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Development of A Nutritious Mocktail Using "Aratiles" (*Muntingia calabura Linn.*) As a Modifier and Natural Sweetener

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ABSTRACT:- This research aims to develop a nutritious mocktail using aratiles as a modifier and a natural sweeter with coconut water as its base and three different fruit as color enhancers, such as mango, watermelon, and pineapple. The basic formulation was 150 grams of aratiles and 200 ml — of coconut water, and it used fruits as color enhancers in varying amounts. Mocktail lot 1 used 100 grams of mango, mocktail lot 2 used 150 grams of watermelon, and mocktail lot 3 used 150 grams of pineapple. Ten University students served as untrained panelists. The developed mocktails were subjected to a taste test, using the 7-point hedonic scale regarding appearance, color, consistency, fruity flavor, and sweetness, and the 9-point hedonic scale on acceptability. The mean panel scores were statistically treated using One-way analysis of Variance (ANOVA). The results showed that among the three formulations of mocktail, the most acceptable was Mocktail 3 with aratiles as a modifier, coconut juice as a base, and pineapple as a color enhancer. Statistically, a significant difference exists between the different formulations in terms of their appearance, fruity flavor, aroma, sweetness, and general acceptability. Aratiles are an excellent natural sweeter in various mocktail formulations. So, it is recommended to make use of this undervalued and untapped tropical fruit.

Keywords:- Beverage, mocktail, aratiles, coconut juice, watermelon, experimental, Cebu City Philippines

I. INTRODUCTION

Muntingia calabura L., domestically known as *aratiles*, is a mainstream consumable natural product in the Philippines (Ragasa et al., 2015). *Muntingia calabura*, the sole species in the variety Muntingia, is a blossoming plant that has a place with *the Elaeocarpaceae* family. This type of plant is a quickly developing organic product tree. It is a pioneer animal variety that flourishes in poor soil, can endure acidic and soluble conditions, and has dry spells (Preethie et al., 2012; Lim, 2012).

The natural products are generally called Jamaican cherry and are red. There are different employments of blossoms. Some people used it as a germicide and as a treatment for stomach issues and fits. It is additionally taken to alleviate cerebral pains and colds. *Muntingia calabura* natural products have cell reinforcement properties (Preethie et al., 2012).

Aratiles is one of the common roadside trees in the Philippines. It is a neotropical tree that has become pantropical. It is a native of the tropical areas of America. It was introduced in the late 19th century, and eventually, the people in the Southeast Asian region adopted it. The tree is known as *capulin, calabura*, and Panama berry in English. People in the Philippines regarded it as dates, aratiles in Tagalog, *and mansanitas* in Ilokano. It is a small evergreen tree growing and flowering continuously and can grow as tall as 5 to 10 meters. The branches spread along and erect the trunk. The leaves are 8 to 10 centimeters long, hairy, stipulate, and have a grayish lower surface.

Moreover, the leaf margins are inequivalent and serrate. The inflorescences usually contain 1 to 3 hermaphrodite flowers. The flowers have erect pedicels and white petals and are pentamerous, with several statements. They are about 2cm in diameter. On the other hand, the berries are approximately 1.5 centimeters in diameter, smooth, red, and globose, and contain numerous seeds in fleshly pulp (Nevado & Ramirez, 1991).

The fruit is taken for granted because of the slightly sandy texture of its fruits, which is deemed unpalatable despite its delightful taste. The fruit is not commonly sold in various markets, and people do not buy it because it is a common plant in many places in the Philippines.

This study tries to use aratiles in a mocktail that can be consumed by health-conscious people with the addition of coconut water and selected fruits. The taste of the ripe fruit is sweet, and the texture is sandy due to the tiny

seeds. In some places, the children eat ripe fruit and green complex, and sometimes, the children also use the unripe children's games as a substitute for marbles and others. The fruit is available all year round.

