

# ***Hedonic test of Lombok Island palm sugar candy formulated with Multi-Purpose Tree Species (MPTS) leaves infusion***

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## **ABSTRACT**

The purpose of this research is to conduct a hedonic test of palm sugar candy mix with multi-purpose tree species (MPTS) leaves infusion using various statistical approaches. This research used *Arenga pinata* sap water as raw material. MPTS leaves infusion is the treatment that was added to a palm sugar candy, including I<sub>1</sub>= Addition of cacao (*Theobroma cacao*) leaves infusion, I<sub>2</sub> = addition of agarwood (*Gyrinops versteegii*) leaves infusion, I<sub>3</sub> = addition of coffee (*Coffea robusta*) leaves infusion, I<sub>4</sub> = addition of soursop (*Annona muricata*) leaves infusion. Respondents gave evaluations using a 5-scale hedonic score for the treatments in 3 parameters, including appearance, aroma, and taste. Evaluation scores were analyzed using four statistical approaches: Kruskal-Wallis, Freidman, ANOVA-CRD, and ANOVA-RCBD. The results show that different treatments resulted in significantly different respondent evaluation scores. Treatment I<sub>1</sub> has the highest score, while I<sub>3</sub> has the lowest score. However, respondents give evaluation scores higher than the threshold value (numeric score >3) in all parameters. This shows that the addition of MPTS leaf infusion has promising prospects for developing palm sugar candy products. The conclusion is cacao leaves infusion addition to palm sugar candy can give the highest hedonic score from respondents in all parameters, including appearance, aroma, and taste.

**Keywords: hedonic; MPTS; palm sugar**

## **INTRODUCTION**

*Arenga pinata* is a valuable non-timber forest product that forest farmers have utilized in Lombok Island (Hidayat & Soimin, 2021). Forest farmers primarily harvest sap water from this plant. That sap water is utilized to make palm sugar (Radam & Rezekiah, 2015).

Palm sugar in Lombok Island is usually sold in bulk pieces of jaggery. Thus, this product is mostly not consumed directly. Palm sugar is complementary to several traditional

local cuisines in Lombok Island (Haryoso et al., 2020).

Direct consumption of palm sugar in the form of palm sugar candy has been widespread recently. This candy is more natural and healthier than artificial candy (Mukhtar et al., 2016). Palm sugar candy could be a potential instant energy source during physical exercise or doing some sport.

Palm sugar candy could be further developed into a functional food product (Sukenti et al., 2019). This could be done by the addition of a compound with antioxidant activity.



Several Multi-Purpose Tree Species (MTPS) have this potency, including coffee (*Coffea robusta*) (Novita et al., 2018), cacao (*Theobroma cacao*) (San et al., 2022), soursop (*Annona muricata*) (Tanjung et al., 2016), and agarwood (Wangiyana et al., 2022) (*Gyrinops versteegii*). Palm sugar candy mixed with MPTS could become a promising new product on Lombok Island.

Sensory evaluation assay is essential for new food products like palm candy mixed with MPTS (Świader & Marczevska, 2021). This assay could measure consumer preference for product development. One sensory evaluation assay that has high sensitivity is a hedonic test.

The hedonic test has been developed to accommodate variation needs in food science (Mazur et al., 2018). Combining hedonic test results using several different statistical approaches is one of the methods to develop hedonic test accuracy and precision (Wangiyana & Triandini, 2022). This approach could be potentially applied to the palm sugar mix MPTS. Thus, this research aims to conduct a hedonic test of palm sugar candy mix with multi-purpose tree species leaves infusion using various statistical approaches.

## **METHODOLOGY**

### **Research material**

This research used *Arenca pinata* sap water and MPTS leaves. Sap water of *Arenca pinata* taken from plantation in Pemenang Village, North Lombok. MPTS leaves, including cacao, coffee, and soursop, were taken from Montong Sapah Village, Central Lombok.

Agarwood leaves were taken from Kekait Puncang village, West Lombok.

This research used a grinding machine (Miyako BL-22 PLY), frying pan with agitation (RRC), electric stove (Eastern Electric), analytical digital scale (Jadever), electric oven (Olike), and silicon candy mould.

