Research Article

Sensory Acceptability of Roselle Leaves (*Hibiscus sabdariffa*) as Souring Agent in Instant Spice Mix

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Abstract

Roselle (Hibiscus sabdariffa) leaves have been growing in popularity in terms of their use in various fields and their potential in the market. Several studies have suggested further development and evaluation of roselle leaves as an additional food source. The purpose of this study is to develop an instant spice mix using the Roselle plant as the souring agent and determine its acceptability in terms of taste, color, texture, and aroma. The study used a completely randomized design with four experimental treatments and a control. Experimental treatments were composed of varying proportions of dried roselle leaves and tamarind powder. Sixty purposely selected respondents, comprising households, food production workers, food service workers, culinary instructors, and culinary students, acted as sensory quality evaluators in the study. The study revealed that all experimental treatments were acceptable in terms of aroma, color, and texture; the taste of experimental treatments 1, 2, and 3, including the control, was rated acceptable except for treatment 4, which contained pure dried roselle leaves. This study further aims to add to the existing knowledge on the utilization, evaluation, and acceptance of roselle leaves in food production.

Keywords:

Roselle leaves, instant food, spice mix, completely randomized design

1 Introduction

The roselle plant is known for its vast potential in the market. As reported, the market size for roselle was valued at 122.8 million US dollars in 2020 and will continue to rise by 252.6 million US dollars in 2030. This indicates that the economic potential for roselle products is quite high (Raju & Roshan, 2021). In Asia-Pacific, the market growth for roselle products based on the compound annual growth rate (CAGR) is forecast to increase by 11.8%, and the powder form of roselle segment has accounted for the highest contributor to the market size (KBV Research, 2021).

The plant has also been reported to include additional nutrients and vital elements such as phosphorus, magnesium, and calcium, which were sourced from its seeds (Da-Costa-Rocha et al., 2014). The calyces of the roselle are also particularly rich in riboflavin, with several major minerals present (Salami & Afolayan, 2020). Phytate, tannins, saponins, protease inhibitors, and oxalate were also identified (Salami & Afolayan, 2021) and have been connected with lower cancer risks. Regular consumption of roselle has also been discovered to prevent nutritional deficiency disorders such as night blindness, scurvy, and rickets (Gemede & Ratta, 2014).

Roselle leaves can be either cooked, steamed, or crushed on a grinding stone and are regarded as a delicacy in many countries due to the preservation of the sour taste of the leaves (Salami & Afolayan, 2021). The acid-rich roselle plant has been used as a souring agent for centuries across the world and is also used in the Filipino soup called sinigang (Queypo-Queddeng, 2011). A sinigang may be prepared with prawns, fish, and pork and is soured by different ingredients; and some households use roselle leaves.

The demand for ready-to-eat, ready-to-cook, ready-to-serve, or instant foods is continuously rising (Mitra & Sharma, 2020). In contemporary society, time has become more valuable and limited, and with the bustling lifestyle, instant products are becoming popular and playing an important part in an individual's life because they require little preparation time (Ali & Ibrahim, 2018). People who are working and living alone outside their families also increase their demand for instant food as it saves time and other resources (Keerthana & Amsaveni, 2022). With this, the present study aimed to develop an instant spice mix made from the leaves of the roselle plant (*Hibiscus sabdariffa*). Specifically, this study sought to determine the level of acceptability in terms of the sensory qualities of the experimental instant spice mix with varying amounts of roselle leaves as a souring agent. This study may be beneficial in maximizing the existing functions of the roselle leaves and, at the same time, contributing to the global trend of instant foods in the form of an instant soup base.

2 Methodology

2.1 Materials

The materials and equipment needed in the production process were the following: a drying rack, food processor, strainer, chopping board, kitchen knife, and bowls; a cooking pot; a wooden spoon; and a weighing scale. Disposable paper cups with covers

for individual packaging of the treatments were also needed. It was guaranteed that all materials and equipment used were clean, thoroughly washed, sterilized, and dried as needed.

2.2 Production of Roselle Leaves Powder and the Spice Mix

In producing roselle powder, clippings of fresh roselle stems were gathered and washed thoroughly; the unnecessary parts, such as deceased leaves or yellowed parts, were removed; and the stems were thoroughly cleaned for any soil, dirt, pests, or insects present. After washing, the clippings were shaken gently to get rid of extra moisture. It was then placed on a drying rack to dry in the sun. It took three days, from 9:00 in the morning until 3:00 in the afternoon, to completely dry the leaves. After it was dried, the leaves were placed into a food processor to pulverize and then sifted to get a more refined texture. In producing the experimental spice mix, ingredients such as roselle leaves, onions, and taro were dried and pulverized to get a uniform texture. All the ingredients were mixed together. The researchers utilized the Culinary Practical Kitchen Laboratory facility of Joji Ilagan International School of Hotel and Tourism Management as the experiment venue, particularly for storage and production of the treatments.

