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Research Article

EFFECT OF CITRIC AND MALIC ACID ON SHELF LIFE AND SENSORY CHARACTERISTICS OF ORANGE JUICE

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ABSTRACT

The current work focuses on the role of citric acid and malic acid in enhancing the shelf life and sensory characteristics of the orange juice. A decrease in total soluble solid (TSS) was observed by refractometer. The sensory analysis using nine point Hedonic scale showed an overall preference towards the 90:20 citric: malic acid ratio. Agar plate colony count of the samples indicated a direct relationship between citric acid concentration and shelf life.

Keywords: Orange juice, Acidic additives, Citric acid, Malic acid, Sensory analysis, Hedonic scale, Brix

INTRODUCTION

Modern life styles has encouraged the customers to prefer juice over direct fruit or pulp. Juices are fat-free, nutrient-dense beverages rich in vitamins, minerals and naturally occurring phyto-nutrients that contribute to good health[1]. There is a vast range of fruit juices consumed worldwide and orange juice is one of the world's most consumed fruit juices. Orange belongs to the family *Rutaceae.* Orange trees are widely grown in tropical and subtropical climates for its sweet fruit, which can be eaten fresh or processed to obtain juice, and for its fragrant peel [2]. The orange most commonly grown today is *Citrus sinensis* (sweet orange) which differs from *Citrus aurantium*, the bitter orange. The orange has become the most commonly grown fruit tree in the world [3] and sweet oranges account for approximately 70% of the citrus production[4]. The fruit is yellow or orange when ripe and its peel contains essential oil [5]. The endocarp or pulp consists of tightly packed membranous juicy sacs. After peeling orange, can be eaten directly or grind to obtain juice.

Orange juice is rich source of essential nutrients and antioxidants. The total antioxidants activity of orange juice is found to be higher than the orange wine[6], 100g edible portion of orange juice contains Energy (46 kcal), Carbohydrates (11.54 g), Sugars (9.14g), Dietary fiber (2.4g), Fat (0.21g), Protein (0.70g), Thiamine Vit. B1 (0.100mg), Riboflavin Vit. B2 (0.040mg), Niacin Vit. B3 (0.400mg), Pantothenic acid B5 (0.250mg), Vitamin B6(0.051mg) Folate Vit. B9 (17µg), Vitamin C (45mg), Calcium (43mg), Iron (0.09mg), Magnesium (10mg), Phosphorus (12mg), Potassium (169mg) and Zinc (0.08mg) [7].

With increasing productivity there has been growing need of developing more effective processing and preservation formulations [8]. Juice processing industries are flourishing faster. Several food additives are added to enhance the flavour, appearance and shelf life of food products. In the present study, the synergistic activity of citric and malic acid in orange juice as a more viable (noteworthy) combination in fruit juice acid additives for a far superior sensory perception without significant loss of shelf life have been studied. In our previous work we have reported similar trends in results for mango juice [9].

MATERIALS AND METHODS

Preparation of orange juice:

Ripe oranges were purchased from Vegetable market Vellore TN (India) and refrigerated till usage. The Juice from freshly squeezed oranges was filtered using plastic sieve net and Whatman no.1 filter paper and 10 ml of filtered juice was diluted with 90 ml sterilised distilled water. Further 11 g cane sugar was added to adjust the sweetness.

Preparation of acid additive variants:

Six variants of citric and malic acid in the ratio 100:0, 95:5, 90:10, 80:10, 66:33, 33:66 and a control containing no citric and malic acid additive were formulated by dissolving citric (Sigma Aldrich) and malic acid (Thirumalai Chemicals Pvt. Ltd India) in the required ratio. The samples were refrigerated at 7°C and were analysed on per week basis for pH, Total Suspended Solid (TSS) using brix meter (refractometer). Shelf life of the variants was also analysed by nutrient agar plating method.

Shelf-life estimation:

The shelf life of orange juice mixed with acid variants was measured by agar plate spreading. Colony counter was used to count the microbial count in the juice sample on weekly basis.

Sensory survey:

A panel of 20 volunteers was chosen from amongst the university staffs and students to find the optimum ratio of citric and malic for a suitable sensory perception. The survey was conducted twice employing nine point hedonic scale[10]. The selection criteria for volunteers was that they must have been in habit of consuming fruit juice at least thrice a week. Of the total volunteers 70% were males and 30 % were females. Two ranges of age distribution of the volunteers, 70% (20-24 years) and 30% (25-47 years) was considered. The volunteers were served with 10 ml each of the seven variants i.e. 100, 95:5, 90:10, 80:10, 66:33, 33:66 and control juice samples at a regular intervals. They rated each of the variant on the basis of aroma, colour, texture, flavour and overall impression 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. Comments and suggestions column was also provided.