Mocktails are similar to cocktails but without the alcohol content. At present, mocktails are becoming very popular because they are a good source of nutrients and, at the same time, a very healthy drink, yet only a few people know this information. Hence, this study develops a healthy mocktail using the ripe fruit of the *aratiles* so that it can be helpful to the people and can add income to the people in rural areas. *Aratiles* are known to have grown in areas almost everywhere in the tropics, and the fruit would be viable to produce a healthy mocktail using *aratiles* as a modifier and natural sweetener with coconut water as the base with three types of fruits for color enhancer, namely mango, watermelon, and pineapple.

II. LITERATURE REVIEW

Aratiles (*Muntingia calabura Linn)* is a well-known wild Filipino berry that has been found to have health benefits when consumed. It is common. This tree is commonly found in backyards, parks, and roadsides where birds and bats usually scatter their seeds. It has white flowers and sweet red berries, which are measured (Gaerlan & Villegas, 2015). It is known locally in Malay as 'Kerukup Siam.' It is native to the American continent and is widely cultivated in warm areas of the Asian region, including Malaysia. Various parts of this tree have several documented medicinal uses in Southeast Asia and tropical America (Zakaria et al., 2010).

M calabura is tropical species. It colonizes open disturbed sites in tropical lowlands. It thrives in poor soil and tolerates acidic and alkaline conditions and drought. However, it is intolerant of saline conditions. Birds and fruit bats disperse their seeds. The sweet, ripe fruit is eaten fresh. In Mexico, the fruits are eaten and sold in local markets. The fruits can be processed into jams or cooked in tarts. The leaf infusion can be made into tea (Lim, 2012).

Aratiles is a fast-growing tree 5 to 10 meters high with spreading branches. Leaves are hairy, sticky, alternate, distichous, oblong-ovate to broadly oblong-*lanceolate*, 8 to 13 centimeters long, with toothed margins, pointed apex, and inequilateral base, one side rounded and the other acute. Flowers are about 2 centimeters long, white, extra-axillary, solitary or in pairs. Sepals are 5, green, reflexed, *lanceolate*, about 1 centimeter long. Petals are white, obovate, 1 centimeter long, deciduous, and spreading. Fruit is a berry, rounded, about 1.5 centimeters in diameter, red on ripening, smooth, fleshy, sweet, and many-seeded (Stuart Exchange Organization, n.d.).

According to the Global Biodiversity Information Facility, there are various names of *muntigia calabura L*., such as calabur-tree, capulin, and Jamaica-cherry. *Muntingia calabura*, the sole species in the genus *Muntingia*, is a flowing plant native to southern Mexico, the Caribbean, Central America, and western South America, south to Peru and Bolivia. Common names include (English) *calabur* tree, capulin, Jamaica cherry, Panama berry, strawberry tree, Singapore cherry, Sabah cherry, Bajelly tree; (Tagalog) *aratilis*, and *saresa*; and (Cebuano, Ilokano) *mansanitas* and *gasagase* in Kannada. It is a 7–12 m tall tree with tiered and slightly drooping branches. It has serrated leaves 2.5–15 cm long and 1–6.5 cm wide. The flowers are small, white, and slightly malodorous. It gives rise to 1.0- to 1.5-cm light red fruit. The fruit is edible, sweet, and juicy, containing many tiny (0.5-mm) yellow seeds. It is a pioneer species that thrives in poor soil and can tolerate acidic and alkaline conditions and drought. Birds and fruit bats disperse their seeds. It is cultivated for its edible fruit and has become naturalized in some other parts of the tropics, including southeastern Asia. As a pioneer plant, it could help condition the soil and make it habitable to other plants. However, it might also be considered an invasive species since it might outcompete indigenous plants (Inaturalist.org, 2016).