2.3 Composition Experimental Treatments and Control

The researchers utilized a Completely Randomized Design (CRD) with five treatments as shown in Table 1. Each treatment was labeled as T1 (Treatment 1), T2 (Treatment 2), T3 (Treatment 3), T4 (Treatment 4), and T5 (Treatment 5) for easier identification. Treatments 1, 2, 3, and 4 were the experimental treatments while Treatment 5 is the control treatment. The formula of the control treatment was based on a commercial instant tamarind soup base mix available in the local market. The rest of the treatments followed the same formula as the control treatment but varied in the amount of Roselle powder and tamarind powder.

Table 1: Experimental Treatments and the Control

Treatment	Composition
T1	7g Roselle Powder + 21g Tamarind Powder + 2g Salt + 4g Onion Powder + 4g Tomato Powder + 2g Taro Powder + 2g MSG + 2g Sugar
T2	14g Roselle Powder + 14g Tamarind Powder + 2g Salt + 4g Onion Powder + 4g Tomato Powder + 2g Taro Powder + 2g MSG + 2g Sugar
T3	21g Roselle Powder + 7g Tamarind Powder + 2g Salt + 4g Onion Powder + 4g Tomato Powder + 2g Taro Powder + 2g MSG + 2g Sugar
T4	28g Roselle Powder + 2g Salt + 4g Onion Powder + 4g Tomato Powder + 2g Taro Powder + 2g MSG + 2g Sugar
T5 (control)	28g Tamarind Powder + 2g Salt + 4g Onion Powder + 4g Tomato Powder + 2g Taro Powder + 2g MSG + 2g Sugar

Treatments were packed individually, with a weight of 44 grams per pack. To prepare the soup for sensory evaluation, each pack of the treatment was diluted in two liters of boiling water per batch. Each evaluator was given a sample of the soup from every treatment in soup bowls. The production process and sensory evaluation methods of this research were inspired by the studies of Dormido et al. (2019) and Tappy et al. (2019), which explored souring agents using other fruits.

2.4 Research Participants and Method

Sixty (60) individuals were purposely selected for this study to give their evaluation rates on the sensory qualities of the treatments. The researchers considered individuals who have a background in food production and evaluation. They were composed of a random mix of households, including mothers who frequently cook sinigang dishes, food production workers, food-service workers, culinary instructors, and culinary students within General Santos City, Philippines.

Before conducting the sensory evaluation, the researchers secured permission from the administration of the Joji Ilagan International School of Hotel and Tourism Management as well as the local government unit of the city to conduct the study. Upon receiving approval, the researchers set up a survey station in General Santos Oval Plaza. The said area was the most favorable venue to get a good number of participants, being known as a diversely crowded spot in the city.

During the survey, participants were asked to participate voluntarily. The purpose of the study was explained. Each treatment was labeled randomly. The participants were provided with drinking water to cleanse their palates before tasting each treatment for an accurate sensory evaluation.

A four-point scale was used to measure the level of acceptability of each treatment in this study. Responses range from 1 (disliked much) to 4 (liked much). Each treatment was rated for its sensory qualities in terms of aroma, texture, color, and taste. The mean was used to describe the acceptability of the treatments, and Kruskal-Wallis and Tukey HSD post hoc analyses were used to analyze the significant difference between the levels of acceptability in terms of sensory qualities of a commercial instant spice mix and the developed instant spice mix with roselle leaf powder in varying amounts, and the significant difference between the levels of acceptability in terms of sensory qualities of the experimental treatments.

3 Findings

3.1 Acceptability of the Experimental Treatments and the Control

This research comprised of sixty (60) evaluators. Majority of the respondents are culinary students (62%) followed by food service workers (18%) and food production workers (11%).

Table 2 shows the general acceptability level of experimental treatments of roselle leaves spice mix. It shows that all experimental treatments and the control are described as acceptable. Only treatment 4 got the lowest rating of acceptability in terms of taste.

