, it is needed to know the maximum limit of the addition of sorghum flour [6]. The purpose of this research was to obtain proportion of sorghum flour, sweet potato flour and soyabean flour that produce cookies with good characteristics and accepted by consumers. Organoleptic characteristics observed include overall appearance, colour, taste, aroma, and hardness.

2. Materials and Method

Table 1: Formulation of Ingredients Used in Sorghum Cookies Making.

Ingredients	Amount (grams)
Flour*	100
Margarine	57.14
Sugar flour	43
Egg yolk	8.02
Skimmed milk powder	4.29
Baking powder	0.35
Salt	0.35
* sorghum flour, sweet potato flour and soyabean flour	

Table 2: Ratio of Composite Flour.

Treatments	Dehulling time of sorghum grains	Sorghum flour (g)	Sweet potato flour (g)	Soyabean flour (g)
A	6 minutes	70	10	20
B		60	20	20
C		50	30	20
D		40	40	20
E	8 minutes	70	10	20
F		60	20	20
G		50	30	20
G		40	40	20
I	10 minutes	70	10	20
J		60	20	20
K		50	30	20
L		40	40	20

2.1. Materials

Sorghum flour was obtained from sorghum seed milled with dehulling time for 6 minutes, 8 minutes, and 10 minutes. Meanwhile, sweet potato flour and soybean flour were their commercial brands. The fineness of sorghum flour used was 80 mesh, while the amount of soy flour used in all the balance remains in compliance with the secondary data. Others ingredients were bought at supermarket at Jatinangor. The formulation of ingredients used can be seen in Table 1.

2.2. Methods

Steps taken in this research included making sorghum flour, determining proportion of sorghum flour, sweet potato flour, and soy flour, and making cookies from the proportion that has been determined. Hedonic test was used to determine the proportion

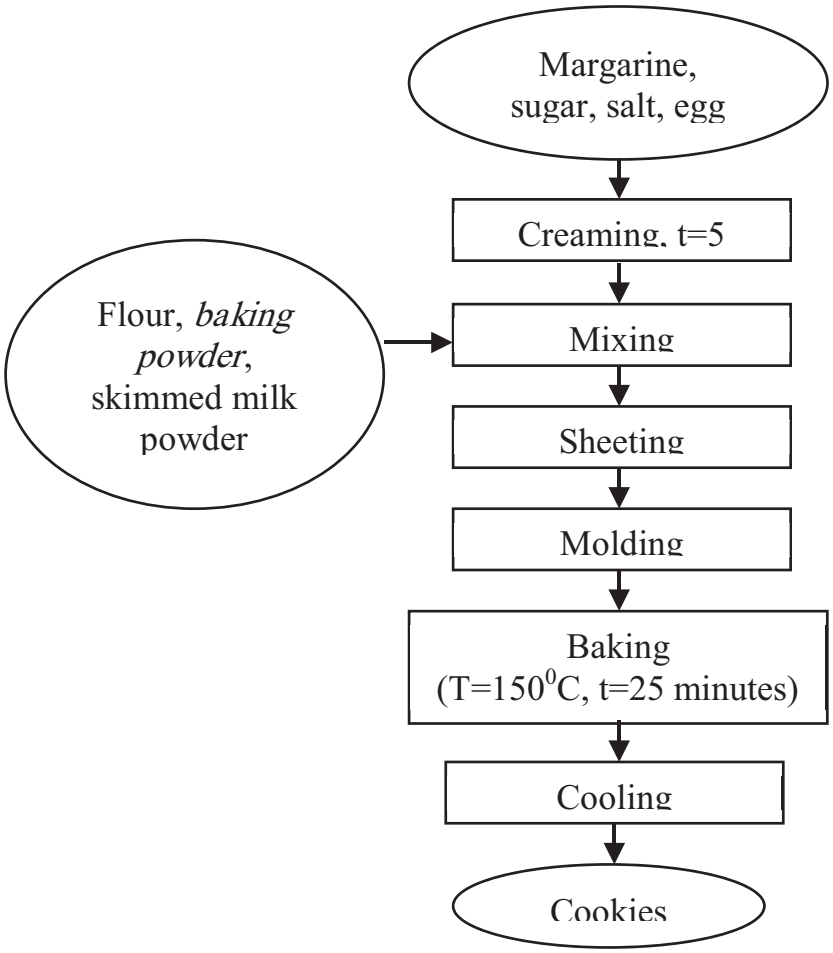

Figure 1: The Process of Making Cookies [12].

that will be used. The process of making cookies from composite flour is given in Figure 1.

