Production and evaluation of physicochemical, nutritional, sensorial and microbiological properties of mixed fruit juice blend

ABSTRACT

Fruits belong to class of foods that supply human diet with nutritive requirements including vitamins and minerals which are essential for normal body health and function. In recent age, a significant importance is given for the development of nutritious and health beneficial foods. Fruit juices collected from different fruits when blended do not only improve the physicochemical and nutritional properties but also enhance the sensorial or organoleptic properties. The present study was carried out to determine the physicochemical, nutritional, microbiological analysis and sensory evaluation of mixed fruit juice blend. Juice of orange (Citrus sinensis), apple (Malus domestica), and mosambi (Citrus limetta) were blended in the ratio of sample-I (30% apple:30% orange:40% mosambi), sample-II (40% apple:30% orange:30% mosambi), sample-III (30% apple:40% orange:30% mosambi), sample-IV (50% apple:30% orange:20% mosambi), sample-V (30% apple:20% orange:50% mosambi), and sample-VI (20% apple:50% orange:30% mosambi) to evaluate all quality characteristics. Their colour properties were evaluated in term of hue angle, chroma and colour difference (∆E) respectively. The physicochemical parameters analysis carried out included total soluble solids (TSS), total titratable acidity (TTA), pH, acidity (FA), volatile acidity (VA), pH, and vitamin C. There were significant differences (p˂0.05) in the TSS of the samples. However, sample-V (30% apple:20% orange:50% mosambi) showed the highest TSS of 9.02 mg which significantly differed from other samples (p˂0.05). Sample-IV (50% apple:30% orange:20% mosambi) showed the highest titratable acidity (.59%) as compared with other samples. The highest value of pH was found to be 5.01 for sample-IV (50% apple:30% orange:20% mosambi). Sample-VI (20% apple:50% orange:30% mosambi) blend had the highest hue angle, chroma and colour changes of 72.14, 25.29 and 54.48 and vitamin C, that is, Ascorbic acid (.33g/l) content compared with other samples. The nutritional compositions study showed that, sample-VI (20% apple:50% orange:30% mosambi) has the significantly higher carbohydrate (51.67%), protein (.78%) and ash (1.24%) than other samples, while sample-V (30% apple:20% orange:50% mosambi) has higher dietary fibre (12.84%) and fat (2.82%) content. Microbiological analysis of all samples in terms of total plate count (TPC) ranges from 44-60 in 10^1 dilution and 4-5 in 10^7 dilutions and was found satisfactory. Moreover, other pathogenic bacteria count was found nil. The general acceptability of the mixed fruit juice blend samples were moderately liked by the panellists, and sensorial quality studies showed that sample-V (30% apple:20% orange:50% mosambi) had the highest overall acceptability of 8.37 over other samples and as such, can be considered good for consumption.

