Organoleptic properties of functional powdered drink products based on palm sugar

I S Rianse¹, U Rianse¹, S Wahyuni¹, W Gusmiarty¹, RH F Faradilla¹*, Zulfikar¹, W K Baka², Tamrin¹, K Fatmala¹, Sarbia¹, Nofiana¹, K Astuti¹, Erawati¹ and A Ramadhan¹

¹Faculty of Agriculture, Universitas Halu Oleo, Kendari, Southeast Sulawesi, Indonesia
²Faculty of Cultural Science, Universitas Halu Oleo, Kendari, Southeast Sulawesi, Indonesia

E-mail: *fitrifaradilla@uho.ac.id

Abstract. This study aimed to characterize the organoleptic properties of functional powdered drinks based on palm sugar. The drinks were prepared with palm sugar as the main matrix and spices in several concentrations as additional flavour. The spices were cinnamon, clove, lemongrass, red ginger and ginger. Type and concentration of the spices greatly affected the sensory properties and hedonic level of the drink products. In general, panellists preferred products with darker brown colour and mild spice flavour. Some spices, such as cinnamon and lemongrass increased the brown colour intensity. Among all tested samples, only lemongrass and red ginger flavored palm sugar drinks were liked by panelists for all studied parameters (colour, aroma and taste). Ginger flavored samples also got relatively high preference score for almost all sensory categories. However, the taste of ginger was found to suppress the unique sweet taste of the palm sugar. Therefore, special attention should be made to the amount of added ginger to preserve the distinctive flavour of palm sugar.

1. Introduction

Palm sugar is a sweetener derived from palm trees, especially from the species of Arenga pinnata [1]. This sugar has a unique aroma, flavour and brown colour, which distinguish it from Table sugar. Heat treatment to the sap of palm trees during palm sugar production triggers the Maillard reaction that is responsible for the unique properties of the palm sugar [2]. Because of these distinctive organoleptic properties, palm sugar is largely used in Indonesian traditional sweet cuisines. In South East Sulawesi for example, palm sugar is produced by about 2,577 ton in 2015 and 2,278 ton in 2016 [3].

Despite its popularity in Indonesia, demand for palm sugar is still lower than that of refined sugarcane [4]. Palm sugar is mostly absorbed by small food ventures as a sweetener for handmade culinary. There are only small number of mass-produced processed foods that use palm sugar as the sweetener. As a result, palm sugar producers could only sell their products to the traditional market with limited income.

New product development based on palm sugar is important to increase the value and demand of this sweetener. However, most of the attempts only focus on the substitution of refined cane sugar
with palm sugar, such as in chocolate products [5], juices [6] and cream cheese [7]. Food products with palm sugar as the main matrix are still scarce.

Palm sugar itself is known to have an antioxidant effect and source of iron [8-11]. Thus, this sugar is potential as an ingredient for functional food. Therefore, this research aimed to develop functional powdered drink with palm sugar as the main matrix and spices as the additional flavour. This paper will focus on the organoleptic properties of the drink products. Spices used were cinnamon, clove, lemongrass, red ginger and ginger. These spices were expected to not only contribute to flavour, but also to the functional properties of the product since these spices are also known to have bioactive compounds, which are effective as an antioxidant and antimicrobial agents [12-14].

2. Materials and methods

2.1. Materials
Palm sugar was obtained directly from the producers in Muna Island, South East Sulawesi, Indonesia. Cinnamon, clove, lemongrass, red ginger and ginger were purchased from local markets. Cinnamon and clove were in dried form, while lemongrass, red ginger and ginger were fresh.

2.2. Preparation of the spices
Cinnamon was cut into small cubes and washed with water. Washing was necessary because cinnamon was sold without packaging. The cinnamon pieces were then drained and sun-dried for 5 minutes. After that, they were roasted for 3 minutes. The roasted cinnamon was crushed and sifted to form a cinnamon powder. Cloves were prepared in the same manner with cinnamon, except they did not need to be washed. Fresh red ginger and ginger were peeled and washed. Lemongrass was also washed before use. The lemongrass, peeled red ginger and peeled ginger were then shredded. Table 1 lists the concentration of added spices. The concentration was varied between spices because based on our preliminary research, a small amount of cinnamon and clove was enough to give a strong flavour, while the other spices produced a noticeable flavour at a higher concentration.

