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Research Article

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Optimization of citric acid and malic acid to enhance flavour and shelf life of mango juice

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ABSTRACT

Mango (Mangifera indica) is one of the most delicious seasonal fruit, rich in nutrient with unique flavour, fragrance, and taste making it as a common ingredient in fruit based product. Nowadays many industries have been developing various type of mango flavoured product such as soft drink, ice-cream, jams, jellies, fruit cheese etc. In industry to enhance flavour and shelf life of mango fruit various flavouring agent and preservatives are added. Some common organic acid which naturally occur in fruit are also used to enhance flavour and shelf life of product. Generally citric acid is used but in this investigation mixtures of citric acid and malic acid have been used to enhance sensory attribute and shelf life of mango juice. Sensory analysis was done by 50 volunteer in which sensory attribute such as flavour, sweetness, sourness, overall taste, after taste sweetness and after taste sourness of the juice were evaluated and obtained data was analysed by SPSS software. Result revealed the F4 variant was mostly preferred by the volunteer. For shelf life analysis microbial load, total soluble solid and pH were analysed for four weeks. During this study it was observed that as the concentration of citric acid decreased in formulated variants microbial load has increased. Variant containing 90% citric acid and 10% malic acid was found to be best acidity regulator and variant having 80% citric and 20 % malic acid has best effect on maintaining total soluble solid concentration.

Key words: Mango, Citric acid, Malic acid, Shelf life analysis, Sensory analysis.

INTRODUCTION

Mango (*Mangifera indica*) is a fleshy stone fruit which belongs to family anacardiaceae [1]. Mango fruit is native to south Asia, from where it has been distributed to entire world to become one of the most cultivated fruit in the world. Mango is one of the most delicious seasonal fruit, rich in nutrition with unique flavour, fragrance taste, and health promoting quality making it as a common ingredient in newly developed fruit based product. Nowadays many industries have been developing various type of mango flavoured product like ice-cream, yoghurt, soft drink, jams, fruit cheese, fruit meals for children etc. Generally mango based product is produced from the processing of fruit pulp [2]. In industry to increase Shelf life of pulp generally citric acid, sorbic acid, benzoic acid, Erythorbic acid, and other artificial preservative are used. But there are some acid which naturally present in fruit that is citric acid, malic acid, oxalic acid, tartaric acid etc. Additional addition of citric acid and malic acid does not only increase the Shelf life of pulp but also enhance the flavour, aroma, taste of the product. Citric acid and malic acid is GRAS listed compound which is commonly used in industry as preservative, acidulant or flavouring agent etc. The main important role of citric acid and malic acid is that they inhibit the growth of food spoilage and pathogenic microorganism [3-5]. It is well known that the main effect of organic acid is accounted due to pH, different organic acid has different inhibitory effect. The factors which affect activity of organic acid are number of carboxyl group, hydroxyl group, carbon-carbon double bond in the molecule aromatic, aliphatic characteristic etc. It is very difficult to determine the magnitude effect of a particular organic acid or in some cases even the direction of change in inhibitory effect upon substituting one acid with other acid or net result in food product containing more than one acid [5-9]. As citric acid and malic acid are the most common organic acid which is found in almost all type of fruit,

that's why in this study optimization of citric acid and malic acid has been carried out to find relative concentration of both acids, because the relative concentration of both the acid affect the sensorial and chemical characteristic of juice such as pH, total acidity, microbial load, sweetness, global acceptability etc.

EXPERIMENTAL SECTION

Sample collection

Mango and Table sugar were purchased from local market of Vellore (Tamil Nadu) and stored for juice preparation and further use while the Citric acid and malic acid were provided by Thirumalai Chemical India Pvt. Ltd.

Juice Preparation

In order to find optimum concentration of citric acid and malic acid there were total seven combinations made using base ingredient, pulp of mango which was diluted to 25 %, followed by addition of table sugar. In all the combination pulp and sugar concentration were kept constant while acid additive were varied in the entire variant. The test variants were named as F1 to F7. F7 was prepared as control variant without any additive. In rest of the variant ratio of citric acid to malic acid varied. From F1 to F6 the concentration of additive citric to malic acid varied such as 100 %: 0 %, 95%: 5%, 90%: 10%, 80 %: 20%, 66 %: 33%, 33%: 66% respectively. All the variants were subjected to sensory analysis.