2.3. Organoleptic Testing

Organoleptic testing to the cookies proportion of sorghum flour obtain from various milling times with sweet potato flour and soy flour was done by hedonic test. The hedonic test was conducted to determine the level of panellists' reference to some treatments so it can be known the treatment that was most preferred by panellists. Hedonic test performed in this study used 15 semi-trained panellists with organoleptic parameters include overall appearance, colour, taste, aroma, and hardness.

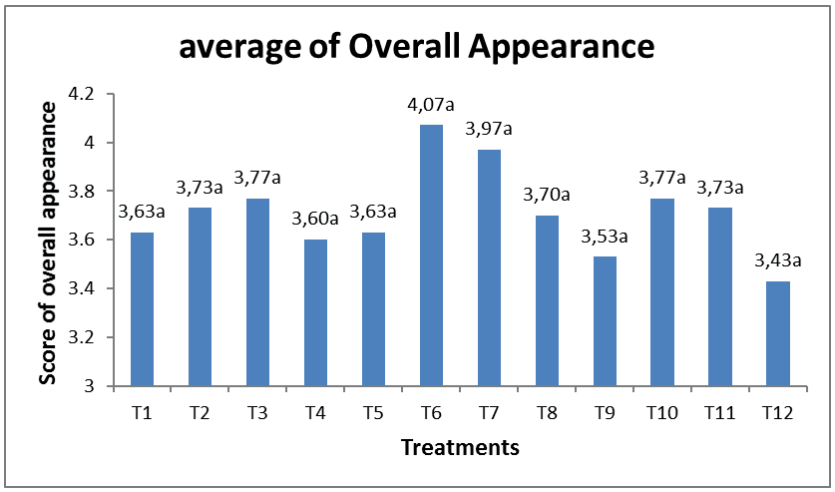

Figure 2: Score of overall appearance at different treatments. Means with different superscripts are significantly different ($p \leq 0.05$).

2.4. Statistical Analysis

The research method based on *Experimental Method* with Randomized Block Design (RBD) in twelve treatments and two repetitions. The treatments were various proportion of sorghum flour (6 minutes, 8 minutes, 10 minutes of dehulling time), sweet potato flour, and soybean flour (Table 2).

3. Result and Discussion

Statistical Analysis showed that proportion of sorghum flour, sweet potato flour, and soyabean flour gave non-significant effect on organoleptic characteristics (overall appearance, colour, taste, aroma, and texture).

Based on Figure 2, the treatment given did not give significant effect to the overall appearance of cookies. The average value of panellists' fondness to the overall appearance of cookies ranged from 3.43 to 4.06 which show the overall appearance produced from each treatment; assessed from rather like to like by panellists.

No significant difference effect of sorghum flour's proportion from various time of milling period with sweet potato flour and soy flour to the level of fondness to the overall appearance. It is because cookies from each treatment have the same colour, appearance, and size and also have no defect in cookies. Cookies colour that was assessed identical can be seen from the results of hedonic test of cookies towards colour's fondness in which treatments given provided similar effects. The same shape and size of cookies due to cookie dough moulding process was done by using the same mould, so that after the baking process the cookies shape produced was similar. In addition, no damage or defects in the entire treatment of cookies causes panellists

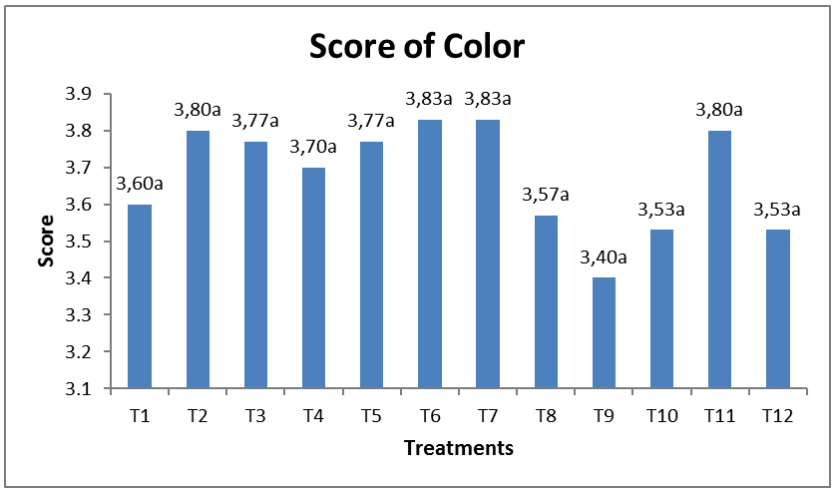

Figure 3: Score of color at different treatments. Means with different superscripts are significantly different ($p \leq 0.05$).