Key words: Microbiological, nutritional, physico-chemical, sensory properties.
Fruits have been shown to contain high amount of minerals, moisture, low ash and crude fibre and are sources of sugar, vitamin A, C and B groups, low protein and lipid. Fruits being a seasonal crop by nature have prompted many scientists to embark on researches on how to process fruit juices and preserve them for usage during off-season. The orange most commonly grown today is *Citrus sinensis* (sweet orange) which differs from *Citrus aurantium*, the bitter orange. Sweet orange commonly called orange is a member of citrus family and a major source of vitamins, especially vitamin C, sufficient amount of folacin, calcium, potassium, thiamine, niacin and magnesium (Angew, 2007). Fruits belong to the citrus group described as “hesperidium,” which means a fruit with sectioned pulp inside a separable rind. Citrus fruits, as such, have long been valued for their wholesome nutritious and antioxidant properties. It is a scientifically established fact that citrus fruits especially oranges by their abundance of vitamins, antioxidants, and minerals can benefit in many ways. Moreover, it is now an acknowledged fact that the other biologically active, non-nutrient compounds in the citrus fruits such as phytochemical antioxidants, soluble and insoluble dietary fibre, and pectin, help in cutting down cancer risk, chronic diseases like arthritis, obesity, and coronary heart diseases. By binding to bile acids in the colon, pectin has also been shown to reduce blood cholesterol levels by decreasing its re-absorption in the colon. The fruit is low in calories, and contains no saturated fats or cholesterol. Oranges is an excellent source of vitamin C (provides 48.5 mg per 100 g, about 81% of DRI). Vitamin-C is a powerful natural antioxidant which helps the human body develop resistance against infectious agents and scavenge harmful, pro-inflammatory free radicals from the blood. The fruit contains a variety of phytochemicals. Hesperetin, naringenin, and naringenin are flavonoids found in citrus fruits. Naringenin is found to have a bioactive effect on human health as antioxidant, free radical scavenger, anti-inflammatory and immune system modulator. Oranges also contain very good levels of vitamin-A, and other flavonoid antioxidants such as α and β-carotenes, β-cryptoxanthin, zeaxanthin and lutein. These compounds have been known to have antioxidant properties. Vitamin-A is also required for maintaining healthy mucosa and skin and essential for good eye sight. It is also a very good source of B-complex vitamins such as thiamin, pyridoxine, and folates. These vitamins are essential in the sense that the human body requires them from external sources to replenish. The fruit contains some amount of minerals such as potassium and calcium. Potassium is an important component of cell and body fluids that helps control heart rate and blood pressure through countering pressing effects of sodium (Arnarson, 2014). Orange juice is a rich source of essential nutrients and antioxidants. The total antioxidants activity of orange juice is found to be higher than the orange wine (Miller and Evans, 1997). A 225 ml glass of orange juice contains approximately 125 mg of vitamin C, 500 mg of potassium, and 75 mcg of folic acid (Whitney and Rolfes, 1999). One medium orange provide approximately 70 mg of vitamin C, 235 mg of potassium, 3.0 g non-starch polysaccharides (NSP) contributing to meeting the daily fibre goal (Whitney and Rolfes, 1999). Fruit juices are liquid, non-alcoholic products with a different degree of clarity and viscosity, obtained through pressing or breaking up the fruits with or without sugar or carbon dioxide addition (Costescu et al., 2006). Fruit juices are ready and rich sources of vitamins, fibre and mineral salts for human consumption (Costescu et al., 2006). Fruits consumption is beneficial to health and contributes to the prevention of degenerative processes, particularly in lowering the incidence and mortality rate of cancer and cardiovascular diseases (Rapisarda et al., 1999). Based on fruits antioxidant capacities, these fruit juices are used as indicators for healthy nourishment as well as protection factors of the human body against oxidative destruction (Costescu et al., 2006). The increasing social and economic importance of food products besides the technology complexity of producing, processing and fragile food materials requires a more extensive knowledge of their physical properties because the rheological properties play an important role in the handling and quality attributes of processed foods (Shahnavaz and Sheikh, 2011). Present dietary scenario necessitates exploring the possibilities of incorporating novel ingredients in commonly consumed foods rather than developing new food product (Aleem-Zakir et al., 2012). Food is one of the most important necessities for man. Their regular and copiously consumption maintains health and makes up for the losses in the human diet. Costescu et al. (2006) recommended the consumption of natural juices with pulp from food and medical points of view. Juice blending is one of the best methods to improve the nutritional quality of the juice. It can improve the vitamin and mineral content depending on the kind and quality of fruits and vegetables used (De Carvalho et al., 2007). Nutritional, chemical composition and the effect of storage on various fruits (orange, mosambi and apples) and their juices have been reported (Ogunsola and Akinyele, 1995; Nazarudeen, 2010). Muhammad et al. (2007) reported on the storage conditions on vitamin C and pH value of cashew apple juice have been studied (Emelike and Ebere, 2015a). Orange (*Citrus sinensis*) belongs to the genus citrus of the family Rutaceae. It is a distinguished, widely consumed fresh fruits and particularly appreciated for its tangy taste. Its pulp is an excellent source of vitamin C, providing 64% of the daily requirement of an individual. Apart from vitamin C content of orange juice, it is also rich in folic acid, potassium and excellent source of bioactive antioxidant phytochemical and they are important trade commodities in most countries. Pineapple (*Ananas comosus*) is an economically important plant in the Bromelaceae family which encompasses about 50 genera and 2000 species mostly epiphytic. The
worldwide total pineapple production is between 16 - 19 million tons. Pineapple and its juice is nonalcoholic drink and the demand continues to rise mainly due to increasing awareness of its health benefits. Its juice have an proximate composition of 81.2 – 86.2% moisture, 13 – 19% total solid of which sucrose, glucose and fructose are the main compositions, 0.4% fibre and a rich source of vitamin C. Mixed fruit juice blends together can be produced from various fruits such as orange, mosambi and apple in order to combine all the basic nutrients present in these different fruits. This usually gives a better quality juice nutritionally and organoleptically. Studies have shown that the practice of mixing different exotic fruits positively impact on the flavour and taste of the fruit and fruit products (Nwachukwu et al., 2007; Ogiehor et al., 2008). Apart from nutritional quality improvement, blended juice can be improved in its effects among the variables, thus it cannot depict the net effects of various parameters on the reaction rate. Moreover, one could think of a new product development through blending in the form of a natural health drink, which may also be served as an appetizer. Therefore, to produce mixed fruit juice from the blends of orange/Mosambi/apple fruits is the objective of this research. Also, this study was carried out to compare the physical, chemical, nutritional, microbiological and sensory properties of the different blends and finally optimisation of suitable fruit juice blend for better acceptability.