### **MPTS infusion preparation**

MPTS tree samples, including cacao, coffee, soursop, and agarwood, were selected based on criteria that fulfil forest health monitoring (Supriyanto & Iskandar, 2018). Leaves from the MPTS tree sample were selected based on size, shape, and condition. Young leaves from top 3 branches with lengths from 5 cm to 15 cm, no necrosis and chlorosis symptoms were chosen for MPTS infusion (Triandini et al., 2022).

MPTS leaves were washed with flowing water three times to clear dirt and dust. The leaves were then chopped into small particles using a grinding machine. Leaves particles are then dried using the oven at 120 °C for two hours until water contains the remaining 10% (Wangiyana et al., 2019).

MPTS leaf infusions with a concentration of 0.02 gr/L. MPTS leaf particles were extracted using distilled water at 70 °C for 5 minutes. Filtration using qualitative filter paper was carried out to separate filtrate and residue (Wangiyana & Triandini, 2021). The filtrate from this process is MPTS leaves infusion and was stored at 4 °C before being mixed with water sap of *Arenca pinata*.

### **Palm Sugar Candy Mix MPTS infusion Production**

MPTS leaf infusion is the primary treatment in palm sugar candy (Table 1). A qualitative filter previously filtered the water sap of *Arenga pinata* before being mixed with MPTS leaf infusions. The proportion of MPTS leaves infusion and water sap is 1: 5.

Palm sugar candy mixed with MPTS leaf infusion is based on the regular palm sugar production method with some modifications (Victor & Orsat, 2018). Two liters of the mixture of palm water sap and MPTS leaves infusion were cooked in a frying pan with agitation for 60 minutes. The mixtures were heated until the volume was 8% of the initial volume and became viscous. Viscous palm sugar material is solidified at 30 °C in the silicone candy mould.

Table 1.  
Treatment of MPTS leaves infusion

<b>Code</b>	<b>Treatment Description</b>
I <sub>1</sub>	Addition of cacao leaves infusion
I <sub>2</sub>	Addition of agarwood leaves infusion
I <sub>3</sub>	Addition of coffee leaves infusion
I <sub>4</sub>	Addition of soursop leaves infusion

### **Hedonic Test**

Hedonic tests of palm candy mix MPTS leaf infusion were carried out by an organoleptic assessment from 30

untrained respondents (Triandini & Wangiyana, 2022). Respondents gave the evaluation using a 5-point hedonic scale (Table 2). This hedonic scale is converted into a numeric scale for statistical analysis purposes (Wangiyana et al., 2021). Numeric score 3 is the threshold value to indicate that the respondents respond positively to the palm sugar candy mixed with MPTS leaves infusion in 3 parameters: appearance (color and texture), aroma, and taste.

Table 2.  
Hedonic scale and numeric scale

<b>Hedonic Score</b>	<b>Numeric Score</b>
Like very much	5
Like moderately	4
Like slightly	3
Dislike moderately	2
Dislike extremely	1

### **Data Analysis**

Data analysis is conducted using descriptive and inductive statistical approaches. Numeric score of each treatment Descriptive analysis is conducted in the form of a spider web diagram. Inductive statistics is conducted using different statistical approaches, including the Kruskal-Wallis test, Freidman test, ANOVA-CRD (Analysis of Variance – Completely Randomized Design), and ANOVA-RCBD (Analysis of Variance – Randomized Complete Block Design) (Wangiyana & Triandini, 2022).

Table 3.  
Summary of statistical method approaches in this research

Statistical Approach	Assumption	Linier model	Description
Kurskal-Wallis	Palm Sugar Candy and respondents are homogenous	$H = \frac{12}{N(N+1)} \sum_{i=1}^k \frac{R_i^2}{n_i} - 3(N+1)$	Ri = ranking in the column N = Total Number of Sample ni = Number of treatments
Freidman Test	Respondents are heterogeneous (become group)	$X^2 = \frac{12}{bt(t+1)} \sum r^2 - 3b(t+1)$	b = Number of Group t = Number of Treatments r = Number of ranking
ANOVA CRD	Normal distribution of numeric scale and respondents are homogenous	$Y_{ij} = \mu + \tau_i + \varepsilon_{ij}$	Y <sub>ij</sub> = An observation μ = The Experimental Mean τ <sub>i</sub> = The Treatments Effect ε <sub>ij</sub> = The Experimental Error
ANOVA RCBD	Normal distribution of numeric scale and respondents are heterogeneous (become block)	$Y_{ij} = \mu + \tau_i + \beta_j + \varepsilon_{ij}$	Y <sub>ij</sub> = An observation μ = The Experimental Mean τ <sub>i</sub> = The Treatments Effect β <sub>j</sub> = The Block Effect ε <sub>ij</sub> = The Experimental Error