Yusof et al. (2013) conducted a study to determine the antinociceptive potential of the methanol extract of *Muntingia calabura L*. (MEMC) and to isolate and identify the bioactive compound(s) responsible for the observed antinociceptive activity. The MEMC and its partitions (petroleum ether (PEP), ethyl acetate (EAP), and aqueous (AQP) partitions) in the dose range of 100, 500, and 1000 mg/kg were tested using the formalin-induced nociceptive test. The PEP, which exerted the most effective activity in the respective early and late phases, was further subjected to the fractionation procedures and yielded seven fractions (labeled A to G). These fractions were tested at 300 mg/kg, with distilled water or 10% DMSO (negative controls), morphine, and aspirin (positive controls) for potential antinociceptive activity. Of all fractions, Fraction D showed the most significant antinociceptive activity, which is considered equieffective to morphine or aspirin in the early or late phase, respectively. Further isolation and identification processes on fraction D led to the identification of three known and one new compounds, namely, 5-hydroxy-3, 7, 8-trimethoxyflavone (1), 3,7-dimethoxy-5-hydroyflavone (2), two ′,4′-dihydroxy-3′-methoxychalcone (3), and calaburone (4). At the dose of 50 mg/kg, compound 3 exhibited the highest percentage of antinociceptive activity in both phases of the formalin test. In conclusion, the antinociceptive activity of MEMC involved partly the synergistic activation of the flavonoid types of compounds.

In the study of Zakaria et al. (2010), the in vitro antimicrobial activity of various extracts, partitions, and fractions of *Muntingia calabura* (*Elaeocarpaceae*) leaves against a selected panel of microorganisms. The

leaves of *M. calabura* were soaked separately in the aqueous, chloroform, and methanol solvent systems in the 1:20 (w/v) ratio for 72 h, and these procedures were repeated three times. Antimicrobial testing was carried out using the micro-broth dilution method. The microbes targeted were Staphylococcus *aureus* 25923, *S. aureus* 33591 (a multi-drugs resistant*S. aureus* (MRSA) isolate), Escherichia coli 35218, *Pseudomonas aeruginosa* ATCC 27853, Candida albicans 10231 and Microsporum canis ATCC 36299. The methanol extract inhibited MSSA (MIC = 1250 µg/ml; MBC = 1250 µg/ml) and MRSA (MIC = 1250 µg/ml; MBC = 1250 µg /ml) and was considered the most effective extract and was further partitioned sequentially using the aqueous, petroleum ether and ethyl acetate. The ethyl acetate partition exhibited practical antibacterial activities with the MIC/MBC value of 156 and 313 µg/ml against *S. aureus* 25923 and *S. aureus* 33591, respectively. The ethyl acetate partition underwent a fractionation process. It yielded 15 fractions (A1-A15), of which only fractions A9 to A15 effectively inhibited the growth of *S. aureus* 25923 and S. *aureus* 33591 with MIC/MBC values ranging from 78 to 2500 µg/ml.

The cardiovascular effect of the crude methanol extract from the leaf of *Muntingia calabura L. (Tiliceae*) was investigated in the anesthetized rats. The crude methanol extract was sequentially fractionated to obtain water-soluble extract (WSE). Intravenous administration of the WSE (10, 25, 50, 75, or 100mg/kg) produced an initial followed by a delayed decrease in systematic arterial pressure (SAP) in a dose-dependent manner. The *M. calabura*-induced initial hypotension lasted 10 minutes, and the delayed depressor effect commenced after 90 minutes and lasted for at least 180 minutes post-injection. Conversely, the same treatment had no appreciable effect on the heart rate (HR) of the blood gas/electrolyte concentrations. Both initial and delayed hypotensive effects of WSE (50mg/kg, i.v.) were significantly blocked by pre-treatment with a nonselective nitric oxide (NO) synthase (NOS) inhibitor, NG-nitro-L-arginine methyl ester (Cheng et al., 2006).

III. OBJECTIVES OF THE STUDY

This study aims to develop healthy mocktails using *aratiles* as a modifier and natural sweetener, coconut water as a base, and selected pureed fruits. Further, this study intends to determine the optimum ratio of the base, modifier, and natural sweetener and selected tropical fruits as color enhancers; acceptability of the various mocktail formulation regarding the appearance, color, consistency, flavor, and aroma; direct material costs of the most acceptable mocktail; most preferred mocktail based on consumers' preference testing; significant difference between and among the various mocktail formulation in terms of their sensory attributes and consumers' preference rating was also computed.

IV. MATERIALS AND METHODS

This investigation utilized the experimental research design. This means that the study focuses on the cause and effect relationship of developing a healthy mocktail using *aratiles* as a modifier and sweetener and using coconut water as a base with pureed fruit namely mango, watermelon and pineapple. There were ten untrained University students who tasted and rated the mocktail, using random sampling technique. For data analysis, this study calculated the weighted mean to determine the acceptability of the mocktail and ANOVA to measure the significant difference between and among the various mocktail formulations.