Sensory Analysis

All the formulated test variant were subjected for analysis based on following sensory attribute such as flavour, sourness, sweetness, overall taste, sweetness after taste and sourness after taste, using a nine-point hedonic scale. The scoring system was as per follows - Like extremely = 9, Like very much = 8, Like moderately = 7, Like slightly = 6, Neither like nor dislike = 5, Dislike slightly = 4, Dislike moderately = 3, Dislike very much = 2, Dislike extremely = 1. A separate entry for comments and suggestions were provided. Total 50 volunteer were selected (20-Female, 30-Male). Volunteer were asked to read through the questionnaires and the meaning of each attribute was explained to volunteer to avoid any misinterpretation prior to evaluation. Panellist member were asked to rinse the mouth with water in between each variant test.

Shelf life Analysis

For the shelf life analysis of formulated test variant, microbial load were estimated by spread plate technique and based on that colony forming unit per millilitre (CFU/ml) were estimated, each variant were analysed for four weeks. Plating of each test variant was done with the nutrient agar, using sterile distilled water each test variant were diluted to 10^{-3} and plating is done with both stock as well as diluted test sample, and entire set of experiment was performed in triplicates. Number of colony was counted by colony counter. Weekly pH and total soluble solid were estimated by pH pen and portable refractometer respectively.

Statistical Analysis

Obtained data from result of sensory analysis were analysed by SPSS software version 12 for windows. The data represented as mean score (average score of acceptance) for each variant. To determine the difference between mean score one way analysis of variance (ANOVA) was used for all sensory attribute at $p \leq 0.005$.

RESULTS AND DISCUSSION

Sensory Analysis

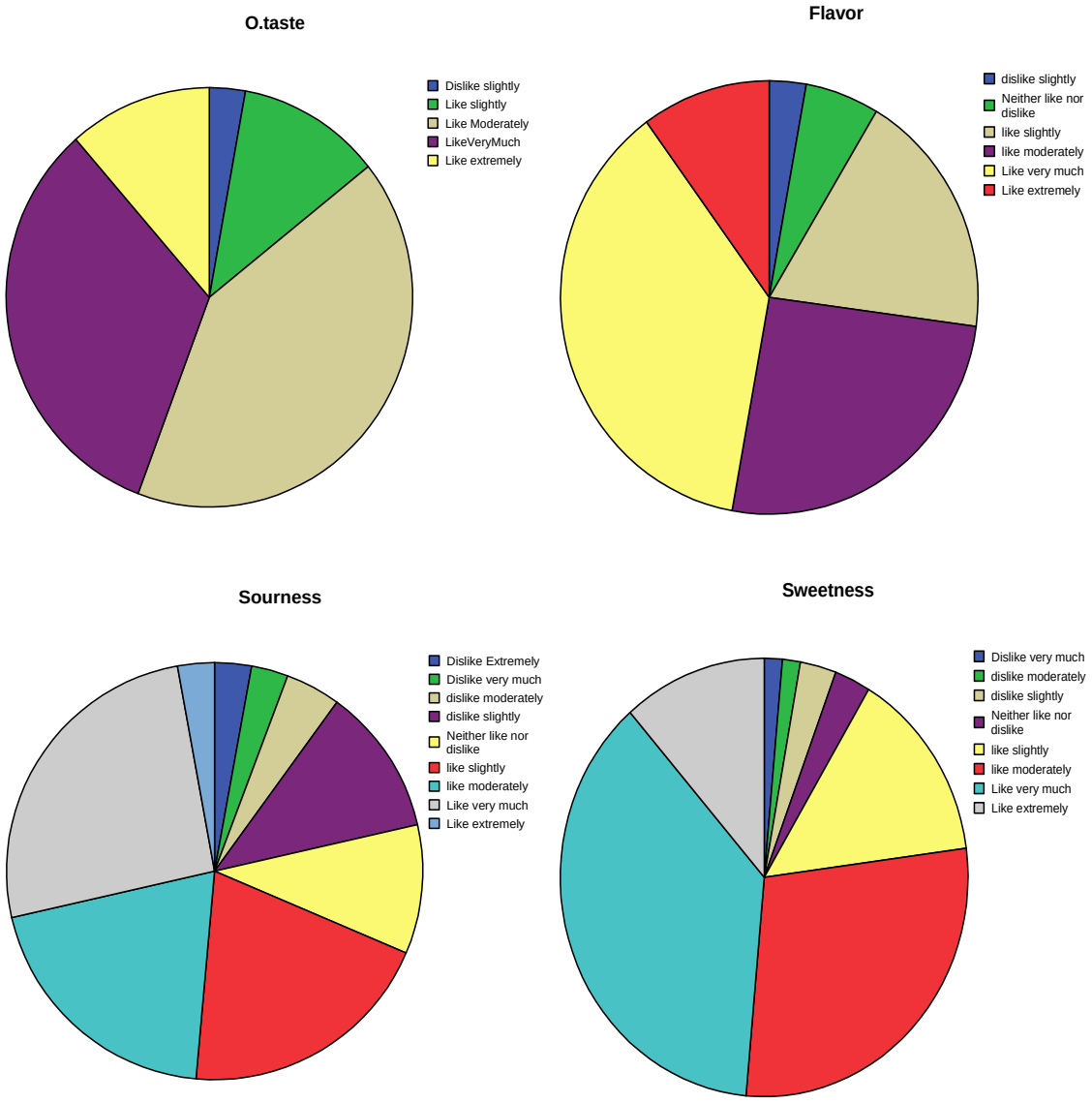
The result of sensory evaluation has been represented in TABLE 1. The data shows the average score of acceptance of the formulated fruit juice with respect to overall taste, sweetness, sourness, flavour, after taste sweetness and aftertaste sourness. Range for average score of acceptance were found to be for overall taste (6.900 to 7.900), sweetness (6.500 to 7.700), sourness (5.300 to 7.000), flavour (6.800 to 7.400), after taste sweetness (6.300 to 7.500) and aftertaste sourness (5.000 to 6.900).

