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Innovation Experiment in Making Dengue Food Using Cassava Leaves (Manihot Esculenta) as a Substitution Beef

Nur Al-faida[1], Sukriadi Sukriadi[2], Irawati Irawati[3], Mia Mariana Mote[4], Yaningsi Novita[5], Amos Edowai[6]
[1-6]Nutrition Study Program, Sekolah Tinggi Ilmu Kesehatan Persada Nabire, Papua, Indonesia
Correspondence email: alfaidanur@gmail.com

Abstract Cassava is a staple food source that is abundant in Indonesia. Cassava leaves have been known to our people for a long time as an alternative vegetable to replace most vegetables in general. For those who are used to it, cassava leaves are a unique vegetable, and can stimulate your appetite, but for those who have never tasted it, it may take time to get used to it. The texture of cassava leaves is rough, so they are only suitable for cooking in a few ways. The aim of this research is to find out the most preferred formula for making beef jerky from cassava leaves. This research is experimental research with the research design used, namely Pre-Experimental Design with a One-shot case study type of research. Based on the research that has been carried out, the conclusion in this study is that of the 4 treatments given, it is seen from the color aspect that the most preferred treatment is P12 (100%), the taste aspect of the treatment is P12 986.7), the aroma aspect is P11 (80%) and the P12 texture (83.3%). For further research, it is hoped that variables such as water content and HCN can be added to cassava leaves.

Keywords: Aroma, Cassava Leaves, Jerky, Flavor, Texture, Color

1. INTRODUCTION

Cassava is a staple food source that is abundant in Indonesia. Its productivity is 229.51 quintals/hectare (Central Bureau of Statistics, 2015). Currently, cassava processing is not only carried out by large industries, but is also developed in small industries such as small and medium enterprises (SMEs). The amount of cassava processing results will be directly proportional to the waste produced, one of which is cassava leaf waste. Cassava leaves have been widely known by our society since long ago as an alternative vegetable to replace most vegetables in general. For those who are used to it, cassava leaves are unique vegetables, and can stimulate appetite, but for those who have never tasted it, it may take time to get used to it. The texture of cassava leaves is rough, so it is only suitable for cooking in a few ways.

Cassava leaves are a type of vegetable that is very popular, easy to find and cheap. Cassava leaves are usually processed into soup, urap, or stir-fry. Cassava leaf dishes can also be found in Padang restaurants. In addition to being used as vegetables, cassava leaves can be processed into various types of food, considering their delicious taste and rich nutritional content. Cassava leaves contain minerals, vitamins, essential amino acids, and proteins that are very good for the body (Syakur, 2012). Cassava, in addition to its tubers which are always used, its leaves have the potential to be a natural dye because cassava leaves have a natural pigment in the form of chlorophyll. Chlorophyll is a green dye which is the main pigment in

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plants which is usually found in leaves. The chlorophyll content in cassava leaves can reach 18.141 mg/l (Dharmadewi, 2020).

Dendeng is a slice or ground meat that is dried with a mixture of spices often served as a side dish in the form of plates. The process of making dendeng is done by slicing or grinding the meat that you want to make dendeng, then mixing it with spices and then drying it in the sun until dry (Kristen Wacana, 2019). So far, jerky with vegetable mixture has been widely made. So the idea began to emerge to make processed jerky products by adding other mixtures, as additional ingredients in the form of vegetable food ingredients. The following are processed jerky with vegetable ingredients such as young jackfruit jerky (Astawan, 2006), banana heart jerky (Putro, 2006), breadfruit jerky (Rosida et al., 2008), and mushroom jerky (Listyowati, 2014).

Papua is an island in Indonesia that is famous for its rich biodiversity, one of which is in Nabire Regency where cassava plants are found in abundance, because there are so many local people in Nabire Regency who make cassava their staple food and must be consumed every day, while cassava leaves are used as vegetables or sold in markets to increase income. Due to the limited processing of cassava leaves, and supported by the many nutritional contents and benefits of cassava leaves, product modification or product diversification is carried out to increase the economic value of cassava leaves, increase the shelf life of cassava leaf products. The economic conditions of Papuan society are not evenly distributed, not everyone can eat meat or enjoy beef jerky, besides the relatively expensive price, the quality of meat is currently declining, even meat that is not fit for consumption appears. Therefore, researchers tried to make jerky using cassava leaves.