finally give a good assessment (from rather like to like) to the overall appearance of cookies. Proportion sorghum flour, sweet potato flour, and soy flour did not give effect to the colour, and shape, and does not give damage to cookies so the score of overall appearance of cookies obtained was similar.

Proportion composite flour that did not affect the overall appearance was also found in Widianingsih research [7]. Proportion banana weevil flour, sweet potato flour, and mung bean flour does not give significantly different effect to the fondness of cookies overall appearance, in which the average value generated was from dislike to rather like. This result is also similar to Okpala and Okoli [16], where the addition of sorghum flour by 16.7%, 33.3%, and 50% did not give a significantly different effect to appearance of composite cookies.

Based on Figure 3, the average value of panellists' fondness to cookies colour ranged from 3.40 to 3.83, which showed the colour produced from each treatment assessed rather like. Based on the assessment of panellists, the rather like value was based on cookies colour that was yellowish brown.

The treatment given did not give a significantly different effect due to supporting materials that also contributed to the cookies colour. Materials that affected the colour of cookies was primarily sugar and skim milk. Sugar affects the cookies colour because it is related to browning reaction that occurs during the roasting. The browning reaction that occurs during the time happens as the result of non-enzymatic reactions, which are Maillard and caramelization reactions [8]. Caramelization reaction is a complex reaction happened as the result of heating on carbohydrates (sucrose and reducing sugars). This reaction produces compound with conjugated double bonds which absorbs colour so that their products have dark colour [9]. According to Manley [10] protein in skim milk contributes to the Maillard reaction which affects the colour

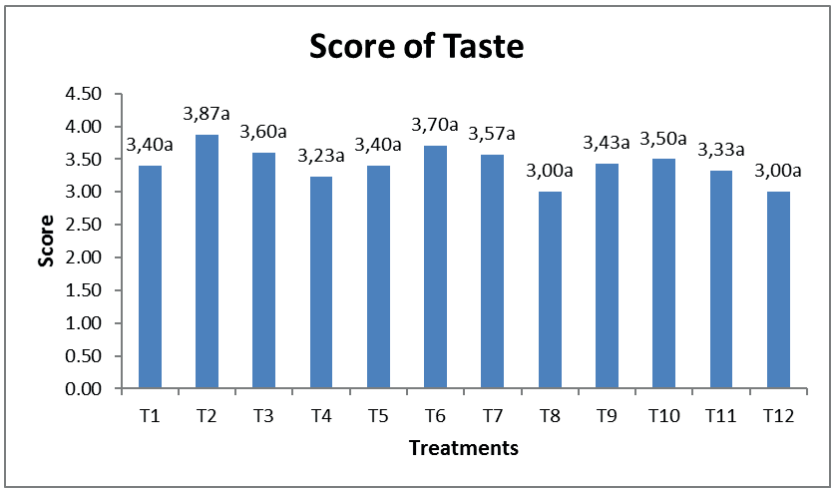

Figure 4: Score of taste at different treatments. Means with different superscripts are significantly different ($p \leq 0.05$).

of cookies. Maillard reaction is the reaction between the amino acids from protein with reducing sugars which produce coloured compound, where the dark colour will increase along with the increasing temperature and time of roasting.

Based on Figure 4, treatment given did not give significant effect to the taste of cookies. The average value of panellists' fondness to cookies taste ranging from 3.00 to 3.87 which showed that the taste produced from every treatment assessed was rather like. Based on panellist' appraisement, rather like value was based on sweet and savoury taste of cookies. The treatment given did not give a significantly different effect due to cookies taste is rather affected by supporting materials used especially margarine and sugar.

Margarine has a fat content and protein that cause savoury flavours in cookies produced. According to Winarno [11], the cause of the taste increase from a food product is determined by the amount of protein and fat in the product. The statement is supported by Fellow [12] which states that the protein content of a food ingredient is fairly high correlated with consumers' assessment, especially in terms of taste.