SPSS software (version 12) was used to analyse the sensory data. The data represented an average score of acceptance for each variants. The difference between the mean scores was determined by Turkey's HSD[11] (Honestly Significant Difference) and all the sensory attribute were reported at $p \leq 0.005$.

RESULTS AND DISCUSSION

Variation in pH of the juice:

There was decrease in pH of the juice samples with time. This may be due to the gradual increase in the microbial activity. At the end of second week turbidity and foul smell was observed in the juice samples owing to high microbial growth, similar findings have been reported previously in chilled orange juice[12].

Total soluble solids

A decrease in the total soluble solids (˚Brix) content of the juice was observed with storage figure 1. Over time, a drop in Total Soluble Solids was found with increasing concentrations of malic acid and maximal for the control. This can be explained as follows, the microbes in the juice sample with their growth fermented sugar leading to a drop in total soluble solids, an accompanying fermentation odour was also detected in the samples.

The ˚Brix drop was observed lowest for 100% citric acid variant and greatest for control indicating maximum decrease of sugar content on account of consumption by the microbial fauna.

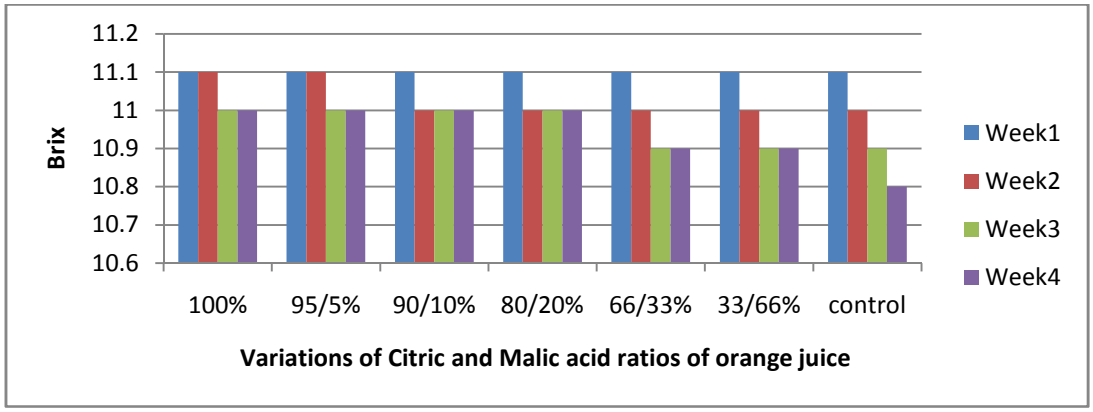

Fig. 1: Variation of total soluble solids (TSS) on weekly basis for juice samples with different ratios of Citric and Malic acid.

Microbial count:

There was increase in the microbial colony on the successive weeks in all variants. It was observed that with increase in the citric acid concentration there was decrease in the microbial count. 100% citric acid was most potent in inhibiting microbial growth. Citric and malic acid addition were found to reduce the rate of spoilage as compared to the control sample. Their antimicrobial effect is well established owing to pH lowering and cell membrane damage of the microbes[13].

Sensory analysis:

Analysis of fruit juice samples using the nine point hedonic scale indicate a trend of overall preference towards 90:10 citric: malic acid ratio (average score of acceptance: 7.55) as the optimum concentration of organoleptic choice most preferred, 66:33 citric: malic acid sample (average score of acceptance: 7.45) was a close second on the sensory survey, followed by 95:5 and 80:20 both having overall liking score of 7.35, control sample was found score least (average score of acceptance 5) in the survey.

For sweetness parameter the variant 33:66 citric: malic acid sample (average score of acceptance: 7.05), for sourness parameter the variant 33:66 citric: malic acid sample, for flavor parameter the variant 90:10 and 80:20 citric: malic acid sample, for tartness 66:33 citric: malic acid sample and for overall taste sweetness and sourness the variant 66:33 citric: malic acid sample scored highest respectively on the nine point hedonic scale sensory survey.Fig.3

Citric acid is one of the most widely used acidifier for foods. It imparts a rapidly building up tart taste, contrastingly malic acid is responsible for smoother and longer lasting tart taste and a clear organoleptically synergistic effect exists between both the acids as indicted by the results.