TABLE 1: Average score of acceptance for formulated variant.

VARIANT	Overall taste	Sweetness	sourness	flavour	after taste sweetness	After taste sourness
F1	7.5000	7.1000	6.3000	7.3000	6.8000	6.1000
F2	7.4000	7.3000	7.0000	7.3000	7.0000	6.9000
F3	7.3000	7.2000	6.0000	7.0000	6.5000	6.0000
F4	7.9000	7.7000	6.5000	7.4000	7.5000	6.2000
F5	7.6000	7.6000	5.7000	7.6000	6.3000	5.6000
F6	6.9000	6.5000	5.8000	6.8000	6.4000	6.3000
F7	6.9000	6.9000	5.3000	6.9000	6.3000	5.0000

In this study attribute for organoleptic analysis, overall taste, sweetness, sourness, flavour, aftertaste sweetness and after taste sourness were only taken because all the ingredient of formulated juice variant were kept constant for all the variants only the acid composition varied, hence this will be mainly affecting flavour, sourness, sweetness, after taste sweetness and after taste sourness.

Figure1: Relative frequency of respondent with respect to hedonic scale.



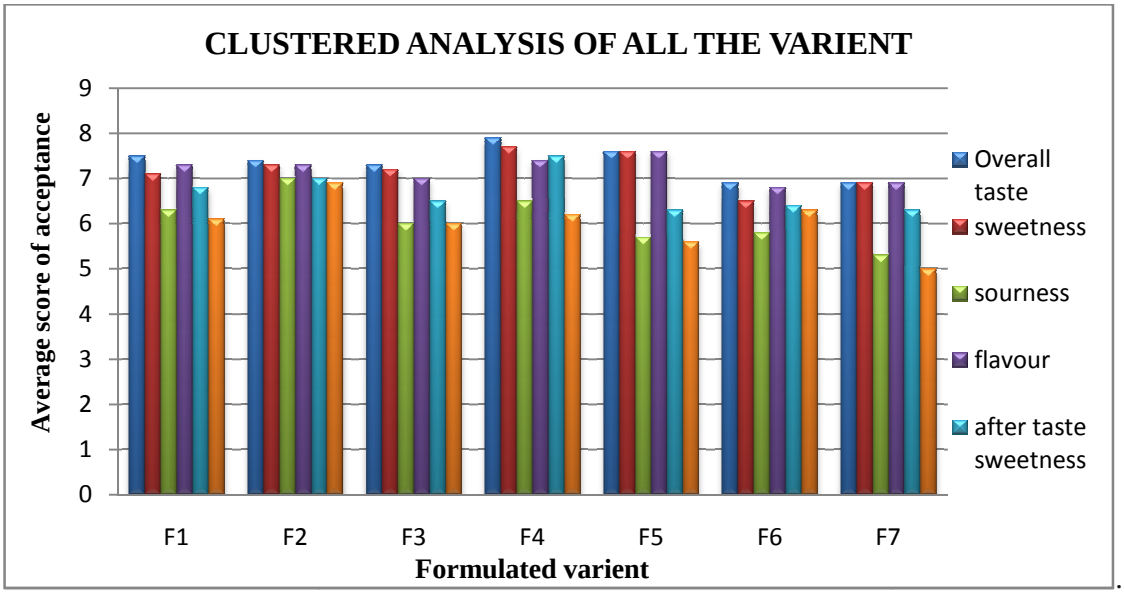
Overall Taste

Taste is the one of the most important parameter when evaluating sensory attribute of food product because a food product may have high nutrient content, good appearance but without good taste food product cannot be accepted. Overall taste of variants F4 was mostly liked by the panellist member with average score of acceptance 7.900 which is significantly higher than the rest of the formulated variant, this variant contain 80% citric acid and 20% malic acid. F5 was the another variant as second preference of volunteer with average score of acceptance 7.600, while control variant (F7) without additive and the variant containing highest amount of malic acid (F6- 66% malic acid and 33% citric acid) in all the formulated variant got least average score of acceptance 6.900.

Flavour