2. RESEARCH METHODS

This research is an experimental research type with the research design used, namely Pre-Experimental Design with the type of One-Shoot Case Study research where this research contains a group given treatment and then the results are observed. In this experiment, the subjects were given several types of treatment and then the results were measured (Kurniawan, 2018).

This research will be conducted at the Food Nutrition Technology and Food Materials Science Laboratory at the STIKes Persada Nabire Campus.

In this study using 4 formulas namely P10 (250 g) cassava leaves, P11 (200 g) cassava leaves, P12 (150 g) cassava leaves and P13 (100 g) cassava leaves. To make jerky from cassava leaves, first you have to prepare tools such as Gloves, Spoons, Cutting Boards,

Steaming Pans, Frying Pans, Spatulas, Plates, Basins and Baking Pans. For ingredients such as cassava leaves, eggs, tapioca flour, wheat flour, coriander, shallots, garlic, kada, oil, salt and flavoring.

Before processing, the first step that needs to be done is to separate the cassava leaves from the stalks and then wash them with clean water. Then steam them for about 25 minutes. After that, the steamed cassava leaves are cooled for 5 minutes. Then sliced and seasoned.

Data processing and analysis using the Kruskal Wallis test and the Mann-Whitney advanced test. This test is conducted to determine the average difference in acceptability of 4 samples. If the results are significant, the Mann-Whitney test is continued to determine the differences between each sample.

3. RESULTS

The results of the study with organoleptic tests conducted at the STIKes Persada Nabire campus with a total of 30 panelists with 4 treatments and 3 repetitions were students of STIKes Persada Nabire. Organoleptic testing used a hedonic scale of 1-5, namely very dislike, like, somewhat like, like and very like. The following are the results obtained in this study.

1. Acceptability of cassava leaf jerky based on color aspect.

   Panelists' acceptance of the color aspect of cassava leaf jerky involves the sense of sight. The data obtained can be seen in the following table:

   Based on table 1.5 above, it shows that the acceptability of cassava leaf jerky from the aspect of color based on the most preferred criteria is P12 with a presentation of 100%, P11 with a presentation of 96.7%, P13 with a presentation of 63.3% and P10 with a presentation of 50%. The results of the Kruskal-Wallis test show a value of $p < 0.05$, which means there is a significant difference in the aspect of the color of cassava leaf jerky.

Table 1. Acceptability of Cassava Leaf Jerky Based on Color Aspect

Color	Treatment								*P-Value*
	P10		P11		P12		P13		
	f	%	f	%	f	%	F	%	
Very Dislike	1	3.3	1	3.3	0	0	2	6.7	0.03
Do not like	4	13.3	0	0	0	0	2	6.8	
Kinda Like	7	23.3	0	0	0	0	4	13.3	
Like	15	50.0	29	96.7	30	100	19	63.3	
Really like	3	10.0	0	0	0	0	3	10	
Total	30	100	30	100	30	100	30	100	

Source: Primary Data, 2024

2. Acceptability of cassava leaf jerky based on taste aspect

Panelists' acceptance of the taste aspect of cassava leaf jerky involves the sense of taste. The data obtained can be seen in the following table:

Table 2. Acceptability of Cassava Leaf Jerky Based on Taste Aspect

Flavor	Treatment								*P-Value*
	P10		P11		P12		P13		
	f	%	f	%	f	%	F	%	
Very Dislike	1	3.3	1	3.3	0	0	2	6.7	0.02
Do not like	0	0	1	3.3	0	0	2	6.7	
Kinda Like	1	3.3	2	6.7	1	3.3	5	16.7	
Like	21	70	25	83.3	26	86.7	18	60	
Really like	7	23.3	1	3.3	3	10	3	10	
Total	30	100	30	100	30	10	30	100	

Source: Primary Data, 2024

Based on table 2 above, it shows that the acceptability of cassava leaf jerky from the aspect of taste based on the most preferred criteria is P12 with a presentation of 86.7%, P11 with a presentation of 83.3%, P10 with a presentation of 70% and P13 with a presentation of 60%. The results of the Kruskal-Wallis test show a value of $p < 0.05$, which means there is a significant difference in the aspect of the taste of cassava leaf jerky.