Table 2: Acceptability of the Experimental Treatments and the Control in Terms of the Sensory Qualities

Treat-ments	Aroma		Texture		Color		Taste	
	mean	description	*mean*	description	*mean*	description	*mean*	description
T1	3.07	Acceptable	3.03	Acceptable	3.00	Acceptable	3.05	Acceptable
T2	3.02	Acceptable	2.97	Acceptable	3.00	Acceptable	3.23	Acceptable
T3	3.05	Acceptable	3.18	Acceptable	3.20	Acceptable	3.30	Acceptable
T4	3.03	Acceptable	3.02	Acceptable	3.07	Acceptable	2.37	Unacceptable
T5 (Control)	3.40	Highly Acceptable	3.22	Acceptable	3.26	Highly Acceptable	3.25	Acceptable

Using the Kruskal-Wallis H Test to determine the difference between the levels of acceptability in terms of the aroma of the experimental groups and the control group, as shown in Table 3, it shows that the p-value (0.000) is less than the significance value (0.05). Therefore, there is a significant difference in the level of acceptability in terms of the aroma of the treatments. Referring to Table 4, it is observed that a significant difference is highlighted between the experimental treatments and the control. Experimental treatments showed no significant difference in terms of aroma.

Table 3: Kruskal-Wallis H Test for Difference between the Levels of Acceptability in terms of Aroma

Groups	N	Median	Rank Sum	*H-stat*	p-value	Remarks
T1	60	3	8622	14.757	0.000	With significant difference*
T2	60	3	8302			
T3	60	3	8470			
T4	59	3	8168			
T5 (Control)	60	3	11 288			

*There is a significant difference (P-value < 0.05)

The Tukey HSD post hoc analysis was applied to determine the difference between treatments. It was revealed, as shown in Table 4, that there was no significant difference between the treatments in their level of acceptability in terms of aroma, but there was a significant difference between the treatments and the control.

Table 4: Tukey HSD *post hoc* Analysis for Difference between the Levels of Acceptability in terms of Aroma

Groups		Mean	q-stat	p-value	Remarks
T1	Treatment 2	0.050	0.733	0.985	no sig. dif.
	Treatment 3	0.017	0.245	1.000	no sig. dif.
	Treatment 4	0.033	0.479	0.997	no sig. dif.
	Control	0.333	4.892	0.006	with sig. dif.
T2	Treatment 1	0.050	0.733	0.985	no sig. dif.

	Treatment 3	0.033	0.489	0.997	no sig. dif.
	Treatment 4	0.017	0.252	1.000	no sig. dif.
	Control	0.383	5.626	0.001	with sig. dif.
T3	Treatment 1	0.017	0.245	1.000	no sig. dif.
	Treatment 2	0.033	0.489	0.997	no sig. dif.
	Treatment 4	0.016	0.235	1.000	no. sig. dif.
	Control	0.350	5.137	0.003	with sig. dif.
T4	Treatment 1	0.033	0.479	0.997	no sig. dif.
	Treatment 2	0.017	0.252	1.000	no sig. dif.
	Treatment 3	0.016	0.235	1.000	no. sig. dif.
	Control	0.366	5.350	0.002	with sig. dif.
T5 (Control)	Treatment 1	0.333	4.892	0.006	with sig. dif.
	Treatment 2	0.383	5.626	0.001	with sig. dif.
	Treatment 3	0.350	5.137	0.003	with sig. dif.
	Treatment 4	0.366	5.350	0.002	with sig. dif.

In Table 5, the Kruskal-Wallis H test was used to determine the difference between the levels of acceptability in terms of the color of the experimental groups and the control group. The p-value (0.002) is less than the significance value (0.05). Therefore, there is a significant difference between the level of acceptability in terms of the color of the experimental groups and the control group. Hence, the developed instant spice mix with roselle leaf powder as a souring agent does not have the same level of acceptability as tamarind powder.

Table 5: Kruskal-Wallis H Test for Difference between the Levels of Acceptability in terms of Color

Groups	N	Median	Rank Sum	*H-stat*	p-value	Remarks
T1	60	3	8026.5	9.092	0.002	With significant difference*
T2	60	3	8026.5			
T3	60	3	9816			
T4	60	3	8797			
T5 (Control)	58	3	9885			

*There is a significant difference (P-value < 0.05)

In Table 6, the Tukey HSD post hoc analysis was applied to determine the difference between treatments. It was revealed in Table 5 that there was no significant difference between the level of acceptability in terms of the color of treatment 1 and the rest of the groups. However, there was a significant difference between treatment 1 and the control. It was also revealed that there was no significant difference between treatment 2 and the rest of the treatments except the control. For treatments 3 and 4, there was no significant difference between the levels of acceptability in terms of the color of the said treatments and the rest of the treatments, including the control.

