CONSUMERS' PREFERENCES ON DIFFERENT KALAMANSI NIP VARIANTS (PLAIN KALAMANSI, WITH CARROTS, WITH CUCUMBER, WITH CHAYOTE)

EDELYN S. ALBISO, JAMAICA MERALLES, RICHEL JOY BITGUE, IMELDA MARIANO, ERLINDA M. PALACIO
SPAMAST- Institute of Agriculture and Entrepreneurial Studies

Corresponding Authors: ***edsalbiso@yahoo.com; jmeralles@spamast.edu.ph***

ABSTRACT

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The study was conducted to explore and introduce alternative variants in the processing of Kalamansi nip aside from the currently produced Kalamansi nip with ginger extract. An experiment was carried out using a Complete Randomized Design with four treatments: T1 – plain Kalamansi, T2 – Kalamansi with carrots, T3 – Kalamansi with cucumber, and T4 – Kalamansi with chayote, each replicated three times. Samples were subjected to sensory evaluation using a 9-point Hedonic Scale, assessing taste, odor, color, and general acceptability, with 90 evaluators—mostly female, in their late 20s, college graduates, and married—participating. Nutrient analysis and cost-return analysis were also performed for each treatment. Results showed that all the proposed variants were acceptable and viable for market introduction, concluding that chayote, carrots, and cucumber are promising variants in terms of both acceptability and nutrient content. Furthermore, Kalamansi nip juice

production offered a potential return on sales of 32% to 33%, generating a net income of ₱37 to ₱40 per bottle, which could triple when processed further into Kalamansi juice, yielding ₱121 to ₱125 per 350-ml bottle.

INTRODUCTION

In support of the nation's objective of capacity building and productivity enhancement among farmers, women, and their families (Davao Regional Development Plan 2017-2022), this project aims to provide a potential source of livelihood to target beneficiaries and facilitate the mobility of agricultural products produced within the province and nearby areas. Chapter 8 of the Regional Development and Investment Program 2017-2022 outlines strategies for the state and region to significantly grow the agriculture, fishery, and forestry sectors, increasing access to economic opportunities for small farmers and fisherfolk (Brown et al., 2018). Aligned with this thrust, the study introduced innovations and developed products to enhance agricultural productivity by adding value to and utilizing agricultural commodities. Additionally, the production and development of agri-based commodities known for their health benefits can boost consumers' immune systems, especially amid the current pandemic.

Currently, the Institute of Agricultural Technology and Agribusiness Department is processing plain Kalamansi nip and Kalamansi nip with ginger extract. This research project explored additional variants of Kalamansi nip beyond the existing ginger extract variant (Albiso et al., 2019; Duque & Albiso, 2018; Uy & Albiso, 2018), such as incorporating locally available vegetables known for their health benefits: carrot, cucumber, and chayote.

Kalamansi is a seasonal agricultural commodity with highly variable prices—often low during peak seasons and high during lean periods. Additionally, Kalamansi is perishable, frequently spoiling before sale, causing significant losses as prices often fail to cover production costs. Processing Kalamansi during high-production seasons presents an alternative approach to mitigate these challenges.

Several farmers in the province, particularly in Barangays Lacaron, Talogoy, and Demoloc in Malita municipality, cultivate Kalamansi, with over 1,000 fruit-bearing plants. However, while Kalamansi sells at ₱50 to ₱80 per kilo in public markets, farmers typically receive only ₱20 to ₱30 per kilo or less during peak seasons, resulting in wasted produce. Therefore, the project aims to explore and develop products utilizing Kalamansi for social enterprise development.

Nutritional Profiles of Selected Variants

Carrot: A root vegetable rich in carotenoids, flavonoids, polyacetylenes, vitamins, and minerals, carrots provide multiple health benefits such as

antioxidant, anticarcinogenic, and immune-enhancing properties (da Silva Dias, 2014). Containing about 10% carbohydrates, primarily starch, fiber, and simple sugars, carrots are extremely low in fat and protein. They are an excellent source of vitamin A (beta-carotene), several B vitamins, vitamin K, and potassium (Bjarnadottir, 2019).