## RESULTS AND DISCUSSION

The result has shown that MPTS leaf infusion can be mixed with *Arenga pinata* sap water to produce palm sugar candy. This candy is an innovative product that can support the diversification of *Arenga pinata* utilization on Lombok Island. Palm sugar candy products have different characteristics based on the MPTS leaves raw material (Figure 1).



Figure 1. Palm sugar mix MPTS leaves infusion product. Raw material before solidified (left), candy product after solidified (right)

The cooking process of palm sugar candy mix MPTS leaves infusion

requires a more extended heating period than regular palm sugar production (Kurniawan et al., 2018). This is because the palm water sap as a raw material was added by 20% v/v of leaves infusion. Furthermore, the infusion does not contain any sugar compound, which could affect the solidifying process of the candy (Asikin et al., 2016).

Different P-values have been observed based on different statistical approaches. This P-value determined the significance of the treatment effect on the respondent scoring value (Shrestha, 2019). The lower the P-value of the numeric score, the higher the significant level of the impact (Andrade, 2019). The diversity of P-value can be analyzed using two considerations. First is how the P value of 1 statistical approach on different parameters. Second is how the P value

of 1 parameter on different statistical approaches.

Table 4.  
P-value comparison of different statistical approaches

Statistical Approach	P-Value		
	Appearance	Aroma	Taste
Kruskal-Wallis	0.0006 ***	0.4061 ns	0.0442 *
Freidman Test	0.00001***	0.00001***	0.00001***
ANOVA-CRD	0.0005***	0.3092 ns	0.0406*
ANOVA-RCBD	0.0068**	0.1237 ns	0.0113*

Note: ns = non-significant (P value is more than 0.05), \* = significant (P value is 0.01 – 0.05), \*\* = highly significant (P value is 0.001 – 0.01), \*\*\* very highly significant (P value is less than 0.001).

Table 5.  
DMRT analysis of treatment hedonic score in different parameter

Treatment	Numeric Score Mean Value ( $\pm$ Error Standard)		
	Appearance	Aroma	Taste
I <sub>1</sub>	4.23 $\pm$ 0.13(a)	3.83 $\pm$ 0.14(a)	3.97 $\pm$ 0.13(a)
I <sub>2</sub>	3.43 $\pm$ 0.18(b)	3.47 $\pm$ 0.21(ab)	3.60 $\pm$ 0.18(ab)
I <sub>3</sub>	3.13 $\pm$ 0.18(b)	3.37 $\pm$ 0.19(b)	3.37 $\pm$ 0.19(b)
I <sub>4</sub>	3.43 $\pm$ 0.24(b)	3.53 $\pm$ 0.18(ab)	3.37 $\pm$ 0.16(b)
LSD 0.05	0.47	0.40	0.40

Note: different Mean values followed by the same letters are significantly different ( $p < 0.05$ ). I<sub>1</sub> = Addition of cacao leaves infusion, I<sub>2</sub> = Addition of agarwood leaves infusion, I<sub>3</sub> = Addition of coffee leaves infusion, I<sub>4</sub> = Addition of soursop leaves infusion.

Almost all statistical approaches have an identical pattern of P value signification on different parameters. Kruskal – Wallis and ANOVA-CRD have very highly significant P-values on the appearance parameter, non-significant in the aroma parameter and significant on the taste parameter. ANOVA – RCBD also has a significant P-value on the taste parameter but only a highly significant P-value on the appearance parameter. Freidman test has a very highly significant P-value on all parameters. This shows that the Freidman test is less sensitive to be

used for the hedonic test. This result supports previous research that shows the Freidman test's limitation on hedonic test analysis (Suradi, 2007; Wangiyana & Triandini, 2022).