Table 6: Tukey HSD *post hoc* Analysis for Difference between the Levels of Acceptability in terms of Color

Groups		Mean	q-stat	p-value	Remarks
T1	Treatment 2	0.000	0.000	1.000	no sig. dif.
	Treatment 3	0.200	3.253	0.148	no sig. dif.
	Treatment 4	0.067	1.084	0.940	no sig. dif.

	Control	0.259	4.171	0.028	with sig. dif.
T2	Treatment 1	0.000	0.000	1.000	no sig. dif.
	Treatment 3	0.200	3.253	0.148	no sig. dif.
	Treatment 4	0.067	1.084	0.940	no sig. dif.
	Control	0.259	4.171	0.028	with sig. dif.
T3	Treatment 1	0.200	3.253	0.148	no sig. dif.
	Treatment 2	0.200	3.253	0.148	no sig. dif.
	Treatment 4	0.133	2.169	0.542	no. sig. dif.
	Control	0.059	0.945	0.963	no sig. dif.
T4	Treatment 1	0.067	1.084	0.940	no sig. dif.
	Treatment 2	0.067	1.084	0.940	no sig. dif.
	Treatment 3	0.133	2.169	0.542	no. sig. dif.
	Control	0.192	3.096	0.187	no sig. dif.
T5 (Control)	Treatment 1	0.259	4.171	0.028	with sig. dif.
	Treatment 2	0.259	4.171	0.028	with sig. dif.
	Treatment 3	0.059	0.945	0.963	no sig. dif.
	Treatment 4	0.192	3.096	0.187	no sig. dif.

The Kruskal-Wallis H test was used to determine the difference between the levels of acceptability in terms of the texture of the experimental groups and the control group (as shown in Table 7). The p-value (0.005) is less than the significance value (0.05); therefore, there is a significant difference between the level of acceptability in terms of the texture of the experimental groups and the control group. Hence, the developed instant spice mix with roselle leaf powder as a souring agent does not have the same level of acceptability in terms of texture as tamarind powder.

Table 7: Kruskal-Wallis H Test for Difference between the Levels of Acceptability in terms of Texture

Groups	N	Median	Rank Sum	*H-stat*	p-value	Remarks
T1	60	3	8598.5	7.603	0.005	With significant difference*
T2	60	3	8049			
T3	60	3	9900.5			
T4	60	3	8470.5			
T5 (Control)	60	3	10131.5			

*There is a significant difference (P-value < 0.05)

The Tukey HSD post hoc analysis was applied to determine the difference between treatments, as shown in Table 8. It was revealed that there was no significant difference between the level of acceptability in terms of the texture of treatment 1 and the rest of the groups. It was also revealed that there was no significant difference between treatment 2 and the rest of the experimental groups. However, there was a significant difference between treatment 2 and the control. Furthermore, there was no significant difference between treatment 3 and all the treatments, including the control. Lastly, there was no significant difference between treatment 4 and all of the treatments, including the control.

Table 8: Tukey HSD *post hoc* Analysis for Difference between the Levels of Acceptability in terms of Texture

Groups		Mean	q-stat	p-value	Remarks
T1	Treatment 2	0.067	1.164	0.923	no sig. dif.
	Treatment 3	0.150	2.620	0.346	no sig. dif.
	Treatment 4	0.017	0.291	1.000	no sig. dif.
	Control	0.183	3.202	0.160	no sig. dif.
T2	Treatment 1	0.067	1.164	0.923	no sig. dif.
	Treatment 3	0.217	3.784	0.060	no sig. dif.
	Treatment 4	0.050	0.873	0.972	no sig. dif.
	Control	0.250	4.367	0.019	with sig. dif.
T3	Treatment 1	0.150	2.620	0.346	no sig. dif.
	Treatment 2	0.217	3.784	0.060	no sig. dif.
	Treatment 4	0.167	2.911	0.241	no. sig. dif.
	Control	0.033	0.582	0.993	no sig. dif.
T4	Treatment 1	0.017	0.291	1.000	no sig. dif.
	Treatment 2	0.050	0.873	0.972	no sig. dif.
	Treatment 3	0.167	2.911	0.241	no. sig. dif.
	Control	0.200	3.493	0.100	no sig. dif.
T5 (Control)	Treatment 1	0.183	3.202	0.160	no sig. dif.
	Treatment 2	0.250	4.367	0.019	with sig. dif.
	Treatment 3	0.033	0.582	0.993	no sig. dif.
	Treatment 4	0.200	3.493	0.100	no sig. dif.