MATERIALS AND METHODS

The fully matured, freshly harvested pineapple, apple and mosambi were procured from the local market of Kokrajhar and were brought to the Central Institute of Technology, Kokrajhar for the study. All the laboratory analysis was performed in the laboratory of department of food engineering and technology.

Procedure

Preparation of orange Juice

Orange juice is one of the important raw material for blend preparation. Orange juice was prepared as shown in Figure 1.

Preparation of mosambi juice

Mosambi is another ingredient for mixed juice blend preparation. The mosambi juice extraction is shown in Figure 2.

Preparation of apple juice

The remaining fruit for mixed fruit juice blend preparation is apple. The apple juice preparation from the selected apple is shown in Figure 3.

Preparation of orange /apple/mosambi juice blends

Therefore, after the extraction of orange juice, mosambi juice and apple juice, the mixed fruit juice blend is prepared by considering the following ratios as shown in Table 1.

Physicochemical and nutritional analysis of mixed fruit juice blend

The method of Onwuka (2005) was used for the physiochemical analysis of the mixed fruit juice blend leather samples and the parameters determined were total titratable acidity (TTA), total soluble solids (TSS) and pH. Moreover for proximate composition or nutritional analysis, the method of AOAC (2012) was adopted for mixed fruit juice blend for the determination of ash, fat, crude fibre, protein contents and carbohydrate content.

Colour measurement

Colour measurement performed using spectrophotometer Ultra Scan Pro (D65 Hunter Lab, USA) to obtains values of L*, a*, b*, L* measured the darkness (black, 0 to white, 100), while a* measure range colour from -a*(greenness) to +a*(redness), b* for blueness (-b*) to yellowness (+b*). hue angle (h*), chroma and colour change (∆E) were determined based on a* and b* value obtained:

Hue angle (h*) = tan^-1(b*/a*)
Chroma =√(a^2+b^2)
∆E =√(ΔL^2+Δa^2+Δb^2).

Preparation of standard ascorbic acid solutions

Fifty milligrams of sodium bicarbonate was dissolved in 50b ml distilled water, to this was added 50 mg of 2, 6-dichloroindo-phenol sodium. The mixture was diluted to the 200 ml volume with distilled water. The final solution was then filtered using a filter paper (whatman paper) into an amber bottle and tightly stopped and stored under refrigeration temperature.