Most parameters have the same pattern of P-value on all statistical approaches. The taste parameter has a significant P value on Kruskal-Wallis, ANOVA-CRD, and ANOVA-RCBD. The aroma parameter has a non-significant P-value on Kruskal-Wallis, ANOVA-CRD, and ANOVA-RCBD. Appearance parameter has a very highly significant

P-Value on Kruskal-Wallis, Freidman Test, and ANOVA-CRD while highly significant P-Value on ANOVA-RCBD. It could be inferred that respondents give homogeny scoring on aroma parameter (even if it is very highly significant in the Freidman test).

DMRT (Duncan Multiple Range Test) results show that at least one of the treatments was significantly different compared to others. DMRT can specifically differentiate the hedonic score in aroma parameter, which has not been described in the previous statistical approach. This result shows the sensitivity of DMRT (Permanasari et al., 2010). Treatment I<sub>1</sub> (cacao leaves infusion) has the highest average hedonic score among other treatments in all parameters. On the other hand, Treatment I<sub>3</sub> (coffee leaves infusion) has the lowest average hedonic score among other treatments in all parameters.

The highest hedonic score analysis (numeric score equal to 5) shows an identical result with DMRT. Most respondents prefer I<sub>1</sub> treatment (cacao leaves infusion) with 39% proportion (Figure 2). Meanwhile, treatment I<sub>3</sub> (Addition of coffee leaves infusion) has the lowest proportion of maximum score from respondents with only 17%.

Spider web analysis results show that treatment I<sub>1</sub> (cacao leaves infusion) has the best hedonic score given by the respondents in all parameters (Figure 3). I<sub>1</sub> treatment has the largest area formed by appearance, aroma, and taste parameters in the spider web chart. This result shows the advantage of this treatment in all parameters

compared to other treatments (Fang et al., 2017).

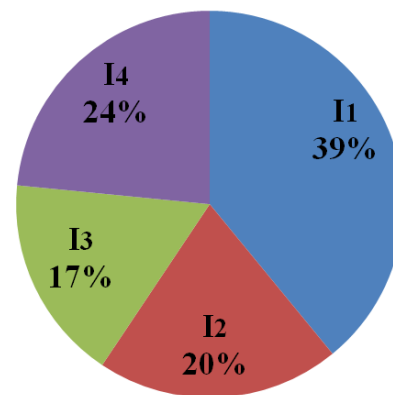


Figure 2. Proportion of respondents giving maximum hedonic score for each treatment. (I<sub>1</sub>= Addition of cacao leaves infusion, I<sub>2</sub> = Addition of agarwood leaves infusion, I<sub>3</sub> = Addition of coffee leaves infusion, I<sub>4</sub> = Addition of soursop leaves infusion)

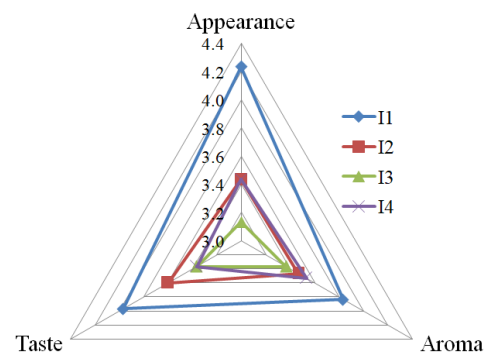


Figure 3. Spider web analysis of treatment hedonic score in each parameter (I<sub>1</sub>= Addition of cacao leaves infusion, I<sub>2</sub> = Addition of agarwood leaves infusion, I<sub>3</sub> = Addition of coffee leaves infusion, I<sub>4</sub> = Addition of soursop leaves infusion)

MPTS infusion addition in palm candy has a promising prospect. This is indicated by the hedonic assay in this research, which shows that respondents give average scores higher than threshold values (numeric score > 3). This can be a positive result since the respondents are the consumers' representatives in the consumer

preference assay research scale (Zhang et al., 2020). Cacao leaf infusion is the MPTS that can initiate the best respondent evaluation among other MPTS leaf infusions. Palm sugar candy should be developed by combining it with this MPTS infusion.

## CONCLUSION

Different MPTS infusion additions in palm sugar candy can give significantly different hedonic score evaluations among the respondents using different statistical approaches, including Kruskal-Wallis, Freidman test, ANOVA-CRD, and ANOVA-RBCD. Adding cacao leaves infusion to palm sugar candy can give the highest hedonic score from respondents in all parameters, including appearance, aroma, and taste.

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