| Flavour    | Code | Concentration (% w/w) |
|------------|------|-----------------------|
| Cinnamon   | Cn1  | 1                     |
|            | Cn1.5| 1.5                   |
|            | Cn2  | 2                     |
| Clove      | Cl1  | 1                     |
|            | Cl1.5| 1.5                   |
|            | Cl2  | 2                     |
| Lemongrass | L10  | 10                    |
|            | L15  | 15                    |
|            | L20  | 20                    |
| Red Ginger | RG7  | 7                     |
|            | RG10 | 10                    |
|            | RG15 | 15                    |
| Ginger     | G10  | 10                    |
|            | G15  | 15                    |
|            | G20  | 20                    |
2.3. Preparation of the palm sugar powdered drinks

2.3.1. Palm sugar powdered drink with cinnamon or clove flavour. A block of palm sugar was sliced and weighed for 100 g. The sugar was heated and stirred for 25 minutes or until it was melted and thick. Cinnamon or clove powder was added according to the treatments (Table 1). Heating and stirring were continued for another 20 minutes. At this point, sugar crystals were started to form. The mixture was removed from the heat and stirred until it reached room temperature. The stirring should be continued during the cooling process to avoid the formation of large crystals. The samples were then ground and stored in airtight packaging.

2.3.2. Palm sugar powdered drink with lemongrass, red ginger, or ginger flavour. Sliced palm sugar (100 g) was heated until it was melted. The grated lemongrass, red ginger, or ginger was added to the melted sugar according to the treatment (Table 1). The mixture was kept heated and stirred until sugar crystals were formed. After that, the heat was removed from the mixture. Stirring was continued until it reached room temperature and the samples were ground and packed.

2.4. Organoleptic test

An organoleptic test was done in two sections. The first test was to describe the properties of the powdered drink (colour, aroma, taste and texture), while the second was the hedonic test (the preference level of the colour, aroma and taste parameters). Both of the tests were conducted to 12 untrained panellists using a five-point categorical scale, which was:

1. Descriptive study
   a. Colour : 1 = very light brown, 2 = light brown, 3 = slightly brown, 4 = brown and 5 = dark brown
   b. Aroma : 1 = spices aroma undetected, 2 = spices aroma slightly detected, 3 = slightly spices-like aroma, 4 = spices-like aroma, 5 = spices aroma detected very much.
   c. Taste : 1 = not sweet at all, 2 = not sweet, 3 = slightly sweet, 4 = sweet, 5 = very sweet.
   d. Texture : 1 = very coarse, 2 = coarse, 3 = slightly fine, 4 = fine, 5 = very fine.

2. Hedonic study
   1 = very dislike, 2 = dislike, 3 = neutral (neither like nor dislike), 4 = like, 5 = very like

Each 20 g sample was diluted in 100 mL of hot water (80°C) in a vacuum insulated bottle. Within one hour, the drink was served warm to each panellist. The texture of the powdered drink was evaluated by asking the panellists to rub the powder between their fingers and decide how fine the powder was.

3. Results

3.1. Cinnamon flavour

Table 2 shows the results of the sensory test of the palm sugar drink which was added with cinnamon. There were three different concentrations of the added cinnamon: 1, 1.5 and 2% (w/w). The brown colour of the palm sugar drink tended to be darker with an increase in cinnamon concentration. Change in the aroma of the drink was not distinctive between formulations. All of the cinnamon flavored drink had a cinnamon-like aroma. Taste of the drink was between slightly sweet to sweet. This showed that the ratio between sugar and water was appropriate (neither too sweet nor too plain). The amount of the cinnamon also did not affect the granule size of the drink since the texture of all samples was the same, which was slightly fine.

Table 2 also shows the preference level of the panellists on the colour, aroma and taste of the samples containing cinnamon. In general, panellists’ preference was between neutral (neither like nor dislike) and like. They favour the colour of Cn2, which contained 2% cinnamon, but prefer the taste of Cn1. The colour of the Cn2 was browner than the other two samples. This may be the reason why the
panellists like the colour of this sample. However, the panellists seemed to less favour the taste of cinnamon, so that they like the sample that contained the least amount of this spice.

Table 2. Sensory properties of cinnamon flavoured samples

| Properties       | Samples       | Cn1   | Cn1.5  | Cn2   |
|------------------|---------------|-------|--------|-------|
| colour           | score (SD)    | 3.3 (0.8) | 3.6 (0.8) | 3.8 (0.9) |
| Category         |               | Slightly brown | Brown   | Brown |
| aroma            | score (SD)    | 4.0 (0.4) | 4.0 (1.0) | 3.8 (1.3) |
| Category         |               | Cinnamon-like | Cinnamon-like | Cinnamon-like |
| taste            | score (SD)    | 3.7 (1.1) | 3.4 (1.2) | 3.8 (1.0) |
| Category         |               | Slightly sweet | Slightly sweet | Slightly sweet |
| texture          | score (SD)    | 2.8 (0.9) | 2.8 (0.9) | 3.1 (1.3) |
| Category         |               | Slightly fine | Slightly fine | Slightly fine |