3. Acceptability of cassava leaf jerky based on aroma aspect

The panelists' acceptance of the aroma aspect of cassava leaf jerky involves the sense of smell. The power obtained can be seen in the following table:

Table 3. Acceptability of Cassava Leaf Jerky Based on Aroma Aspect

Aroma			Treatment						*P-Value*
	P10		P11		P12		P13		
	f	%	f	%	f	%	f	%	
Very Dislike	0	0	0	0	0	0	3	10	0.02
Do not like	1	3.3	1	3.3	2	6.7	4	13.3	
Kinda Like	6	20	2	6.7	7	23.3	9	30	
Like	21	70	24	80	19	63.3	10	33.3	
Really like	2	6.7	3	10	2	6.7	4	13.3	
Total	30	100	30	100	30	100	30	100	

Source: Primary Data, 2024

Based on table 3 above, it shows that the acceptability of cassava leaf jerky from the aroma aspect based on the most preferred criteria is P11 with a presentation of 80%, P10

with a presentation of 70%, P12 with a presentation of 63.3% and P13 with a presentation of 33.3%. The results of the Kruskal-Wallis test show a p value <0.05, which means there is a significant difference in the aroma aspect of cassava leaf jerky.

4. Acceptability of cassava leaf jerky based on texture aspect

The panelists' acceptance of the texture aspect of cassava leaf jerky involves the sense of taste. The power obtained can be seen in the following table:

Table 4. Acceptability of Cassava Leaf Jerky Based on Texture Aspect

Texture	Treatment								*P-Value*
	P10		P11		P12		P13		
	f	%	f	%	f	%	f	%	
Very Dislike	2	6.7	0	0	0	0	2	6.7	0.04
Do not like	2	6.7	1	3.3	0	0	2	6.7	
Kinda Like	5	16.7	0	0	2	6.7	7	23.3	
Like	18	60	24	80	25	83.3	14	46.7	
Really like	3	10	5	16.7	3	10	5	16.7	
Total	30	100	30	100	30	100	30	100	

Source: Primary Data, 2024

Based on table 4 above, it shows that the acceptability of cassava leaf jerky from the texture aspect based on the most preferred criteria is P12 with a presentation of 83.3%, P11 with a presentation of 80%, P10 with a presentation of 60% and P13 with a presentation of 46.7%. The results of the Kruskal-Wallis test show a p value <0.05, which means there is a significant difference in the texture aspect of cassava leaf jerky.

5. Hedonic Test of Cassava Leaf Jerky Based on Color Aspects

Hedonic test of cassava leaf jerky based on color aspect can be seen in the following table.

Table 5. Hedonic Test of Cassava Leaf Jerky Based on Color Aspect

Parameter	Mean Value of Sample Hedonic Test			
	P10	P11	P12	P13
Color	3.50 ±0.97a	3.90±0.59ac	4.00±0.50a	3.60±0.99b

Information:

a = significantly different from b and c

ab = significantly different from c and vice versa

bc = significantly different from a and vice versa and so on

The results of the Kruskal Wallis test of color parameters showed P<0.05, H0 was rejected, there was a significant difference in treatment (P10, P11, P12, and P13) on the color of cassava leaf jerky. To see which groups were different, a Mann-Whitney test was performed. The results of the Mann-Whitney test showed that the level of preference for the color of cassava leaf jerky was significantly different (p<0.05) at P10 and P11, P10 and P12. However, it was not significantly different (p>0.05) at P10 and P13, P11 and P12, P11 and P13 and P12 and P13.

6. Hedonic Test of Cassava Leaf Jerky Based on Taste Aspect

   The hedonic test of cassava leaf jerky based on the taste aspect can be seen in the following table:

Table 6. Hedonic Test of Cassava Leaf Jerky Based on Taste Aspect

Parameter	Mean Value of Sample Hedonic Test			
	P10	P11	P12	P13
Flavor	4.10 ±0.75a	3.80±0.71ac	4.07±0.36be	3.60±1.00ade

Information:

a = significantly different from b and c

ab = significantly different from c and vice versa.

bc = significantly different from a and vice versa and so on.