Preparation of metaphosphoric acid–acetic acid solution

Metaphosphoric acid (7.5g) was added to a 20% solution of acetic acid in a 250 ml volumetric flask and stirred. The mixture was diluted to the 250ml mark with distilled water, filtered and stored at 4°C.
Collection of selected Orange from market

Washing and Cleaning

Peeling of orange

Juice extraction by juicer

Filtration by sterile muslin cloth

Clarified orange juice collected in bowl

**Figure 1:** Preparation of orange juice.

Collection of Selected mosambi from the market

Washing and Cleaning with tap water

Peeling

Crushing for juice extraction in juicer

Filtration by sterile muslin cloth

Filtered Mosambi juice collected in bowl

**Figure 2:** Preparation of mosambi juice.

**Vitamin C determination**

The method of AOAC (2012) was used. Metaphosphoric acid–acetic solution (5 ml) was pipette and added to a 2 ml ascorbic acid standard solution in Erlenmeyer flasks in triplicates. This was titrated against indophenols solution
Collection of selected Apple from the market

Washing and Cleaning

Cut into slices and then remove seed and core

Boiling

Crushing into pulp

Filtration

Filtered Apple juice

Figure 3: Preparation of apple juice.

Table 1: Blending ratios for the mixed fruit juice blend.

<table>
<thead>
<tr>
<th>Samples</th>
<th>S-I</th>
<th>S-II</th>
<th>S-III</th>
<th>S-IV</th>
<th>S-V</th>
<th>S-VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>30</td>
<td>40</td>
<td>30</td>
<td>50</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>Orange</td>
<td>30</td>
<td>30</td>
<td>40</td>
<td>30</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>Mosombi</td>
<td>40</td>
<td>30</td>
<td>30</td>
<td>20</td>
<td>50</td>
<td>30</td>
</tr>
</tbody>
</table>

until a distinct rose-pink colour formed and persisted for more than 5 s. The initial and final readings of the burette were recorded. Blanks were prepared in the same way as above and the average titre of indophenols dye used was calculated. The mixed fruit juice blend were dissolved in water and 2 ml sample was added to 5 ml of metaphosphoric acid–acetic acid solution in a 50 ml Erlenmeyer flask and was titrated with the indophenol dye solution until a distinct rose-pink colour persisted for more than 5 s. This was done in triplicate and the initial and final readings of the burette was taken and used to calculate the average titre of dye used.

Sensory evaluation

Nine-point hedonic scale is widely used for acceptance testing when the goal is to determine how much a specific product is liked by the consumer. It consists of a balanced bipolar scale around the neutral category (5 = neither liked nor disliked), with four positive categories (6, 7, 8, and 9 = liked slightly, liked moderately, liked very much, and liked extremely, respectively) and four negative categories (1, 2, 3, and 4 = disliked extremely, disliked very much, disliked moderately and disliked slightly, respectively) (Lim, 2011). All the data are normally distributed and expressed as Mean ± SD (Das, 2008).

Microbiological analysis

Microbiological analysis was carried out for all mixed fruit juice samples using pour plate method or plate count agar (PCA) by spread plate method according to Harrigan et al.
The plates, after being plated with suspension of microorganisms of different dilutions, were incubated at 37°C and the colonies were counted after 48 h of incubation. The plates with colony forming units per ml (cfu/mL) ranging from 30-300 were considered for counting as the colonies less than 30 would have run into greater statistical inaccuracy and the colonies greater than 300 would have been tedious to count. Pathogenic microbial count was also recorded. Detection of Salmonella spp. was done according to Varadaraj (1993). Detection of Staphylococcus aureus, a food poisoning organism was carried out according to Colee et al. (1989).