Chayote (Sechium edule): Locally available, especially in Barangay Little Baguio, chayote enjoys widespread consumer acceptance due to its nutritional and bio-functional properties. Vieira et al. (2018) highlighted chayote's diverse nutritional, phytochemical, and pharmacological attributes and its potential applications in food, cosmetics, pharmaceuticals, nanotechnology, and biotechnology. Recovering valuable compounds from chayote by-products also presents economic and environmental benefits for waste management.

Cucumber: Related to melons and characterized by about 15 calories per cup and 95% water content, cucumbers contain lignans, vitamin K, cucurbitacins and derivatives (triterpenoids), flavonoids (apigenin, luteolin, quercetin, kaempferol), antioxidants such as beta-carotene, vitamins B and C, and trace minerals (Murad, 2020). Their high water content and nutrients make cucumbers excellent as a water supplement and a potential alternative to sports drinks. Moreover, cucumbers can be used topically, internally, and aid in mood stabilization by modulating stress.

These four Kalamansi nip variants—plain, with carrot, cucumber, and chayote—were subjected to sensory evaluation by selected faculty and staff of SPAMAST-Malita Campus. The research outputs aim to generate additional income sources for target beneficiaries, particularly women from Barangay Buhangin, as part of the college's extension program.

Objectives

The study aimed primarily to explore alternative variants in Kalamansi nip production. Specifically, it sought to:

1. Determine the acceptability of Kalamansi nip variants with agricultural commodities (carrot, cucumber, chayote) in terms of odor, color, viscosity, and general acceptability.
2. Determine the nutrient contents of the different Kalamansi nip variants.
3. Conduct microbial analysis on the different Kalamansi nip variants, including:

   3.1. Determining the shelf-life of Kalamansi nip.

   3.2. Performing a cost-benefit ratio analysis for the processing of Kalamansi nip and juice.

MATERIALS AND METHODS

Research Design

An experimental research design in Complete Randomized Design was used in the study, with four treatments and three replications per treatment. The study involved 30 evaluators in every replication, or a total of 90 evaluators who conducted a sensory evaluation of the Kalamansi nip in different variants as follows:

T1- Plain Kalamansi nip
T2-Kalamansi nip with carrots
T3-Kalamasni nip with cucumber
T4-Kalamansi nip with chayote

Processing of Kalamansi nip

The processing of Kalamansi nip with other variants was similar to the preparation of Kalamansi nip with ginger extract (Albiso et al., 2019). The same ratio was also used, but was only replaced with the proposed variants (Plain kalamansi, with carrots, with cucumber, and with chayote) as follows:

60% - sugar
30% - Kalamansi
10% - variants (plain kalamansi, carrots, cucumber, and chayote)

Data Gathering Procedure

The following data were gathered from the study:

Acceptability Ratings. The acceptability of the Kalamansi nip in different variants was determined through sensory evaluation in terms of odor, color, taste, and general acceptability using a 9-point Likert Scale as follows:

9 - Liked Extremely
8 – Liked Very Much
7 – Liked Moderately
6 – Liked slightly
5 – Neither Liked nor Disliked
4 – Disliked slightly
3 – disliked moderately
2 – disliked very much
1 – disliked extremely

Nutrient Analysis. Samples of Kalamansi nip in different variants were produced on November 28, 2020. Packed in glass bottles, the researchers submitted the samples to the UIC Science Resource Center for nutrient analysis. Results of the analysis were reported 17 days from the day they were produced. The following tests were conducted to determine the calories, carbohydrates, total sugar, crude fat, crude protein, total solids, ash, sodium, iron, calcium, magnesium, potassium, and phosphorus.

Microbial Analysis. Samples of Kalamansi nip in different variants were produced and packed into glass bottles and submitted to the UIC Science Resource Center for microbial analysis. Results of the analysis were reported 21 days from the day they were produced.

Cost-Benefit Ratio. The cost to produce and the benefits in terms of income from processing were determined and analyzed. This was done to know the income potential in the processing of Kalamansi nip and juice.