The results of the Kruskal Wallis test of color parameters showed P<0.05, H0 was rejected, there was a significant difference in treatment (P10, P11, P12, and P13) on the taste of cassava leaf jerky. To see which groups were different, a Mann-Whitney test was performed. The results of the Mann-Whitney test showed that the level of preference for the taste of cassava leaf jerky was significantly different (p<0.05) at P10 and P11, P10 and P13, and P12 and P13. However, there was no significant difference (p>0.05) at P10 and P12, P11 and P12, P11 and P13.

7. Hedonic test of cassava leaf jerky based on aroma aspect.

   The hedonic test of cassava leaf jerky based on the aroma aspect can be seen in the following table:

Table 7. Hedonic Test of Cassava Leaf Jerky Based on Aroma Aspect

Parameter	Mean Value of Sample Hedonic Test			
	P10	P11	P12	P13
Aroma	3.80 ±0.61a	3.97±0.55bd	3.70±0.70ce	3.27±1.17ad

Information:

a = significantly different from b and c

ab = significantly different from c and vice versa

bc = significantly different from a and vice versa and so on.

The results of the Kruskal Wallis test of color parameters showed P<0.05, H0 was rejected, there was a significant difference in treatment (P10, P11, P12, and P13) on the aroma of cassava leaf jerky. To see which groups were different, a Mann-Whitney test was performed.

The results of the Mann-Whitney test showed that the level of preference for the aroma of cassava leaf jerky was significantly different (p<0.05) at P10 and P13, P11 and P13. However, it was not significantly different (p>0.05) at P10 and P11, P10 and P12, P11 and P12 and P12 and P13.

8. Hedonic test of cassava leaf jerky based on texture aspect.

The hedonic test of cassava leaf jerky based on texture aspects can be seen in the following table:

Table 8. Hedonic Test of Cassava Leaf Jerky Based on Texture Aspect

Parameter	Mean Value of Sample Hedonic Test			
	P10	P11	P12	P13
Texture	3.60 ±1.00a	3.97±0.55acd	4.03±0.41ae	3.60±1.07bd

Information:

a = significantly different from b and c

ab = significantly different from c and vice versa

bc = significantly different from a and vice versa and so on

The results of the Kruskal Wallis test of color parameters showed P<0.05, H0 was rejected, there was a significant difference in treatment (P10, P11, P12, and P13) on the texture of cassava leaf jerky. To see which groups were different, a Mann-Whitney test was performed.

The results of the Mann-Whitney test showed that the level of preference for the texture of cassava leaf jerky was significantly different (p<0.05) at P10 and P11, P10 and P12, and P11 and P13. However, there was no significant difference (p>0.05) at P10 and P13, P11 and P12, P12 and P13.

Color

Color is a visual characteristic that can be assessed by the eye, so if the color of the product produced is less attractive, it will reduce consumer preference for the product (Nintami and Rustanti, 2012).

Based on table 1.5, it shows that the acceptability of cassava leaf jerky in terms of color based on the most preferred criteria is P12 with a presentation of 100%, P11 with a presentation of 96.7%, P13 with a presentation of 63.3% and P10 with a presentation of 50%.

Cassava leaf jerky P12 is paler compared to P10, P11 and P13, this is influenced by the addition of fewer cassava leaves compared to the P10 and P11 formulas.

The results of the Kruskal Wallis test of color parameters showed $P<0.05$, H0 was rejected, there was a significant difference in treatment (P10, P11, P12, and P13) on the color of cassava leaf jerky. To see which groups were different, a Mann-Whitney test was performed.

The results of the Mann-Whitney test showed that the level of preference for the color of cassava leaf jerky was significantly different ($p<0.05$) at P10 and P11, P10 and P12. However, it was not significantly different ($p>0.05$) at P10 and P13, P11 and P12, P11 and P13 and P12 and P13.

This research is in line with the research conducted by Sari, NM, & Ninsix, R (2017) entitled The Effect of Adding Cassava Leaf Porridge (Manihot Esculenta) on the Characteristics of the Sticks Produced, which states that the higher the level of cassava leaf porridge addition, the browner the sticks produced.

In addition to the number of cassava leaves that affect the frying process, it also plays an important role in the color changes of the jerky and the heat treatment given causes differences in color for each formula.