Hedonic

| colour           | score (SD)    | 3.3 (0.9) | 3.3 (0.9) | 3.6 (0.9) |
| Category         |               | Neutral* | Neutral | Like |
| aroma            | score (SD)    | 3.4 (0.8) | 3.1 (1.0) | 2.9 (1.2) |
| Category         |               | Neutral | Neutral | Neutral |
| taste            | score (SD)    | 3.8 (0.8) | 3.2 (0.9) | 3.2 (0.9) |
| Category         |               | Like | Neutral | Neutral |

*Neither like nor dislike

3.2. Clove flavour
The sensory properties of the palm sugar drink with added clove are presented in Table 3.

Table 3. Sensory properties of clove flavoured samples

| Properties       | Samples       | C11   | C11.5  | C12   |
|------------------|---------------|-------|--------|-------|
| colour           | score (SD)    | 2.8 (0.9) | 2.9 (1.0) | 2.4 (0.7) |
| Category         |               | Slightly brown | Slightly brown | Not brown |
| aroma            | score (SD)    | 2.9 (0.6) | 3.0 (0.8) | 2.5 (0.8) |
| Category         |               | Slightly clove-like | Slightly clove-like | Slightly clove-like |
| taste            | score (SD)    | 3.8 (0.9) | 4.1 (0.6) | 4.0 (0.9) |
| Category         |               | Sweet | Sweet | Sweet |
| texture          | score (SD)    | 2.8 (1.3) | 3.3 (0.9) | 3.5 (0.9) |
| Category         |               | Slightly fine | Slightly fine | Fine |

Hedonic

| colour           | score (SD)    | 3.3 (0.7) | 3.4 (0.7) | 3.1 (0.8) |
| Category         |               | Neutral* | Neutral | Neutral |
| aroma            | score (SD)    | 3.3 (0.7) | 3.5 (0.8) | 2.9 (1.0) |
| Category         |               | Neutral | Like | Neutral |
| taste            | score (SD)    | 3.8 (0.9) | 3.5 (0.9) | 3.3 (1.2) |
| Category         |               | Like | Like | Neutral |

*Neither like nor dislike

Amount of added clove was the same with the amount of added cinnamon, which was 1, 1.5 and 2% (w/w). Unlike the cinnamon flavored samples, increase in clove concentration reduced the intensity of the brown colour. The aroma of the clove was not too strong at least up to 2% (w/w) concentration. The sweetness level of the drink was acceptable as it was in the category of sweet for all samples. Interestingly, the fineness of the drink powder improved with an increase in clove
concentration. Clove powder might act as crystal seeds that prevented the formation of large sugar crystals. The concentration of seeds has been widely known to have effects on the crystal size and uniformity [15]. The affective test had also been done with regard to the colour, aroma and taste of the clove-flavoured palm sugar drink products. The concentration of the clove did not affect the panellists’ preference on the colour (Table 3). On the other hand, the amount of added clove affected the panellists’ fondness for aroma and taste. Aroma of C11.5, which contained 1.5% (w/w) clove, was the most preferred one. Higher clove concentration reduced the liking on the aroma. Panellists also liked the taste of the drink when the clove concentration was up to 1.5% (w/w).

3.3. Lemongrass flavour
Lemongrass was added to the drink mix in three different concentrations: 10, 15 and 20% (w/w). These concentrations were a lot higher than the concentration of added cinnamon and clove. Amount of added spices was determined during the preliminary research. We found that products containing cinnamon or clove in a concentration higher than 2% (w/w) had sharp smell and taste, which was unfavourable. In contrast, a pleasant aroma and taste were found when the addition of lemongrass, red ginger and ginger was higher than 5% (w/w). It is also worth to note that the cinnamon and clove were added in dried form, while the other spices were in the fresh form, which contained higher moisture content. Thus, it was reasonable to require more lemongrass, red ginger and ginger in order to boost the flavour of the drink products.