Statistical Analysis

Analysis of Variance in a Complete Randomized Design was used to determine variances in the acceptability scores of Kalamansi nip in different variants in terms of color, odor, taste, and general acceptability. Results with significant differences were subjected to post-hoc Analysis.

RESULTS AND DISCUSSION

Sensory Evaluators' Profile

Kalamansi juice using the produced Kalamansi nip in different variants was evaluated by 30 evaluators for every replication, or a total of 90 sensory evaluators. The evaluators had an average age of 29.67 years, and most of them were female (61.11%). In terms of educational attainment, most of the respondents were college graduates (78.89%) and were married (63.33%).

Table 1. *Profile of the sensory evaluators*

Particulars	f	%	Mean
Age			29.67 years old
Gender			
Female	55	61.11	
Male	35	38.89	
Total	90	100	
Educational Level		-	
Elementary Graduates	4	4.44	
High School Graduate	7	7.78	
College Graduate	71	78.89	
Master's Degree Holder	6	6.67	
Doctor's Degree Holder	2	2.22	
Total	90	100	
	90	100	
Civil Status		-	
Single	33	36.67	
Married	57	63.33	
Total	90	100	

Acceptability of Kalamansi juice in different variants in terms of taste. Table 1 shows the acceptability score results on the sensory evaluation of Kalamansi juice in different variants in terms of taste. Results of the study show that the Kalamansi nip with carrots shows the highest acceptability rating of 7.52, which was described as "Liked Very Much." The rest of the treatments were "Liked Moderately." Analysis of variance showed a significant difference from the control that was noted on T4 (Chayote), which implies significantly lower acceptability. Nevertheless, the acceptability of Chayote, just like the other treatments, was high at 6.93 (Liked Much).

Table 1. *Acceptability scores of Kalamansi juice in different variants in terms of taste*

Particulars	Mean	Description	f	F	
				1%	5%
T1-Pure Kalamansi nip	7.47	LM	4.673*	4.070	7.59
T2-with carrots	7.52	LVM			
T3-with cucumber	7.17	LM			
T4-with chayote	6.93	LM*			

* - Significant

Acceptability of Kalamansi juice in different variants in terms of odor

Table 2 shows the acceptability score results on the sensory evaluation of Kalamansi juice in different variants in terms of odor. Results of the study show that the juice with pure or plain Kalamansi nip had the highest acceptability rating of 7.12, whereas those with cucumber and chayote were less acceptable. Some evaluators who made remarks on the samples, they had noted a somewhat unpleasant odor that was evident in the nip with cucumber and chayote. However, all were described as "liked moderately," and Analysis of Variance showed no significant difference in the acceptability of Kalamansi juice regardless of the variant used.

Table 2. *Acceptability scores of Kalamansi juice in different variants in terms of odor*

Particulars	Mean	Description	f	F	
				1%	5%
T1-Pure Kalamansi nip	7.12	LM	0.875ns	4.070	7.59
T2-with carrots	7.10	LM			
T3-with cucumber	6.66	LM			
T4-with chayote	6.77	LM			

ns - not significant

Acceptability of Kalamansi juice in different variants in terms of color

Table 3 shows the acceptability score results on the sensory evaluation of Kalamansi nip in different variants in terms of color. Results of the study show that the Kalamansi nip with carrots shows to have the highest acceptability rating of 7.48. However, all treatments were liked moderately. A significant difference was noted between T3 and T1, whereas a highly significant difference was noted between T2 and T3.

It was noted that the color of the Kalamansi juice, when mixed with water, was almost the same. This may be attributed to the color of the brown sugar used, which was notable in all treatments. Moreover, the orange color of the carrot extract was able to produce a more delightful color.