Flavour is the sensory impression of food product which differentiates one food product from the other food product. Flavour is mainly determined by the chemical sense of taste and smell. As earlier mentioned that citric acid and malic acid have been used as additive to enhance flavour and self life of mango juice. Among all formulated variant F5 was the best rated by the volunteer which has average score of acceptance 7.60. This variant has 66% citric acid and 33% malic acid.

Figure 2



Sweetness and Sourness

Sweetness and sourness are main important attribute of this study because varying concentration of citric to malic affect these attribute, perception of sweetness and sourness also vary with respect to consumer. Outcome of sensory evaluation indicate that each variant has significant variation in degree of sweetness and sourness. F4 and F2 were the variant mostly liked by volunteer with respect to sweetness and sourness respectively. F4 has average score of acceptance 7.700 while F2 has 7.00 for their respective attribute. A declining trend in average score of acceptance has been observed as increase in concentration of malic acid in juice for the sourness attribute, for sweetness variant having 80% citric acid and 20% malic acid has been preferred. Even though for attribute after taste sweetness and sourness variant F4 and F2 respectively were mostly accepted by volunteer.

Microbial Analysis:

Microbial load of all test variants has been summarized in Table 2, and clustered analysis for microbial load of test variant has been graphically represented in Figure 3. The result revealed that microbial load in formulated test variants has increased as the concentration of citric acid has decreased. During this study it was observed that in first and second week microbial load was less while rapid increase in microbial load was found during third and fourth week.

Table2: Microbial load of test variant

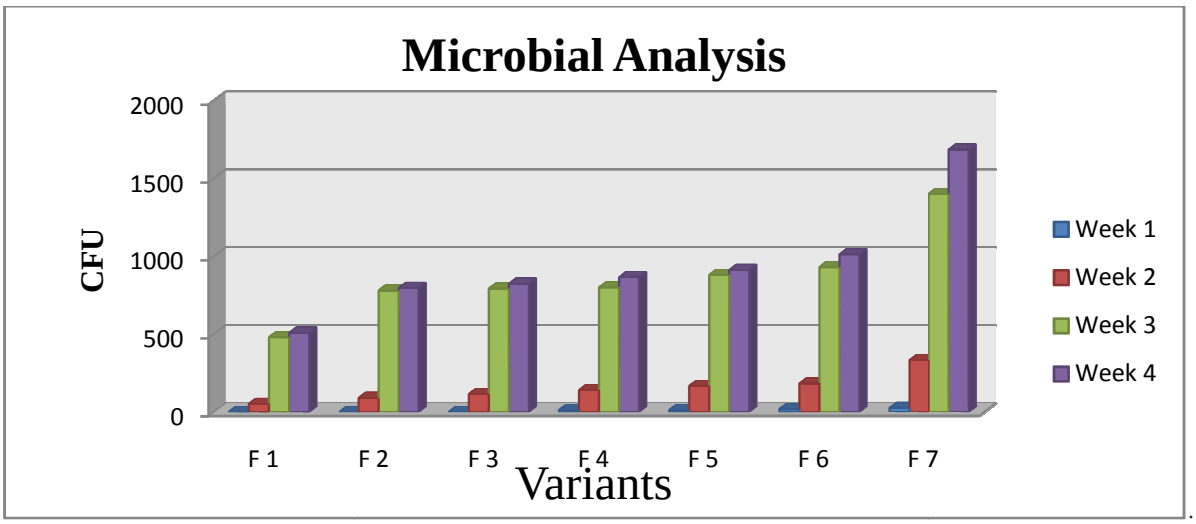
SL. No.	Acid Concentration (Citric : Malic)	Week 1 (CFU/ml)	Week 2 (CFU/ml)	Week 3 (CFU/ml)	Week 4 (CFU/ml)
F 1	100:0 %	0	52	480	508
F 2	95:5%	0	90	780	796
F 3	90:10%	0	115	792	823
F 4	80:20%	12	140	800	865
F 5	66:33%	12	167	880	912
F 6	33:66%	18	183	930	1012
F 7	Control	26	333	1400	1685