In Table 9, the Kruskal-Wallis H test was used to determine the difference between the levels of acceptability in terms of taste of the experimental groups and the control group. The p-value (0.000) is less than the significance value (0.05). Therefore, there is a significant difference between the level of acceptability in terms of taste between the experimental groups and the control group. Hence, the developed instant spice mix with roselle leaf powder as a souring agent does not have the same level of acceptability as tamarind powder.

Table 9: Kruskal-Wallis H Test for Difference between the Levels of Acceptability in terms of Taste

Groups	N	Median	Rank Sum	*H-stat*	p-value	Remarks
T1	60	3	8916	56.466	0.000	With significant difference*
T2	60	3	10288			
T3	60	3	10816			
T4	60	2	4700			
T5 (Control)	58	3	10430			

*There is a significant difference (P-value < 0.05)

The Tukey HSD post hoc analysis was applied to determine the difference between treatments. It was revealed in Table 10 that only treatment 4 has a significant difference in the level of acceptability compared to all the treatments, including the control. In other words, treatments 1, 2, and 3, as well as the control, had no significant difference in their levels of acceptability in terms of taste.

Table 10: Tukey HSD *post hoc* Analysis for Difference between the Levels of Acceptability in terms of Taste

Groups		Mean	q-stat	p-value	Remarks
T1	Treatment 2	0.183	2.400	0.438	no sig. dif.
	Treatment 3	0.250	3.271	0.146	no sig. dif.
	Treatment 4	0.683	8.942	0.000	with sig. dif.
	Control	0.200	2.617	0.347	no sig. dif.
T2	Treatment 1	0.183	2.400	0.438	no sig. dif.
	Treatment 3	0.067	0.872	0.972	no sig. dif.
	Treatment 4	0.867	11.341	0.000	with sig. dif.
	Control	0.017	0.218	1.000	no sig. dif.
T3	Treatment 1	0.250	3.271	0.146	no sig. dif.
	Treatment 2	0.067	0.872	0.972	no sig. dif.
	Treatment 4	0.933	12.213	-0.000	with sig. dif.
	Control	0.050	0.654	0.991	no sig. dif.
T4	Treatment 1	0.683	8.942	0.000	with sig. dif.
	Treatment 2	0.867	11.341	0.000	with sig. dif.
	Treatment 3	0.933	12.213	-0.000	with sig. dif.
	Control	0.883	11.560	0.000	with sig. dif.
T5 (Control)	Treatment 1	0.200	2.617	0.347	no sig. dif.
	Treatment 2	0.017	0.218	1.000	no sig. dif.
	Treatment 3	0.050	0.654	0.991	no sig. dif.
	Treatment 4	0.883	11.560	0.000	with sig. dif.

3.2 Significant difference between the levels of acceptability in terms of sensory qualities of the experimental treatments

Table 11: Summary Table for the Difference between the Levels of Acceptability

Sensory Qualities	*H-stat*	p-value	Remarks
Aroma	14.757	0.000	With significant difference
Texture	7.603	0.005	With significant difference
Color	9.092	0.002	With significant difference
Taste	56.466	0.000	With significant difference

There is a significant difference (P-value < 0.05)

Table 11 shows a summary of the difference between the levels of acceptability of the experimental treatments and the control variable. All the p-values are less than the significance level (0.05); therefore, generally, the experimental treatments and the control group have a significant difference in their levels of acceptability in terms of the different sensory qualities, namely aroma, texture, color, and taste. Hence, the developed instant spice mix with roselle leaves as a souring agent and the control (tamarind powder) have different levels of acceptability in their sensory qualities.

4 Conclusion

The tabulated analysis and interpretation show that all experimental treatments with varying amounts of roselle leaf powder were acceptable in terms of aroma, color, and texture. The taste of experimental treatments 1, 2, 3, and the control was rated acceptable except for treatment 4, which has a pure content of dried roselle leaves. The study also concluded that the experimental treatments and the control group had a significant difference in their levels of acceptability in terms of different sensory qualities, namely: aroma, color, texture, and taste. It has been observed that the most comparable experimental treatment to the commercial treatment is treatment 3. This suggests that the utilization of roselle leaves as a souring agent in a spice mix is acceptable.

This study recommends that further study be undertaken to analyze the shelf life of the product and the cost comparison analysis between the experimental treatments and the control, or standard, instant spice mix. Other plant sources as souring agents may be studied, as may one of the components of an instant spice mix.

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