Table 3. *Acceptability scores of Kalamansi juice in different variants in terms of color*

Particulars	Mean	Description	f	F	
				1%	5%
T1-Pure Kalamansi nip	7.28	LM	5.854*	4.070	7.59
T2-with carrots	7.48	LM			
T3-with cucumber	6.86	LM*			
T4-with chayote	7.20	LM			

*-significant

General acceptability of Kalamansi nip in different variants

Results on the general acceptability of Kalamansi nip in different variants are shown in Table 4. Data shows that the Kalamansi nip with carrots had the highest acceptability rating of 7.74, followed by the plain Kalamansi nip with 7.50. Both were described as "Liked Very Much." Kalamansi nip with cucumber and chayote was liked moderately.

Based on the Analysis of Variance, the general acceptability of T3 (cucumber) was significantly lower than T2 (Carrots), whereas T4 (Chayote) was highly and significantly lower than the acceptability of carrots. However, it could be noted that despite some negative remarks on the odor of cucumber and chayote, the samples were generally liked by the evaluators.

Table 4. *General Acceptability scores of Kalamansi juice in different variants*

Particulars	Mean	Description	f	F	
				1%	5%
T1-Pure Kalamansi nip	7.50	LVM	7.238*	4.070	7.59
T2-with carrots	7.74	LVM			
T3-with cucumber	7.31	LM			
T4-with chayote	7.01	LM			

*-significant

Nutrient Analysis

Samples of Kalamansi nip in different variants were produced and packed in glass bottles and submitted to the UIC Science Resource Center for nutrient analysis. Results of the analysis were reported 17 days from the day they were produced. Tests were also conducted to determine the calories, carbohydrates, total sugar, crude fat, crude protein, total solids, ash, sodium, iron, calcium, magnesium, potassium, and phosphorus. Methods used were of the Official Methods of Analysis of AOAC International, 19th ed.

Results of the nutrient analysis showed that Kalamansi nip with Carrots contains the highest amount of calories which reaching up to 298 kcal/100g.

The human body uses calories from food for walking, thinking, breathing, and other important functions. In terms of carbohydrates, which is the body's main source of energy, the highest recorded amount was 74.34% found in Kalamansi nip with carrots, followed by Kalamansi nip, Kalamansi nip with chayote, and Kalamansi nip with cucumber. For the total sugars, the result showed that Kalamansi nip with chayote contained the highest amount, which was 56.28% followed by Kalamansi nip with cucumber (53.46%), Kalamansi nip with carrots (50.59%), and Kalamansi nip (45.29%). The crude fat of the four samples was also analyzed, but the result showed <0.01 crude fat content. Moreover, for the crude protein, only trace amounts were found, with 0.26% crude protein being the highest from Kalamansi nip with carrots.

Total solids content present in the samples was also determined, wherein results showed that Kalamansi nip with carrots contained the highest amount of 74.83%, followed by Kalamansi nip (74.18%), Kalamansi nip with chayote (73.94%), and Kalamansi nip with cucumber (72.75%). In terms of ash content, Kalamansi nip with carrots showed the highest value of 0.23%.

Minerals are those elements on the earth and present in foods that our bodies need to develop and function normally. Examples of essential minerals for health include calcium, phosphorus, potassium, sodium, magnesium, etc. Kalamansi nip with chayote showed a very high amount of sodium, which reached 72.14 μg/g, compared to the other samples, which only ranged from 21.46 μg/g-47.72 μg/g. The next mineral is iron, which is very important for growth and development. Kalamansi nip with cucumber showed the highest amount of iron (1.20 μg/g). Moreover, another mineral that is important to

Health is calcium. The human body needs calcium to maintain strong bones and carry out many important functions. The result of the nutrient analysis showed that both Kalamansi nip and Kalamansi nip with carrots contained 116 μg/g. Magnesium is one of the important minerals in our body; it helps in maintaining the proper levels of other minerals such as calcium, potassium, and zinc. Based on the results, Kalamansi nip contained the highest amount of magnesium with a value of 78.65 μg/g.