The addition of sugar to cookies dough causes cookies to have sweet taste. Sugar that is used in making cookies is sucrose, which is a disaccharide composed of fructose and glucose. Sucrose is soluble in water and has a high level of sweetness so that is often used as a sweetener [11].

The addition of sugar is very influential on the taste of cookies produced. Based on Dewi's research [13], the treatment of sugar concentration gives a significantly different effect to the fondness of cookies sorghum taste, where the higher the concentration of sugar, the higher the fondness value of cookies. It is also supported by Matz and Matz [8] which found that cookies have distinctive flavour, which is sweet.

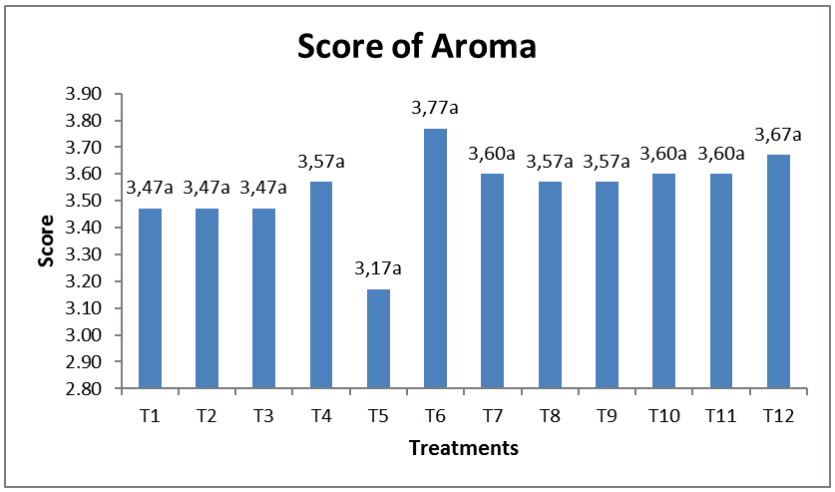

Figure 5: Score of aroma at different treatments. Means with different superscripts are significantly different ($p \leq 0.05$).

Therefore, the addition of sugar in the manufacture of cookies will affect the taste of cookies produced.

Flavour that is generated, besides comes from sugar added, also comes from starch gelatinization due to heating. According to Nurhasanah [14], substitution of wheat flour by arrowroot starch as much as 100%, 80%, 70%, 50%, and 30% does not give a different effect on the taste of cookies produced. Starch gelatinization will result in the increase of the solubility and digestibility of starch. Decomposition of starch by α-amylase enzyme found in saliva will produce the sugars that will give or add a sweet taste to cookies [14].

The establishment of flavour on cookies is also influenced by the roasting process. Maillard reaction occurs when the roasting process happens, where the reaction between proteins with carbohydrates occurs due to heating and produces the final product that is melanoidin, the main compound in the form of cookies colour and flavour [10]. The formulation of supporting materials has the same percentage, and also the roasting process on all treatments uses the same method. Therefore, there is no difference in the level of preference for the taste of cookies.

Based on Figure 5, the treatment given did not give a significantly different effect to cookies aroma. The average value of panellists' preference to the aroma of cookies ranging from 3.16 to 3.76 that shows aroma produced from every treatment was assessed rather like. Based on panellists' assessment, the rather like value was based on cookies aroma that was typical like cookies and there was little aroma of margarine.

Aroma is not only determined by one component, but by several certain components which cause typical odor [11]. The treatment given does not give a significantly different effect due to supporting materials that give greater contribution to cookies aroma than the main material, which are sorghum flour, sweet potato flour, and soy