RESULTS AND DISCUSSION

Evaluation of nutritional composition and physicochemical characteristics

The nutritional composition results of the fruit juice blend produced from apple, orange and mosambi fruits are shown in Table 2.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Carbohydrate (%)</th>
<th>Protein (%)</th>
<th>Ash (%)</th>
<th>Dietary fibre (%)</th>
<th>Fat (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (30% apple : 30% orange : 40% mosambi)</td>
<td>48.54</td>
<td>0.66</td>
<td>0.85</td>
<td>8.54</td>
<td>1.94</td>
</tr>
<tr>
<td>II (40% apple : 30% orange : 30% mosambi)</td>
<td>49.20</td>
<td>0.36</td>
<td>0.90</td>
<td>9.16</td>
<td>2.16</td>
</tr>
<tr>
<td>III (30% apple : 40% orange : 30% mosambi)</td>
<td>50.21</td>
<td>0.66</td>
<td>0.95</td>
<td>10.2</td>
<td>2.24</td>
</tr>
<tr>
<td>IV (50% apple : 30% orange : 20% mosambi)</td>
<td>49.60</td>
<td>0.24</td>
<td>1.06</td>
<td>7.46</td>
<td>0.65</td>
</tr>
<tr>
<td>V (30% apple : 20% orange : 50% mosambi)</td>
<td>48.49</td>
<td>0.66</td>
<td>1.16</td>
<td>12.84</td>
<td>2.82</td>
</tr>
<tr>
<td>VI (20% apple : 50% orange : 30% mosambi)</td>
<td>51.67</td>
<td>0.78</td>
<td>1.24</td>
<td>11.72</td>
<td>2.43</td>
</tr>
</tbody>
</table>

Table 2: Nutritional quality analysis of mixed fruit juice blend.

(1976). The plates, after being plated with suspension of microorganisms of different dilutions, were incubated at 37°C and the colonies were counted after 48 h of incubation. The plates with colony forming units per ml (cfu/mL) ranging from 30-300 were considered for counting as the colonies less than 30 would have run into greater statistical inaccuracy and the colonies greater than 300 would have been tedious to count. Pathogenic microbial count was also recorded. Detection of Salmonella spp. was done according to Varadaraj (1993). Detection of Staphylococcus aureus, a food poisoning organism was carried out according to Colee et al. (1989).

The result showed that sample-VI (20% apple: 50% orange: 30% mosambi) had significantly higher carbohydrate (51.67%), protein (0.78%) and ash (1.24%) than other samples, while sample-V (30% apple: 20% orange: 50% mosambi) had higher dietary fibre (12.84%) and fat (2.82%) content. The least value of carbohydrate, ash, dietary fibre fat and protein were recorded for sample-I (30% apple: 30% orange: 40% mosambi). All the samples of the mixed fruit juice produced showed a high level of carbohydrate. High values of ash content indicated high mineral constituent (Adedeji et al., 2006). The variation in the protein contents could be attributed to different type of fruits used, probably due to the variable nitrogen containing compounds in the fruits. The range of fibre contents recorded by the samples is advantageous as fibre is essential in food as it absorbs water and provides roughage for the bowels, assisting intestinal transit (Ibeji, 2011). The results of the physico-chemical composition and vitamin C content of fruit juice blend produced from apple, orange and mosambi are shown in Table 3.

There were significant differences (p<0.05) in the TSS of the samples. However, sample-V (30% apple: 20% orange: 50% mosambi) showed the highest TSS of 9.02 mg and significantly differed from other samples (p<0.05). The soluble solids content is one of the most important quality parameters in processing. 55% of soluble solids content are sugars, glucose and fructose and their amount and proportions influence the organoleptic qualities of fruit and fruit leathers (Blessing and Ekwunife, 2015). The total titratable acidity showed that all the samples were significantly different (p<0.05) from one another with sample-IV (50% apple: 30% orange: 20% mosambi) recording the highest TTA (.59%) while sample-II (40% apple: 30% orange: 30% mosambi) had the least with (0.42%). Acids present in food do not only improve its palatability but also influence the nutritive value. The acid influence the flavour, brightness of colour, stability, consistency and keep the quality of the product (Adedeji et al., 2006). The pH of the mixed fruit juice were recorded for sample-I (30% apple:30% orange: 40% mosambi), sample-II (40% apple : 30% orange : 30% mosambi), sample-III (30% apple : 40% orange : 30% mosambi), sample-IV (50% apple : 30% orange : 20% mosambi), sample-V (30% apple: 20% orange: 50% mosambi), and sample-VI(20% apple : 50% orange : 20% mosambi) having the highest value and sample-VI (20% apple : 50% orange : 30% mosambi) the lowest value. The pH levels of all the mixed fruit juice samples indicated that they were slightly acidic and this may confer longer keeping quality of them. The result of the study showed that there were significant difference (p<0.05) in the vitamin C level of the three mixed fruit juice blend samples, with that of sample-VI (20% apple : 50% orange : 30% mosambi) being higher (0.33 g/l), followed by sample-V (30% apple : 20% orange : 50% mosambi) (0.22 g/l). The high vitamin C level of the mixed fruit leather was desirable as this vitamin is vital in iron absorption as well as formation of intracellular protein collagen (Ogbonna et al., 2013).

