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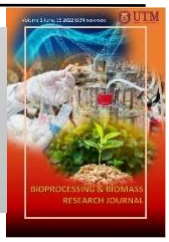

Research Article

Sensory Evaluation of Instant Coffee Drinks Formulated with *Swietenia mahagoni* (Tunjuk Langit)

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ABSTRACT

Tunjuk langit (*Swietenia mahagoni*) is a fruit that is commonly found in tropical areas such as South America, Western India, the Indonesian Islands and Malaysia. The seeds of *S. mahagoni* is known to contain high number of nutritional compounds such as unsaturated fatty acids and phenolic compounds. The seeds of *S. mahagoni* have been utilized as traditional medicine for hypertension and diabetes and its health benefit has attracted the interest of researchers. However, it is still underutilized in the commercial market due to its bitter taste. The aim of this study was to formulate instant coffee drink incorporated with *S. mahagoni* powder. Two different combinations of raw materials were prepared and evaluated for their sensory properties via acceptance test and descriptive test. According to the results, the formulation with nano sugar (sugar cane extract) received higher overall scores compared to the formulation with sucralose. Different sweetener affected the aroma and taste of the product but not the appearance and texture. The intensity of sweetness from sucralose was stronger compared to the sweetness from nano sugar and it hindered the coffee taste which impacted the sensory experience of the panels. The ideal coffee that the consumer is looking for is a good balance of sweet and bitter taste along with smooth and creamy texture. This study provides a potential formulation of instant coffee drinks incorporated with healthy *S. mahagoni* powder for commercial market.

INTRODUCTION

Swietenia belongs to the genus of Meliaceae family. There are three types of species based on its geographical location namely *Swietenia humilies* Zucc (Pacific Coast mahagoni), *Swietenia macrophylla* King (Honduran mahagoni), and *Swietenia mahagoni* which is known as "Tunjuk Langit" in Malaysia (Orwa et al., 2009). The tree of *S. mahagoni* was found growing wild in tropical rainforests with dry and humid temperatures, and can be found mostly in South America, Western India, the Indonesian Islands and Malaysia. The seeds of *S. mahagoni* is known to contain high number of nutritional compounds. According to Sukardiman and Ervina (2020), a number of bioactive compounds are present in the seed of *S. mahagoni* such as phenolic (flavonoids (swietemacrophyllanin, catechin and epichatechin) and tannins), triterpenoids, tetranortriterpenoid (limonoid: mahonin, secomahoganin, swietmanins, swiemahogins, swietenine and swietenolide), saponins and alkaloids.

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The seeds of *S. mahagoni* have been utilized as traditional medicine for hypertension and diabetes and its health benefit has attracted the interest of researchers (Naveen et al., 2014). The bioactive compounds in *S. mahagoni* was found to have effective antidiabetic activity as it can act as the inhibitor of enzyme activity to lower down the glucose level (Md Norodin et al., 2018). Moreover, the phenolic content in the seeds was found to have anti-oxidant activity which is beneficial to human's body for preventing various diseases (Salleh et al., 2014). The study from Preciado et al. (2016) showed that there is a significant antioxidant activity from the extract of *S. mahagoni* which was detected by using the 2,2-diphenyl-1-picrylhydrazyl (DPPH), 2,2'-azino-bis-(3ethylbenzothiazoline-6-sulphonic acid) (ABTS), ferric reducing/antioxidant power (FRAP) and oxygen radical absorbance capacity (ORAC) assays.

Although *S. mahagoni* provides a lot of health benefits to human's body, its usage in commercial product is still relatively underutilized which might be due to its bitter taste. Coffee which is one of the popular beverages in the world can be a potential carrier for *S. mahagoni* and introduced to the daily life of consumers. In Asia, the amount of revenue generated from coffee is USD 23.2 billion in 2023, of which 66% comes from instant coffee and the balance from roast coffee, and the expected compound annual growth rate (CAGR) is 5.32% for year 2023-2028 (Statista, 2023). In Malaysia, there is a growing market for coffee (Ali and Ramanathan, 2021). Based on the data from the International Coffee Organization (ICO), Malaysia was ranked third among 58 countries in the region for the highest growth in coffee consumption in 2021. Thus, this study attempts at developing a new instant coffee drink formulated with *S. mahagoni*.

However, due to the bitter nature of *S. mahagoni*, a suitable formulation with other ingredients is required to develop a product with desirable sensory properties. For instant coffee drinks, the main ingredients are creamer (dairy or non-dairy, 47-92%), coffee (2-20%) and sweetener (<0.01-20%), while additives such as flavor, stabilizer, thickener and emulsifier may also be added (Hafizal et al., 2022; Vimercati et al., 2020).