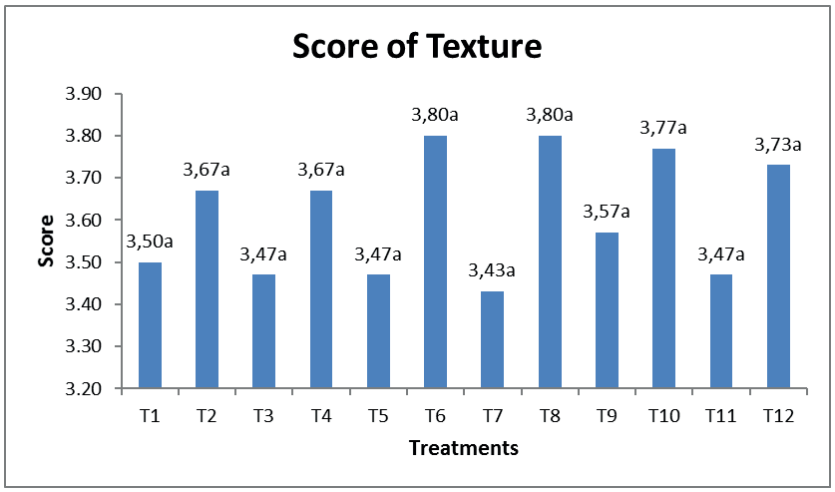

Figure 6: Score of texture at different treatments. Means with different superscripts are significantly different ($p \leq 0.05$).

flour. The three types of flour do have a distinctive aroma, but when the flour was combined with other ingredients which have greater amount to make a food product so that the aroma contained in flour could no longer smell on products produced. Thus, the proportion of sorghum flour, sweet potato flour, and soy flour does not affect the aroma of cookies.

The higher the addition of margarine and sugar on corn cookies will affect the aroma of cookies so it is more preferred by the panellists. However, by the addition of these materials, the aroma of corn flour became did not smell [15]. According to Van Beynun [16], common cereal starch (corn, wheat, sorghum, and rice) has a distinctive aroma of raw seeds. Similar results were also seen in Dewi's research [13], that cookies made from sorghum flour substitution have the same scent, where the aroma smelled comes from supporting materials in cookies, but the most prominent aroma is that of margarine. Similar to the study, cookies aroma produced in this research was also affected by materials used, such as margarine, skim milk, and sugar.

Margarine is an emulsion of water and oil (w / o) with a minimum fat content of 80%. Fats used in margarine derived from vegetable or animal fats. Margarine is a butter substitute with taste, aroma, appearance and nutritional value that are almost the same. Margarine when roasting will melt and produce a fragrant aroma [11].

According to Belitz et al [17], the emergence of aroma on bakery products can be caused by the Maillard and caramelization reactions. Volatile compounds as the products of caramelization reaction generally are in the form dihydrofuran-ones, cyclopentenolones, cyclohexenolones, and pyrones. Maltol compound that has caramel flavour can also arise from heating or caramelization maltose. With the existence of the same components and processing, the aroma generated in each treatment is equal and cannot be distinguished by the panellists.

Based on Figure 6, the treatment given did not give a real impact on cookies hardness. The average value of panellists' fondness to cookies hardness ranging from 3.43 to 3.80 that shows taste that is produced from every treatment is assessed rather like. According to panellists assessment, the rather like value was based on cookies hardness that was good enough, not difficult to be broken yet not crumbly. The treatment given did not give effect which was significantly different due to cookies hardness was more affected by moisture and supporting materials used, such as sugar and fat (margarine).

The water content in the product can affect the hardness of the product. Cauvian and Young [18] described that the increase in the amount of water content in a product can reduce the hardness value because the loss of its crispness characteristic. Sugar that is added in the making of cookies does not only affect the taste of cookies, but also the hardness. Sugar (sucrose) in cookie's dough is soluble in water then will experience recrystallization or produce amorphous form after roasting. The higher the sugar content, the texture of the cookies will be increasingly hard [10]. As previously described, fat also affects the structure of cookies. The higher the fat content, the hardness value will decrease. Sugar and fat added in the making of sorghum cookies, the amount and the water content for all treatment is believed to be the same so that the hardness value produced was no difference.

Proportion of composite flour that does not affect the hardness fondness is also found in Widianingsih research [7]. The proportion of banana weevil flour, sweet potato flour, and mung bean flour does not give a significantly different effect to the fondness of cookies hardness, where the average value produced is ranging from dislike to rather like. The result is also similar to that of Okpala and Okoli research [19], where the addition of sorghum flour by 16.7%, 33.3%, 50%, and 66.6% does not give a significantly different effect to the texture of composite cookies.

4. Conclusion

Significant ($P \leq 0.05$) variations were not found among cookies prepared with different proportion of sorghum flour (6 minutes, 8 minutes, 10 minutes of dehulling time), sweet potato flour, and soyabean flour with respect to their overall appearance, colour, taste, aroma, and hardness. However, all over organoleptic characteristics were slightly prefered by panelist.

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