Colour analysis of mixed fruit juice blend

Hue angle (h*), chroma and colour change (ΔE) were analysed for each sample of mixed fruit juice blend as shown in Figure 4.

Sample-VI (20% apple: 50% orange: 30% mosambi) blend had the highest hue angle, chroma and colour...
Table 3: Physico-chemical quality and vitamin C composition evaluation of mixed fruit juice blend.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Total soluble solid (mg)</th>
<th>pH</th>
<th>Total titratable acidity (%)</th>
<th>Vitamin C (g/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample-I (30% apple:30% orange:40% mosambi)</td>
<td>7.11</td>
<td>4.96</td>
<td>0.56</td>
<td>0.16</td>
</tr>
<tr>
<td>Sample-II (40% apple:30% orange:30% mosambi)</td>
<td>7.2</td>
<td>4.95</td>
<td>0.42</td>
<td>0.18</td>
</tr>
<tr>
<td>Sample-III (30% apple:40% orange:30% mosambi)</td>
<td>6.24</td>
<td>4.98</td>
<td>0.47</td>
<td>0.20</td>
</tr>
<tr>
<td>Sample-IV (50% apple:30% orange:20% mosambi)</td>
<td>7.41</td>
<td>5.01</td>
<td>0.59</td>
<td>0.13</td>
</tr>
<tr>
<td>Sample-V (30% apple:20% orange:50% mosambi)</td>
<td>9.02</td>
<td>4.94</td>
<td>0.55</td>
<td>0.22</td>
</tr>
<tr>
<td>Sample-VI (20% apple:50% orange:30% mosambi)</td>
<td>8.42</td>
<td>4.92</td>
<td>0.35</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Significance level among all samples of mixed fruit juice blend (p<0.05).

Figure 4: Chroma, colour change and hue angle of different samples of mixed fruit juice blend.

changes of 72.14, 25.29 and 54.48, followed by sample-V (30% apple:20% orange:50% mosambi) of 69.17, 22.40 and 51.38.

Microbiogical evaluation of mixed fruit juice blend

The result of the analysis is shown in Table 4. The microbiological examinations of sample-I (30% apple:30% orange:40% mosambi), sample-II (40% apple :30% orange :30% mosambi), sample-III (30% apple :40% orange:30% mosambi), sample-IV (50% apple :30% orange :20% mosambi), sample-V (30% apple:20% orange :50% mosambi) and sample-VI (20% apple :50% orange :30% mosambi) were carried out with total plate count (TPC) and identification of pathogenic organisms viz. *Salmonella* sp and *S. aureus*. Total plate count (TPC) was found satisfactory ranging from 44-60 in 10^1 dilution and 4-5 in 10^7 dilutions in all samples, and other pathogenic bacterial count was also found nil.

Sensory evaluation of mixed fruit juice blend

The result of the sensory evaluation of the mixed fruit juice blend prepared using three different fruits (apple, orange and mosambi) of different proportions are shown in Table 5.