Note:- *CFU(colony forming unit) = $x \times 10^3$, x= no represented in table two .*

In this study total six combination of citric acid and malic were made and used as additive while one control variant was prepared without additive. The control variant has highest number of microbes while least number of microbes was found in F1 variant which contains only citric acid as additive. In first week the variant containing 100%, 95% and 90% citric acid does not have any CFU while the control variant has 26 CFU while other test variant F4, F5 and F6 have 12, 12 and 18 CFU respectively. During second week in entire test variant CFU was found, highest number of CFU in control variant and lowest no of CFU in the variant containing 100% citric acid. Rapid increase in microbial load was found in test variant during third and fourth week the control variant has 1400 and 1685 CFU respectively, while the variant containing 100% citric acid has 480 and 508 CFU. Microbial load in formulated test variant has varied due to the varying concentration of citric acid and malic acid, more the concentration of citric acid

lesser the microbial load, this is because of citric acid has more antimicrobial activity then the malic acid. From this study it can be concluded that citric acid act as better preservative then the malic acid in mango juice.

Figure3



pH and Total Soluble Solid Assessment:

The data of acidity and total soluble solid of different test variant has been depicted in Table 3. In this study it was observed that pH value of each test variant has shown declining trend as the time has passed and the test variant containing highest amount of citric acid has the lowest pH value, as the concentration of citric acid has decreased pH of the test variant has increased. Initially F1 variant having 100% citric acid as additive has least pH value 3.39 while the control variant has highest pH(4.10) followed by F6 with second highest pH value 3.54. After four week of incubation highest fall in pH was found for control variant 21.95%, while least fall in pH was observed for the variant containing 90% citric acid and 10% malic acid that is 9.53%. Among all the variants used for the study, variant containing 100% acid has shown 19.46% fall in pH while the other variant F6 having highest malic acid concentration(66%) among all the formulated variant has shown 19.77% fall in pH. Hence the combination of citric acid and malic acid can be used as better acidity regulator instead of using one acid.

Table3: P^H and total soluble solid

Sl. No.	Acid conc.	pH				Total Soluble Solids			
		Week1	Week2	Week3	Week4	Week1	Week2	Week3	Week4
F 1	100 %	3.39	2.92	2.81	2.73	14.00	13.50	13.10	13.00
F 2	95/5%	3.43	3.40	2.95	2.90	14.00	13.40	13.00	13.00
F 3	90/10%	3.46	3.02	3.02	3.13	14.00	13.10	13.00	12.90
F 4	80/20%	3.48	3.05	3.11	3.12	14.00	13.20	13.20	13.10
F 5	66/33%	3.50	2.98	2.91	2.87	14.00	13.10	12.80	12.90
F 6	33/66%	3.54	3.00	2.93	2.84	14.00	13.10	12.90	12.80
F 7	control	4.10	3.77	3.40	3.20	14.00	12.80	12.80	12.50

Total soluble solid mainly indicate sugar concentration, which was measured by portable refractometer. Initially in all test variants same degree of brix value (14) was observed. During the storage period it was observed that each test variant has shown declining trend of brix value over period of time. After four week of storage, variant containing 80% citric acid and 20% malic acid has shown least fall in brix value 6.42% while highest fall in brix value was observed for control variant without additive with 10.71% fall. Other test variant having additive has not shown significant difference of fall in brix value except F6. Variant F1 and F2 has 7.142% fall in brix value, F3 and F5 has 7.85% fall, while F6 which contain highest amount of malic acid (66%) has shown highest fall in brix value 8.57% among all formulated variants.

CONCLUSION

In this study the citric acid and malic acid is used as additive which enhance flavour as well as shelf life of mango juice. During this study it was found to be that microbial load in the fruit juice has increased on the decreasing the concentration of citric acid, result of this study suggest that citric acid is better preservative then the malic acid. Where as a fixed ratio of citric and malic has better control on maintaining pH (90% citric acid and 10% malic acid) and total soluble solid (80% citric acid and 20% malic acid) instead of using one acid as preservative. Similarly the

variant having 80% citric acid and 20% malic acid was mostly preferred by the consumer. Since research on this fruit with citric acid and malic acid is very rudimentary so further investigation is required to find the optimum concentration of citric acid to malic acid which can enhance shelf life as well as sensory attribute of fruit juice.

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