V. RESULTS AND DISCUSSIONS

This section presents the results on the optimum amount of color enhancer based on the preference of the tasters.

Table 1. Preferred amount of color enhancer

Lots	Enhancer	Base	Modifier/Sweetener
Mocktail 1	**100 grams mango**	**200 ml buko juice**	100 grams aratiles
Mocktail 2	**150 grams watermelon**	**200 ml buko juice**	**100 grams aratiles**
Mocktail 3	**150 grams pineapple**	**200 ml buko juice**	**100 grams aratiles**

The panel chose mocktail lot one as the ideal color enhancer, 100 grams of mango. This was chosen because using 150 and 200 grams of mango in lots 2 and 3 would produce a similar color.

Figure 1. Mocktail Lot 1- *Aratiles* with *buko* juice and mango

Mocktail 2 needs 150 grams of watermelon to reach an ideal color as selected by the panelists. In mocktail 2, 100 grams of watermelon gave a very faint red color, while 200 grams were added to the cloudiness of the mocktail; thus, 150 grams of watermelon was chosen by the untrained tasters.

Figure 2. Mocktail Lot 2-*Aratiles* with *buko* juice and watermelon

Based on the panelist's choice, mocktail Lot 3 needs 150 grams of pineapple to reach an ideal color. Using 100 grams of pineapples produces a very cloudy color that is not close to yellow; using 200 grams produces the same color as using 150 grams, according to the tasters.

Figure 3. Mocktail Lot 3-*Aratiles* with *buko* juice and pineapple

This part shows the results on the acceptability test on the three (3) various formulations of mocktails.

Table 2. General Acceptability of the Developed Mocktail with *Aratiles* as Natural Sweetener Based on Sensory Attributes

Lots	Mean	Interpretation
Mocktail 1	8.7	Like very much
Mocktail 2	5.4	Neither like nor dislike
Mocktail 3	7.6	Like moderately

Table 2 presents the mean ratings of the panelist based on the general acceptability of the three (3) formulations of mocktails. The results showed that mocktail Lot 1 was rated "like very much". The rating means this formulation was the most preferred based on the 9-point hedonic scale of general acceptability. Mocktail Lot 3 was rated as "like moderately," the second (2nd) most preferred mocktail based on the general acceptability of the untrained panelists or tasters. Mocktail Lot 2 was rated as "neither like nor dislike," meaning it is the least preferred mocktail formulation.

Therefore, the result showed that the most acceptable mocktail was mocktail Lot 1. This mocktail contained 100 grams of ripe mango fruit as a color enhancer, 200 ml of coconut water as a base, and 100 grams of *aratiles* as a sweetener.

This section reveals the results of the sensory evaluations of the mocktails by the untrained panelists.

Table 3. Sensory evaluation of mocktail for Lot 1

Sensory Attributes	Mean	Interpretation
Appearance	**6.2**	**Very Good**
Color	**5.9**	**Good**
Consistency	**5.8**	**Good**
Flavor		
Fruity flavor	**6.7**	**Very Good**
Sweetness	**6.6**	**Very Good**
Aroma	**6.4**	**Very Good**

The results of the sensory evaluation of mocktail Lot 1 revealed that appearance, fruity flavor, sweetness, and aroma were all marked as very good by the panelists. Moreover, color and consistency were marked as good. These results imply that the panelists liked the developed *aratiles* mocktail in all its sensory attributes.

Table 4. Sensory evaluation of mocktail for Lot 2

Sensory Attributes	Mean	Interpretation
Appearance	**4.3**	**Average**
Color	**4.6**	**Average**
Consistency	**5.2**	**Good**
Flavor		
Fruity flavor	**6.1**	**Average**
Sweetness	**5.7**	**Good**
Aroma	**4.7**	**Average**

The result of the sensory evaluation of the mocktail in Lot 2 showed that it was only in its fruity flavor, where the evaluation was very good. The consistency and sweetness were rated good, while the appearance and color were rated average.