Table 4. Sensory properties of lemongrass flavoured samples

| Properties   | Samples  | L10  | L15  | L20  |
|--------------|----------|------|------|------|
|              |          |      |      |      |
| Colour       | Score (SD) | 3.0 (0.7) | 3.4 (0.8) | 3.8 (0.8) |
| Category     | Slightly brown | Slightly brown | Brown |
| Aroma        | Score (SD) | 3.4 (0.8) | 3.5 (0.8) | 3.8 (1.2) |
| Category     | Slightly pleasant | Pleasant | Pleasant |
| Taste        | Score (SD) | 3.5 (1.0) | 3.8 (0.7) | 4.4 (0.8) |
| Category     | Sweet | Sweet | Sweet |
| Texture      | Score (SD) | 2.6 (0.8) | 2.6 (0.9) | 2.3 (1.1) |
| Category     | Slightly fine | Slightly fine | Coarse |

| Hedonic      |         |      |      |      |
|--------------|---------|------|------|------|
| Colour       | Score (SD) | 3.5 (0.6) | 3.8 (0.7) | 3.9 (1.0) |
| Category     | Like | Like | Like |
| Aroma        | Score (SD) | 3.5 (1.0) | 3.8 (0.9) | 4.0 (1.3) |
| Category     | Like | Like | Like |
| Taste        | Score (SD) | 3.5 (0.9) | 4.3 (0.9) | 3.6 (1.2) |
| Category     | Like | Like | Like |

Table 4 shows the results of the sensory test. Similar to the samples containing cinnamon, a higher concentration of lemongrass caused the darker brown colour to the drink products. Increase in the amount of grater lemongrass also created the more pleasant aroma. The fineness of the drink powder was also influenced by the lemongrass concentration, where the spice caused coarse texture. This was expected since the particle size of the grated lemongrass was relatively big compared to cinnamon and clove. The only parameter that was not affected by the amount of added lemongrass was the sweetness level. All samples were categorized to have a sweet taste. The lemongrass flavoured palm sugar drink had a big potential to be accepted by consumers. All samples were liked by the panelists for all tested parameters, which were colour, aroma and taste (Table 4).
3.4. Red ginger flavour

Red ginger was added to the palm sugar in three different concentrations: 7, 10 and 15% (w/w). Organoleptic properties of the red ginger flavoured palm sugar drink are shown in Table 5. In general, the sensory characteristics of the samples were similar, regardless of the amount of the added red ginger. All samples had a brown colour, a pleasant aroma, sweet taste and coarse to slightly fine texture. The panellists also liked the colour, aroma and taste of the products.

| Table 5. Sensory properties of red ginger flavored samples. |
|------------------------------------------------------------|
| Samples | RG7 | RG10 | RG15 |
|---------------------------------|-----|-----|-----|
| Colour | Score (SD) | 3.5 (0.7) | 3.5 (0.7) | 3.9 (0.8) |
| Category | Brown | Brown | Brown |
| Aroma | Score (SD) | 3.8 (0.5) | 3.6 (0.5) | 3.9 (0.7) |
| Category | Pleasant | Pleasant | Pleasant |
| Taste | Score (SD) | 3.9 (0.7) | 3.8 (0.5) | 3.8 (0.9) |
| Category | Sweet | Sweet | Sweet |
| Texture | Score (SD) | 2.0 (0.0) | 2.5 (0.6) | 2.0 (0.5) |
| Category | Coarse | Slightly fine | Coarse |

3.5. Ginger flavour

| Table 6. Sensory properties of ginger flavored samples. |
|------------------------------------------------------|
| Samples | G10 | G15 | G20 |
|---------------------------------|-----|-----|-----|
| Colour | Score (SD) | 3.3 (1.1) | 3.9 (0.5) | 3.6 (0.9) |
| Category | Slightly brown | Brown | Brown |
| Aroma | Score (SD) | 3.5 (0.6) | 3.6 (0.7) | 3.8 (0.8) |
| Category | Pleasant | Pleasant | Pleasant |
| Taste | Score (SD) | 4.1 (0.9) | 3.4 (0.7) | 3.0 (1.4) |
| Category | Sweet | Slightly sweet | Slightly sweet |
| Texture | Score (SD) | 2.6 (0.8) | 2.1 (0.9) | 2.3 (1.3) |
| Category | Slightly fine | Coarse | Coarse |

Hedonic

| Colour | Score (SD) | 3.6 (1.1) | 3.6 (0.5) | 3.5 (0.9) |
| Category | Like | Like | Like |
| Aroma | Score (SD) | 3.3 (0.6) | 3.9 (0.8) | 3.9 (1.0) |
| Category | Neutral* | Like | Like |
| Taste | Score (SD) | 3.6 (1.0) | 3.5 (1.1) | 3.4 (1.1) |
| Category | Like | Like | Neutral |

*Neither like nor dislike

The amount of the added ginger (10, 15 and 20% w/w) affected the sensory properties of the palm sugar drink as shown in Table 6. The ginger seemed to increase the brown colour and the pleasant
aroma of the drink. A negative effect was found on the sweetness level of the drink. Sample containing the highest amount of ginger (RG15) had the lowest sweetness level. The spicy taste of ginger might suppress the sweetness of the palm sugar. One may argue that G20 could be less sweet compared to G10 because G20 contained a lesser amount of sugar that G10. However, if we recall the results from Table 4 and Table 5, the sweetness was relatively the same between samples, regardless of the amount of added lemongrass or red ginger. This indicates that ginger had stronger spicy taste than lemongrass or red ginger.