The result showed that the average score for colour of sample-I (30% apple:30% orange:40% mosambi) was 8.0, sample-II (40% apple :30% orange :30% mosambi) was 8.22, sample-III (30% apple :40% orange :30% mosambi) was 7.44, sample-IV (50% apple :30% orange :20% mosambi) was 7.44, sample-V (30% apple:20% orange :50% mosambi) was 8.55 and sample-VI (20% apple :50% orange :30% mosambi) recorded 7.22. From the statistical analysis conducted, though there was slight variation in the colour or appearance of the samples, there was no significant differences (p<0.05), indicating that the appearance of all the samples were liked moderately by the panellists. The average texture score of sample-I (30% apple:30% orange:40% mosambi) was 7.7, sample-II (40%
Table 4: Total plate count (TPC) and pathogenic microbes count of different samples of mixed fruit juice blend.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Dilution factor</th>
<th>10^1</th>
<th>10^2</th>
<th>10^3</th>
<th>10^4</th>
<th>10^5</th>
<th>10^6</th>
<th>Salmonella sp.</th>
<th>Staphylococcus aureus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample-I (30% apple:30% orange:40% mosambi)</td>
<td>48 28</td>
<td>12 10</td>
<td>8 5</td>
<td>5 5</td>
<td>Nil</td>
<td>Nil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample-II (40% apple:30% orange :30% mosambi)</td>
<td>45 30</td>
<td>22 12</td>
<td>8 6</td>
<td>4 4</td>
<td>Nil</td>
<td>Nil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample-III (30% apple:40% orange :30% mosambi)</td>
<td>56 32</td>
<td>20 15</td>
<td>9 5</td>
<td>5 5</td>
<td>Nil</td>
<td>Nil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample-IV (50% apple :30% orange :20% mosambi)</td>
<td>60 32</td>
<td>22 15</td>
<td>10 7</td>
<td>5 5</td>
<td>Nil</td>
<td>Nil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample-V (30% apple:20% orange:50% mosambi)</td>
<td>40 32</td>
<td>20 12</td>
<td>9 5</td>
<td>3 3</td>
<td>Nil</td>
<td>Nil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample-VI (20% apple :50% orange :30% mosambi)</td>
<td>44 25</td>
<td>19 12</td>
<td>9 6</td>
<td>4 4</td>
<td>Nil</td>
<td>Nil</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5: Sensory evaluation of different samples of mixed fruit juice blend.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Colour</th>
<th>Flavour</th>
<th>Texture</th>
<th>Taste</th>
<th>Mouth feel</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample-I (30% apple:30% orange:40% mosambi)</td>
<td>8±0.86</td>
<td>7.22±0.65</td>
<td>7.7±0.67</td>
<td>7.1±0.60</td>
<td>7.4±0.52</td>
<td>7.51±0.45</td>
</tr>
<tr>
<td>Sample-II (40% apple :30% orange :30% mosambi)</td>
<td>8.22±0.65</td>
<td>7.44±0.16</td>
<td>8±0.24</td>
<td>7.55±0.30</td>
<td>8±0.17</td>
<td>7.84±0.10</td>
</tr>
<tr>
<td>Sample-III (30% apple:40% orange :30% mosambi)</td>
<td>7.44±0.23</td>
<td>7.33±0.16</td>
<td>7.55±0.15</td>
<td>7.22±0.28</td>
<td>7.66±0.16</td>
<td>7.46±0.1</td>
</tr>
<tr>
<td>Sample-IV (50% apple :30% orange :20% mosambi)</td>
<td>7.44±0.52</td>
<td>7.44±0.72</td>
<td>7.66±0.70</td>
<td>7.22±0.96</td>
<td>7.55±1.01</td>
<td>7.46±0.65</td>
</tr>
<tr>
<td>Sample-V (30% apple:20% orange:50% mosambi)</td>
<td>8.55±0.52</td>
<td>8.44±0.72</td>
<td>7.22±1.11</td>
<td>8.33±0.86</td>
<td>8.44±0.87</td>
<td>8.37±0.51</td>
</tr>
<tr>
<td>Sample-VI (20% apple :50% orange :30% mosambi)</td>
<td>7.22±0.82</td>
<td>7.33±0.99</td>
<td>7.55±0.88</td>
<td>7±1.32</td>
<td>7.33±0.48</td>
<td>7.28±0.72</td>
</tr>
</tbody>
</table>

Significance level among all samples of mixed fruit juice blend (p<0.05).