As many consumers are concerned with their calorie intake, this study used two types of low-calorie sweeteners i.e., nano sugar and sucralose. Nano sugar is made from concentrated sugarcane juice which makes it more concentrated and seven times sweeter than regular table sugar (Diabetes.co.uk, 2023), while sucralose is a synthetic sweetener derived from the chlorination of sucrose and about 300 times sweeter than sucrose (Schiffman et al., 2008).

Sensory evaluation is a method to elicit, measure, evaluate and interpret food product sensory reactions through visual, tactile, olfactory and gustatory perceptions (Leake, 2007; Stone et al., 2020). In this analysis, various attributes are evaluated, including flavor, appearance, aroma, texture, and others. Since this analysis is conducted by humans, a proper protocol and experimental design should be selected to reduce or eliminate bias, such as an isolated environment to prevent interference with external smell or a healthy panel that does not show too strong preference or dislike against a particular ingredient or product.

This study was designed to evaluate the sensory attributes of two instant coffee drink samples that were formulated with *S. mahagoni*. The findings will be useful in further product development of a healthy coffee drink that is appealing to the consumers.

MATERIALS AND METHOD

Materials

The raw materials used in this study are as listed in **Table 1** and were purchased from the respective suppliers.

Table 1 List of raw materials and suppliers

Raw Materials	Supplier
Coffee powder (Arabica)	A&T Ingredients Sdn. Bhd., Malaysia
Non-dairy creamer	Almer Malaysia Sdn. Bhd., Malaysia
Sucralose	Anhui Jinhe Industrial Co Ltd., China
Nano sugar (sugarcane extract)	P3 Sweetener Global Sdn. Bhd., Malaysia
Gum Arabic (thickener)	Nexira Singapore Pte. Ltd., Singapore
Tunjuk langit powder	Local market in Johor Bahru, Malaysia

Formulation of Instant Drink Mix

The instant coffee mix was prepared according to the formula as shown in **Table 2**, based on previous reports (Hafizal et al., 2022; Vimercati et al., 2020) and a preliminary study. The amount of sweetener in sample 1 (using nano sugar) and sample 2 (using sucralose) was different because of the different sweetness intensity of each type of sweetener and was adjusted to be at the similar level of sweetness based on preliminary study. Two sets of samples were prepared and each of the ingredient was weighed according to **Table 2** then mixed thoroughly. After that, 25 g of each sample mix was dissolved in 160 ml warm water (85-90 °C).

Table 2 Formulation of samples (amounts shown in gram, g)

	Sample 1	Sample 2
Non-dairy creamer	80	80
Coffee powder	18	20
Sweetener *-sample 1: nano sugar* *-sample 2: sucralose*	2	0.015
Tunjuk langit powder	0.015	0.015
Gum Arabic (emulsifier)	0.015	0.015

Sensory Evaluation

A total of 15 semi-trained participants (Deotale et al., 2022; Rodriguez et al., 2020; Yalcinkaya et al., 2022) of males and females were selected as the sensory panel. The age of the participants was between 20 and 30. Our team had ensured that all participants were in good health conditions and did not have any food allergies before the test began. Two types of sensory evaluation were conducted which were acceptance test and descriptive test. A google form was provided to the participants to fill in their personal information and response. The evaluation was divided into two parts, which were acceptance and descriptive test.

Acceptance test was used to identify the degree of liking for individual sensory attributes. The feedback of the respondent was evaluated by using 5-point hedonic scale

where 1 represents extremely dislike, 2 represents slightly dislike, 3 represents neither like nor dislike, 4 represents slightly like and 5 represents extremely like. Each participant was served with 30 ml of sample from each formulation. After consuming the sample, they were required to rate the product based on their acceptability of texture, aroma, appearance, taste and overall acceptability. Plain water was provided to cleanse the palate before serving the next sample to the participants (**Figure 1**).

Figure 1 Set up for the sensory evaluation

The second part of the sensory evaluation was descriptive test. It was used to obtain the detailed description of aroma, flavour and oral texture of the coffee drinks. The main purpose was to collect the qualitative information from the respondent.

RESULTS AND DISCUSSION

Sensory Acceptance Test

Table 3 shows the number of respondents for each point scale and the summary of score for acceptance test in term of appearance, taste, aroma and texture. The average scores of appearance for sample 1 and sample 2 were 3.80 and 3.73 respectively. This shows that the difference in the formulation did not have a significant effect on the appearance of the sample according to the respondents. Meanwhile the average scores of taste for sample 1 and sample 2 were 4.07 and 3.60 respectively, which indicates that the respondents prefer the taste of formulation with nano sugar compared to sucralose as higher rating was given by the participants. For aroma, the average scores were 4.07 and 3.60, while for texture the average scores were 4.33 and 4.00 for sample 1 and sample 2, respectively.

Overall the formulation with nano sugar provided a better experience in terms of taste, aroma and texture compared to sucralose. As a result, sample 1 obtained a higher overall score of 4.07 compared to sample 2 which scored 3.73. These results are summarized in **Figure 2** which shows that sample 1 is further located at the outer region of the radar chart, indicating higher scores and thus better acceptance by the respondents.