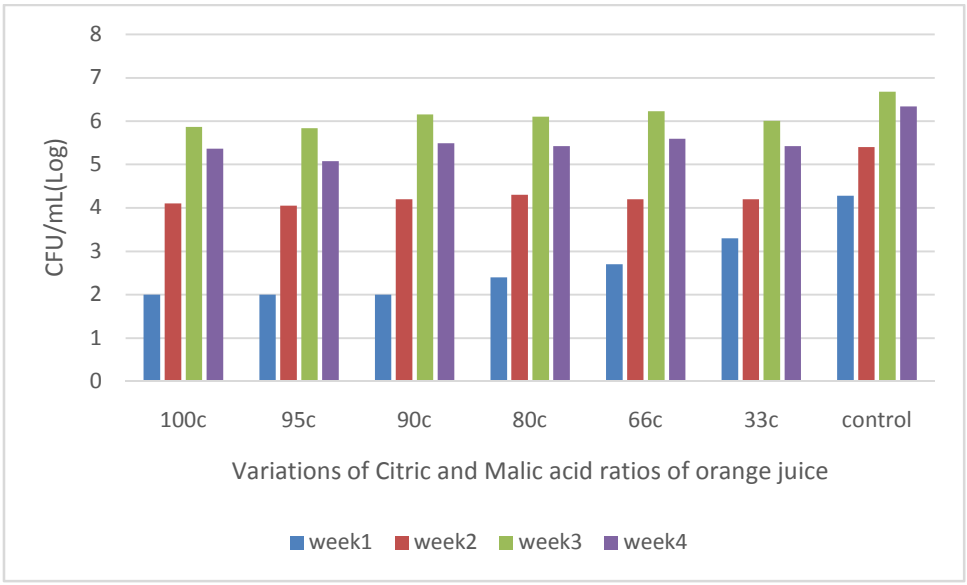

Fig. 2: Microbial growth analysis on weekly basis

c = citric acid

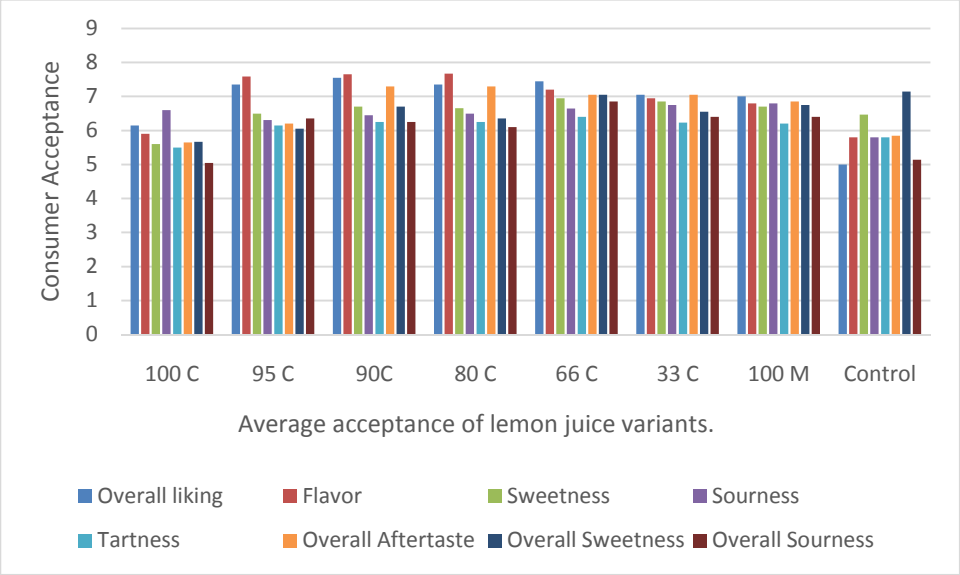

Fig. 3: Sensory analysis of juice samples

CONCLUSION

The results suggest the combination of the citric and malic acids enhances the sensory parameter, no significant synergistic effect in improving the shelf life of the juice samples was found though. Further investigation of this process, considering more stringent parameters may give a clear insight of the combined effect of the two acids in enhancing the overall characteristics of fruit juices.

It was found that with storage, change in the physicochemical properties (pH, titratable acid, total soluble solids and microbiological spoilage) was observed for all the additive acid concentrations (100, 95:5, 90:10, 80:10, 66:33, 33:66 and control) indicating spoilage. An increasing trend towards spoilage was observed with decreasing the concentration of citric acid and malic acid increments. The 100:0 (citric: malic acid) concentration was found to be most stable towards storage. 100% malic acid sample was found to be the least stable concentration. Organoleptically, 90:10 (citric: malic acid) sample was found to be the best indicating that it was the most optimum organic acid ratio preferred as indicated by the survey. More ever 95:5 and 80:20 (citric: malic acid) sample were a close second and it can be suggested that it can be a more viable additive ratio based on its improved shelf life.

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