Apple :30% orange :30% mosambi) was 8.0, sample-III (30% apple :40% orange :30% mosambi) was 7.55, sample-IV (50% apple :30% orange :20% mosambi) was 7.66, sample-V (30% apple:20% orange:50% mosambi) was 7.22 and sample-VI (20% apple :50% orange :30% mosambi) recorded 7.46, though there was no significant difference at (p<0.05) among the samples in their textures. The average flavour score of sample-I (30% apple:30% orange:40% mosambi) was 7.2, sample-II (40% apple :30% orange :30% mosambi) was 7.44, sample-III (30% apple :40% orange :30% mosambi) was 7.33, sample-IV (50% apple :30% orange :20% mosambi) was 7.44, sample-V (30% apple:20% orange:50% mosambi) was 8.44 which was highest and sample-VI (20% apple :50% orange :30% mosambi) recorded 7.33, though there was no significant difference at (p<0.05) among the samples in their flavour scores. The average taste and mouth feel scores of sample-I (30% apple:30% orange:40% mosambi), sample-II (40% apple :30% orange :30% mosambi), sample-III (30% apple :40% orange :30% mosambi), sample-IV (50% apple :30% orange :20% mosambi), sample-V (30% apple :20% orange:50% mosambi) and sample-VI (20% apple :50% orange :30% mosambi) were recorded as 7.1,7,4; 7.35,8,0; 7.22,7.66; 7.22,7.55; 8.33,8.44 and 7.0,7.33 respectively but not significantly different at (p<0.05) from other samples among the samples in their taste and mouth feel. The panelists liked all the mixed fruit juice blend samples moderately. The taste of fruit leather is contributed by the amounts of sugar contained in the fresh pulp. Increase in the amount of sugar beyond optimum amounts may however, reduce the taste ratings thus, requiring optimization (Jain and Neema, 2007). Sweetness rating may also depend on the type of the fruit and may also vary during storage (Ashaye et al., 2005). The average overall acceptability score of sample-I (30% apple:30% orange:40% mosambi) was 7.51, sample-II (40% apple :30% orange :30% mosambi) was 7.84, sample-III (30% apple :40% orange :30% mosambi) was 7.40, sample-IV (50% apple :30% orange :20% mosambi) was 7.46, sample-V (30% apple:20% orange:50% mosambi) was 8.37 which was the highest and sample-VI (20% apple :50% orange :30% mosambi) recorded 7.28, though there was no significant difference at (p<0.05) among the samples in their overall acceptability. Therefore, sample-V (30% apple: 20% orange: 50% mosambi) had highest mean overall acceptability of 8.37 over other samples and can be considered good for consumption. The acceptability of fruits and vegetables is influenced by their taste and aroma. In this study, however, the results of the overall acceptability were positively correlated with the entire sensory attribute tasted. The standard deviation of all fruit juice blend samples are also shown in Table 4. Now it can be seen that all the samples were generally acceptable by the panelist.

Conclusions

Blending of different fruit juices in suitable proportion can enhance the nutritional and physicochemical properties.
Moreover, significant improvement of the mixed fruit juice blend in colour characteristics was measured instrumentally in terms of hue angle, chroma and colour changes. It was also observed that all these mixed fruit juice blend samples were microbiologically safe. The sensorial characteristics revealed that all these mixed fruit juice blend samples overall acceptability was satisfactory.

ACKNOWLEDGEMENT

The authors are grateful to the Department of Food Engineering and Technology, Central Institute of Technology Kokrajhar, Deemed to be University, Govt. of India, Assam, India for providing the necessary laboratory facilities to carry out this research.

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