Table 6 also shows the results of the hedonic test. The color of all samples containing ginger was liked by panelists. Increase in ginger concentration also improved the panelists’ preference on the aroma of the drink products. However, it seemed that the panellists’s preference to the taste of the drink reduced with an increase in the amount of added ginger. This might be due to the reduction of the sweetness of the product and the ginger taste started to dominate the unique palm sugar taste.

4. Conclusion

Types and amount of added spices affected the organoleptic properties of the functional powdered drink products based on palm sugar. In general, the panelist liked the taste of at least one of the formulation of the drink products for each type of spices. The most preferred sample in term of taste for each spice was Cn1 (1% cinnamon), C11 (1% clove), L15 (15% lemongrass), RG7 (7% red ginger) and G10 (10% ginger). The sweetness level of the products was also acceptable (neither too sweet nor too plain). The lowest preference level for all parameters in all samples was neutral (neither like nor dislike). None of the sample was disliked by panellists. This shows that the product was potential to be accepted by consumers.

References

[1] Mogea J, Seibert B and Smits W 1991 Multipurpose palms: the sugar palm (Arenga pinnata (Wurmb) Merr.) Agroforest Syst 13 111-29
[2] Ho C W, Aida W Maskat M Y and Osman H 2008 Effect of thermal processing of palm sap on the physico-chemical composition of traditional palm sugar Pak. J. Biol. Sci. 11 989-95
[3] BPS-Statistics of Sulawesi Tenggara Province Sulawesi Tenggara Province Figures 2017 BPS-Statistics of Sulawesi Tenggara Province
[4] Sahat S F 2017 Peluang Ekspor Gula Semut (Opportunity of ant sugar export) (Warta Ekspor)
[5] Saputro A D, Van de Walle D, Kadivar S, Mensah M A, Van Durme J and Dewettinck K 2017 Feasibility of a small-scale production system approach for palm sugar sweetened dark chocolate Eur. Food Res. Technol. 243 955-67
[6] Arun A, Arun K and Vijayalakshmi S 2017 Substitutes for White Sugar in Fresh Fruit Juice-Sensory Characteristics of Adolescents Research Journal of Pharmacy and Technology 10 3736-40
[7] Erlienawati T C, Suseno T I P and Setijawati E 2018 Pengaruh proporsi gula pasir dan gula aren pada karakteristik cream cheese cake setelah satu minggu penyimpanan beku (The influence of proportion of sugar and palm sugar on the characteristic of the cream cheese cake after one week of frozen storage) Jurnal Teknologi Pangan dan Gizi 16 88-95
[8] Amin N A M, Mustapha W A W, Maskat M Y and Wai H C 2010 Antioxidative activities of palm sugar-like flavouring The Open Food Science Journal 4
[9] Sia J, Yee H B, Santos J H and Abdurrahman M K A 2010 Cyclic voltammetric analysis of antioxidant activity in cane sugars and palm sugars from Southeast Asia Food Chem. 118 840-6
[10] Kikunaga S and Ishibashi G 1997 Bioavailability of iron in brown sugar and palm sugar for iron-deficient rats J. Home Econ. Japan 48 215-23
[11] Hori K and Purboyo R B R 1991 Iron content of palm sugar and its chemical forms in Indonesia Journal of Consumer Studies & Home Economics 15 287-93
[12] Cahyono B, Satriadi H and Munfarida S 2018 Antioxidant activity and total phenolic content in red ginger (Zingiber officinale) based drinks," in *IOP Conference Series: Earth and Environmental Science* p 012025.

[13] Hartanti D, Haqqi M Z U and Hamad A 2018 Potency of combination of essential oils of ginger and lemongrass as fresh chicken meat natural preservative *Advanced Science Letters* **24** 91-4

[14] Ameh S J, Ibekwe N N and Ebeshi B U 2015 Essential oils in ginger, hops, cloves and pepper flavored beverages—A Review *Journal of Dietary Supplements* **12** 241-60

[15] Doki N, Kubota N, Sato A and Yokota M 2001 Effect of cooling mode on product crystal size in seeded batch crystallization of potassium alum *Chem. Eng. J.* **81** 313-6