Table 3 Number of respondents and the score of acceptance test for sample 1 and sample 2

Sample 1	**Appearance**	**Taste**	**Aroma**	**Texture**
0 point	0	0	0	0
1 point	0	0	0	0
2 points	0	0	0	0
3 points	7	5	3	1
4 points	4	4	8	8
5 points	4	6	4	6
Average scores	3.80±0.86	4.07±0.88	4.07±0.70	4.33±0.62
Overall score	4.07±0.78			
Sample 2	**Appearance**	**Taste**	**Aroma**	**Texture**
0 point	0	0	0	0
1 point	0	0	0	0
2 points	0	0	0	0
3 points	4	6	4	2
4 points	6	4	8	6
5 points	4	4	2	6
Average scores	3.73±0.78	3.60±0.86	3.60±0.66	4.00±0.73
Overall score	3.73±0.76			

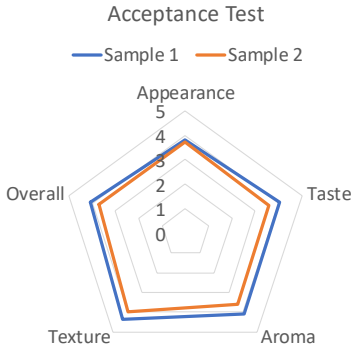

Figure 2 Summary of the sensory evaluation acceptance test result

Sensory Descriptive Test

Descriptive test provides a detailed overview of the sensory attributes of product in term of appearance, aroma, taste and texture. While acceptance test only provides the scores, descriptive test will determine the actual factors that lead to the high or low scores, and relates to the sensory characteristics that the consumer is looking for. The result for the descriptive test is summarized below in **Table 4**.

Table 4 Summary of sensory evaluation descriptive test

Attributes	Description
Appearance	The color for both samples was described as light brown or light medium brown.
Aroma	The respondents described the aroma of sample 1 as dry distillation and smoky while sample 2 as sugar browning and candy like-aroma.
Taste	The respondents described the taste of sample 1 as bitter while sweet for sample 2.
Texture	Both samples were described as smooth and creamy.

According to the respondents, the color for both samples were described as light or light medium brown, with no clear difference between the two. The brown color was mainly attributed by the color of coffee powder (dark brown) while other ingredients were white in color. Since the amount of coffee and creamer was almost the same, both samples yielded brown color with similar intensity.

The respondents described the aroma of sample 1 as dry distillation and smoky while sample 2 as sugar browning and candy like-aroma. The dry distillation aroma is used to describe the roasting smell from the coffee while the sugar browning is used to describe the caramel smell. It can be observed that different combinations of sweetener and a slight difference in the quantity of coffee resulted in different aroma perceived by the consumer. Based on the score from the acceptance test, the respondents seemed to prefer smoky to caramel or candy-like aroma in the coffee drink.

As for the taste, a consistent description was obtained for sample 1 which was bitter while sample 2 was described as sweet. The sweetness of sucralose in sample 2 was able to hinder the bitter taste from the coffee while the intensity of sweetness from nano sugar was relatively weaker so the participants were able to sense the bitter taste from the coffee. Nevertheless, for coffee drinks the bitterness seemed to be an important factor.

In term of texture, the respondents described both samples as smooth and creamy. This shows that the sweetener type and amount of coffee did not cause a significant difference in the texture of the sample. Generally, consumers prefer drinks with creamy and smooth textures compared to watery texture (Moss et al., 2023). Therefore, although sample 1 scored higher in the acceptance test for texture, both samples can be considered as providing a satisfying texture to the consumer.

Overall, the better preference for sample 1 can be attributed to the type of sweetener used in the formulation, and the balance between bitterness and sweetness. Our previous study using papaya powder for instant drink mix also showed that a formula with good balance of bitterness and sweetness is the most preferred by the consumers (Wong et al., 2023).

CONCLUSION

In this study, two samples of instant coffee drinks containing *S. mahagoni* powder was formulated as a potential new product to promote the health benefits and introduce *S. mahagoni* to the commercial market. The results showed that sample 1 which contained nano sugar had an overall higher score of 4.07, compared to sample 2 with sucralose. Nano sugar derived from sugarcane is preferred as a sweetener as it gives an overall good balance of sweetness that does not overly mask the bitterness of coffee while providing smoky aroma which was enjoyed by the respondents. Despite the small amount added, the intensity of sweetness from sucralose is stronger compared to that of nano sugar and it hindered the coffee taste. Different sweeteners affected the aroma and taste of the drink but not the texture and appearance. In conclusion, the sensory evaluation such as acceptance and descriptive tests can provide a holistic view of the food product and can reveal the preference of the consumers. The ideal coffee drink that the consumer is looking for has a good balance of sweet and bitter taste along with smooth and creamy texture.

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