Table 5. *Nutrient test results on Kalamansi Nip in different variants*

Minerals	Kalamansi nip (Plain)	Kalamansi nip with carrots	Kalamansi nip with chayote	Kalamansi nip with cucumber
Calories, kcal/100g	296	298	295	290
Carbohydrates, %	73.75	74.34	73.57	72.34
Total Sugars, %	45.29	50.59	56.28	53.46
Crude Fat, %	<0.01	<0.01	<0.01	<0.01
Crude Protein, %	0.27	0.26	0.19	0.23
Total Solids, %	74.18	74.83	73.94	72.75
Ash, %	0.16	0.23	0.18	0.18
Sodium, µg/g	21.46	47.72	72.14	37.55
Iron, µg/g	0.92	1.12	0.89	1.20
Calcium, µg/g	116	116	110	105
Magnesium, µg/g	78.65	74.92	71.00	70.16
Potassium, µg/g	306	535	368	277
Phosphorus, µg/g	57.94	75.35	55.18	54.76

Potassium is known to be one of the most important minerals in the body. It helps regulate fluid balance, muscle contractions, and nerve signals. Kalamansi nip with carrots showed a very large amount of potassium present in the sample, which reached 535 µg/g compared to the other three samples, which ranged only from 277 µg/g to 368 µg/g. Moreover, the phosphorus content of the Kalamansi nip with different mixtures was determined. Kalamansi nip with carrots (75.35 µg/g) showed a very large amount of phosphorus compared to Kalamansi nip (57.94 µg/g), Kalamansi nips with chayote (55.18 µg/g), and Kalamansi with cucumber (54.76 µg/g).

Cost-benefit ratio analysis

Tables 6 and 7 below show the cost and return data in the processing of Kalamansi nip. The given mixtures and ratios of ingredients can produce 21 350ml bottles of Kalamansi nip, which could be sold at P100 per bottle or a total of P2,100. The costs of raw materials used differed among variants based on their market price during the processing. The labor and overhead costs were based on the man/day requirement in the processing at P500 per day, which was above the minimum wage rate in the region.

Based on the given data, the return could range from 37% to 40%, with

the highest return obtained from Kalamansi nip with chayote. Chayote was the cheapest among the variants. When purchased wholesale, chayote in Little Baguio could be purchased at P1 per piece. On the other hand, the juicy or watery nature of cucumber required fewer kilograms to produce the required extract needed in the mixture; hence, a lesser cost was incurred, and a higher return was also achieved.

Table 6. *Cost and return data in the processing of Kalamansi nip*

PARTICULARS / VARIANTS	**KALAMANSI (PLAIN)**	**CARROTS**	**CUCUMBER**	**CHAYOTE**
SALES REVENUE @ P100/ 350 ml bottle				
Number of Bottles (350 ml) Produce	21	21	21	21
Selling Price per bottle	100.00	100.00	100.00	100.00
TOTAL SALES	**2100.00**	**2100.00**	**2100.00**	**2100.00**
PRODUCT COST				
Materials				
Kalamansi @ P50 per kilo	575.00	500.00	500.00	500.00
Carrots @ P40 per kilo		80.00		
Cucumber @ P30 per kilo			60.00	
Chayote @ P5 each				30.00
Brown Sugar @P38 per kilo	228.00	228.00	228.00	228.00
TOTAL MATERIAL COST	803.00	808.00	788.00	758.00
Labor and Overhead Cost	500.00	500.00	500.00	500.00

TOTAL PRODUCT COST	**1,303.00**	**1,308.00**	**1,288.00**	**1,258.00**
NET INCOME	**797.00**	**792.00**	**812.00**	**842.00**
COST PER BOTTLE OF KALAMANSI NIP	**62.05**	**62.29**	**61.33**	**59.90**
COST RATIO	**62.05%**	**62.29%**	**61.33%**	**59.90%**
INCOME PER BOTTLE	**37.95**	**37.71**	**38.67**	**40.10**
INCOME RATIO	**37.95%**	**37.71%**	**38.67%**	**40.10%**

Cost and return analysis were simulated if Kalamansi nip was processed further into Kalamansi juice. For each bottle of Nip at a ratio of 20 ml(nip) per 250 ml of water, approximately 17 bottles of 350 ml Kalamansi juice could be produced. This could be sold for at least P15 per bottle. Additional costs for water and plastic bottles would be incurred. This would triple the income from the processing of P37-40 per bottle to P121 to P125 per 350-ml bottle of Kalamansi nip.