Table 5. Sensory evaluation of mocktail for Lot 3

Sensory Attributes	Mean	Interpretation
Appearance	**6.5**	**Very Good**
Color	**5.4**	**Good**
Consistency	**5.3**	**Good**
Flavor		
Fruity flavor	**6.5**	**Very Good**
Sweetness	**5.7**	**Very Good**
Aroma	**6.3**	**Very Good**

The result of the sensory evaluation of the mocktail for lot 3 shows that its appearance, fruity flavor, sweetness, and aroma were rated as very good, while the color and consistency were rated as good.

Green plants are gaining greater acceptance from the public and the medical profession due to more significant advances in understanding the mechanism of action by which herbs can positively influence the quality of life (Fugh-Berman, 2000).

This part displays the results of the test of significant differences between the mocktails regarding the sensory attributes. In determining the significant difference among the sensory attributes of the developed mocktails, the One-Way Analysis of Variance (ANOVA) is applied.

Table 6. Results on the test of significant difference in the ratings for the mocktails' appearance

Source of variance	SS	df	MS	F	P	
Treatment	15.2	2	7.6	12.33	<.0001	
(between groups)						
Error	72.1	117	0.62			
Ss/Bl						
Total	87.3	119				

There is a statistically significant difference in the mean ratings of the participants regarding the appearance of the different formulations of *aratiles* mocktails, based on the P value of 0.0001, which is less than 0.05. This indicates that the untrained panelists had a varying appreciation of the appearance of the three (3) formulations of mocktail using articles as natural sweeter and modifier.

Table 7. Results on the test of significant difference in the ratings for the mocktails' color

Source of variance	SS	df	MS	F	P	
Treatment	2.6	2	1.3	0.27	1.33	
(between groups)						
Error	114.6	117	0.98			
Ss/Bl						
Total	117.2	119				

There is no statistically significant difference in mean rating regarding color, as denoted by the P value of 1.33, which is greater than 0.05. It can be deduced that the research panelists had varying evaluations regarding the color of the various formulations of *aratiles* mocktails due to the variation of the ripeness of the aratiles and mango.

Table 8. Results on the test of significant difference in the ratings for the mocktails' consistency

Source of variance	SS	df	MS	F	P		
Treatment (between groups)	2.07	2	1.03	.44	.83		
Error	145.4	117	1.24				
Ss/Bl							
Total	147.47	119					

There is no statistically significant difference in the mean rating of respondents regarding the consistency of the three (3) mocktail formulations, as shown in the P value of 0.83, which is greater than 0.05. These results indicate that as far as consistency is concerned, the responses given can be attributed to random fluctuations in the quantity and quality of the fruits.

Table 9. Results on the test of significant difference in the ratings for the mocktails' fruity flavor

Source of variance	SS	DF	MS	F	P		
Treatment	66.6	2	3.33	28.5	<.0001		
(between groups)							
Error	136.7	117	1.17				
Ss/Bl							
Total	203.3	119					

There is a statistically significant difference in the mean ratings of the respondents when it comes to fruity flavor of the various preparations of *aratiles* mocktails, as denoted by the P value of 0.0001, which is less than 0.05. Regarding the fruity flavor, the given responses cannot be attributed to random fluctuations in the measurement of the ingredients and quality of the fruits.

Table 10. Results on the test of significant difference in the ratings for the mocktails' sweetness

Source of variance	SS	df	MS	F	P
Treatment	15	2	7.5	6.71	.002
(between groups)					
Error	130.7	117	1.12		
Ss/Bl					
Total	145.7	119			

There is a statistically significant difference in the mean ratings of the panelists when it comes to the general acceptability of the three formulations of the *aratiles* mocktails in terms of sweetness, as shown in the P value of 0.002, which is less than 0.05. The responses cannot be attributed to random fluctuations in the saccharinity.