Flavor

Taste is a stimulus that is caused by the product that is eaten and is felt by the sense of taste. The human tongue can generally only taste four types of tastes, namely, salty, sweet, sour, and bitter, but with the presence of aroma, the resulting taste will increase according to the aroma given (Midayanto and Yuwono, 2014).

Based on table 2.5, it shows that the acceptability of cassava leaf jerky in terms of taste based on the most preferred criteria is P12 with a presentation of 86.7%, P11 with a

presentation of 83.3%, P10 with a presentation of 70% and P13 with a presentation of 60%.

The taste of cassava leaf jerky is influenced by the amount of cassava leaves used. The more cassava leaves used, the more cassava leaves are tasted.

The results of the Kruskal Wallis test of color parameters showed P<0.05, H0 was rejected, there was a significant difference in treatment (P10, P11, P12, and P13) on the taste of cassava leaf jerky. To see which groups were different, a Mann-Whitney test was performed.

The results of the Mann-Whitney test showed that the level of preference for the taste of cassava leaf jerky was significantly different (p<0.05) at P10 and P11, P10 and P13, and P12 and P13. However, there was no significant difference (p>0.05) at P10 and P12, P11 and P12, P11 and P13.

Taste has the ability to detect the taste of sweet, salty, sour and bitter. In certain foods, these four tastes are combined to become a unique and interesting taste to enjoy.

Aroma

Aroma is the smell produced from food products, this is caused by the response of volatile compounds from a food product when it enters the nasal cavity and is perceived by the olfactory system (Tarwendah, 2017).

Based on table 3.5 above, it shows that the acceptability of cassava leaf jerky from the aroma aspect based on the most preferred criteria is P11 with a presentation of 80%, P10 with a presentation of 70%, P12 with a presentation of 63.3% and P13 with a presentation of 33.3%.

The results of the Kruskal Wallis test of color parameters showed P<0.05, H0 was rejected, there was a significant difference in treatment (P10, P11, P12, and P13) on the aroma of cassava leaf jerky. To see which groups were different, a Mann-Whitney test was performed.

The results of the Mann-Whitney test showed that the level of preference for the aroma of cassava leaf jerky was significantly different (p<0.05) at P10 and P13, P11 and P13. However, it was not significantly different (p>0.05) at P10 and P11, P10 and P12, P11 and P12 and P12 and P13.

The aroma spread by food is a very strong attraction and is able to stimulate the sense of smell so that it arouses appetite. The emergence of food aroma is caused by the

formation of volatile compounds as a result or reaction due to the work of enzymes or can also be formed without the help of enzyme reactions.

Texture

Texture is a material that consists of size, shape, quantity, and elements that form the material that can be felt by the senses of touch and taste, including the senses of mouth and sight (Antara and Wartini, 2014).

Based on table 4.5 above, it shows that the acceptability of cassava leaf jerky from the texture aspect based on the most preferred criteria is P12 with a presentation of 83.3%, P11 with a presentation of 80%, P10 with a presentation of 60% and P13 with a presentation of 46.7%.

The results of the Kruskal Wallis test of color parameters showed P<0.05, H0 was rejected, there was a significant difference in treatment (P10, P11, P12, and P13) on the texture of cassava leaf jerky. To see which groups were different, a Mann-Whitney test was performed.

The results of the Mann-Whitney test showed that the level of preference for the texture of cassava leaf jerky was significantly different (p<0.05) at P10 and P11, P10 and P12, and P11 and P13. However, there was no significant difference (p>0.05) at P10 and P13, P11 and P12, P12 and P13.

The texture of a product depends on the compactness of its constituent particles when the product is broken, while the quality of its texture is determined by the ease of breaking apart the constituent particles when the product is chewed, and the properties of the particles produced by assessing the texture of a material through the mouth can be felt when the material is broken or chewed and swallowed, (Almusawa M, 2013).

4. CONCLUSION

Based on the research that has been conducted, the conclusion in this study is that of the 4 treatments given, the most preferred treatment in terms of color aspect is P12 (100%), the taste aspect of treatment P12 (986.7), the aroma aspect P11 (80%) and the texture aspect P12 (83.3%).

SUGGESTION

For further research, it is hoped that variables such as water content and HCN in cassava leaves can be added.

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