Table 7. C*ost and return data if Kalamansi nip is processed further into Kalamansi juice*

PARTICULARS / VARIANTS	**KALAMANSI (PLAIN)**	**CARROTS**	**CUCUMBER**	**CHAYOTE**
COST PER BOTTLE OF KALAMANSI NIP	62.05	62.29	61.33	59.90
Number of Kalamansi juices per bottle of Nip	17	17	17	17
Sales (17 bottles of 350 ml juice x 15)	255.00	255.00	255.00	255.00
Cost of 17 bottles of Juice				
Kalamansi Nip	62.05	62.29	61.33	59.90

Water (Mineral Water)@ 250 ml ber bottle P0.001849/ml of water or P0 .46/250 ml)	7.82	7.82	7.82	7.82
Empty Plastic Bottles (12 oz)	102.00	102.00	102.00	102.00
Total	171.87	172.11	171.15	169.72
Net Income from Juice per bottle of Kalamansi Nip	83.13	82.89	83.85	85.28
Income Ratio	32.60%	32.51%	32.88%	33.44%
NET INCOME	**797.00**	**792.00**	**812.00**	**842.00**
Income Per Bottle of Kalamansi Nip	**37.95**	**37.71**	**38.67**	**40.10**
Additional Income in Processing Further to Juice per bottle of Kalamansi Nip	83.13	82.89	83.85	85.28
Total Income Per Bottle of Kalamansi Nip	121.08	120.61	122.51	125.37
TOTAL INCOME PER MIXTURE (21 BOTTLES OF KALAMANSI NIP	2,542.78	2,532.78	2,572.78	2,632.78

SUMMARY

The study was conducted to explore other variants in the processing of Kalamansi nip. An experiment was conducted in a Complete Randomized Design with four treatments (T1-plain Kalamansi, T2-with carrots, T3-with cucumber, and T4-with chayote) and was replicated three times. The samples were evaluated in terms of taste, odor, color, and general acceptability. Samples of Kalamansi nip were utilized to produce juices that were subjected to sensory evaluation using a 9-point Likert Scale. 90 evaluators were 29.67 years old on average, mostly female (61.11%), college graduates (8.89%), and married (63.33%). Samples were also subjected to nutrient and microbial analysis at the UIC Science Resource Center. Results of the study showed that Treatment 2 (carrots) was the most acceptable in terms of color, which was noted to be the

lightest, in terms of taste and general acceptability, though, with differences compared to the other treatments, but those were not significant. In terms of odor, the plain Kalamansi nip was the most acceptable, yet no significant differences were noted. The income ratio of processing Kalamansi nip ranges from 37% to 40% on sales.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of the study, it is concluded that the chayote, carrots, and cucumber are acceptable and are potential variants in the production of Kalamansi nip. Results on the nutrient contents are comparable without significant differences; hence, either of the variants contains important nutrients needed by the consumers.

However, the microbial analysis is not enough to determine the shelf-life of the samples; hence, it is recommended that further studies be conducted to focus on the quality and shelf-life of the product.

It is also recommended that studies be conducted to improve the quality of the product, including the packaging and labeling, and to look into its marketing potential.

Further, the processing of Kalamansi nip can give a return of 32% to 33% based on sales or a net income of P37-40 per 350-ml bottle of Kalamansi nip, which is tripled when processed further into Kalamansi juice, thus giving a net income of P121 to P125 per 350-ml bottle of Kalamansi nip.

Based on the cost and return analysis, the processing of Kalamansi nip and further processing into juice is a profitable undertaking and has the potential to provide additional income to farmers, processors, and sellers, thus enhancing agricultural productivity. With this, the college needs to work on the dissemination, transfer of the technology, and provision of advisory services to farmers and other beneficiaries relative to the production or processing, marketing, and quality improvement of Kalamansi nip.

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