Table 11. Results on the test of significant difference in the ratings for the mocktails' aroma

Source	SS	df	MS	F	P	
Treatment	19.27	2	9.63	8.22	.001	
(between groups)						
Error	137.1	117	1.17			
Ss/Bl						
Total	156.37	119				

There is a statistical significant difference in mean ratings of the respondents on the three formulations of *articles* mocktails when it comes to aroma, as shown in the P value of 0.001, which is less than 0.05. These results indicate that the panelists had a different appreciation of the smell of the mocktail due to the unfamiliarity of the students of aratiles as an ingredient in making the beverages

Table 12. General acceptability of the three (3) formulations of *aratiles* mocktails

Lots	Mean	Interpretation
Mocktail 1	8.7	Like very much
Mocktail 2	5.4	Neither like nor dislike
Mocktail 3	7.6	Like moderately

Table 12 presents the panelist's mean ratings based on the three mocktails' general acceptability. The result showed that mocktail one was rated as "like very much," meaning it was the most preferred based on the 9-point hedonic scale for the test of general acceptability.

Aratiles mocktail in lot 3 was rated as moderately acceptable, the second most preferred mocktail, based on the evaluations of the untrained panelists or tasters. The mocktail in lot 2 was rated as "neither like nor dislike," which was the least preferred mocktail.

Therefore, the result showed that the most acceptable formulation of an aratiles mocktail was in lot 1. This mocktail comprises 100 grams of ripe mango fruit as a color enhancer, 200 ml of coconut water as a base, and 100 grams of *aratiles* as a sweetener.

Table 14. Results for the test of significant difference on the most acceptable mocktail

Source	SS	df	MS	F	P	
Treatment	66.6	2	3.33	28.5	<.0001	
(between groups)						
Error	136.7	117	1.17			
Ss/Bl						
Total	203.3	119				

There is a significant difference in the mean ratings of the participants on the general acceptability of the developed mocktails, as shown in the P value of 0.0001, which is much lower than the 0.05 significance level. It indicates a substantial variation in the participants' preference for the various formulations of mocktails with *aratiles* as the modifier and natural sweetener.

At the time of the study, articles were abundant in many places in the study locale and usually just harvested, and there was no market price assigned to this fruit. The market price of the ripe mango was Php17.00 per piece, while coconut or buko juice was Php25.00 per liter.

Table 15. Direct Material Costs of the 3 Mocktail Formulations

Lots	Prevailing Market Price	Measurement	Unit Price	Quantity Used	Total Cost
Mocktail 1					
"Aratiles"	None	1 kilo	none	100 grams	**Php15.00**
Coconu Juice	P25.00 per liter	1 liter	P5.00	200 ml.	
Mango	P17.00 per ripe mango	1 ripe mango	P10.00	100 grams	
Mocktail 2					
"Aratiles"	None	1 kilo	none	100 grams	**Php14.00**
Buko Juice	P25.00 per liter	1 liter	P5.00	200 ml.	
Watermelon	P17.00 per ripe mango	P70.00 per kilo	P9.00	150 grams	
Mocktail 3					
"Aratiles"	none	1 kilo	none	100 grams	**Php 15.00**
Buko Juice	P25.00 per liter	1 liter	P5.00	200 ml.	
Pineapple	P17.00 per ripe mango	P50 per 500 grams	P8.00	150 grams	

Producing lot 1 for the aratiles mocktail used 100 grams of *aratiles*, 200 ml of coconut juice, and 100 grams of mango. The total cost of producing a mocktail in lot 1 was Php 15.00.

Moreover, in preparing lot 2 for the mocktail articles, 100 grams of *articles*, 200 ml. of coconut juice, and 150 grams of mango were used. The total cost was Php 14.00, which is Php1.00 cheaper.

Further, the ingredients in producing lot 1 for the article mocktail used 100 grams of articles, 200 ml of coconut juice, and 100 grams of mango. The cost of producing an aratiles mocktail for lot 3 was also Php 15.00.

VI. CONCLUSION

Aratiles are commonly found throughout the Philippines island. However, this tropical fruit is considered undervalued since only a few people consume it, and it is not fully utilized as a natural sweeter in various mocktail formulations or any type of beverage. Also, there was a dearth of knowledge among the Filipinos about the potential use and nutritional value of this fruit that can be usually found in the backyard of many Filipinos.

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