Science World Journal Vol. 19(No 4) 2024 https://dx.doi.org/10.4314/swj.v19i4.37
www.scienceworldjournal.org
ISSN: 1597-6343 (Online), ISSN: 2756-391X (Print)
Published by Faculty of Science, Kaduna State University

Full Length Research Article

EVALUATING THE QUALITY AND SENSORY CHARACTERISTICS OF WATERMELON AND APPLE JUICE BLENDS

Irene Akua Idun, *Paul Kweku Tandoh, Michael Osei, Divina Allotey

Department of Horticulture, Kwame Nkrumah University of Science and Technology, Kumasi

*Corresponding Author Email Address: pktandoh.canr@knust.edu.gh Phone: +233 243237465

ABSTRACT
The fruit juice industry is a growing globally and the practice of mixing different fruits to make a juice blend is a recent trend being exploited in the industry. Little has been done to maximize the nutrients and sweetening content. This study evaluated the quality and sensory properties of the watermelon/apple juice blend. The watermelon and apples were obtained in the ripe stages, they were washed and chopped into smaller sizes and then blended separately. The design for the study was a Completely Randomized Design (CRD). Data collection and analysis were performed on pH, Total Titratable Acidity, Total Soluble Solids, protein, ash, crude fibre, potassium, potassium, calcium, iron, copper and zinc. The study revealed that 66.67% watermelon and 33.33% apple blend (W4AM) as well as the 25% watermelon and 75% apple blend (W5AM) recorded the highest value for total soluble solids (12.167 °Brix, 12.333 °Brix) and titratable acidity (0.034%, 0.034%) respectively. W5AM blend also recorded the highest vitamin C content (9.983 mg/100 g). Generally, the proximate composition of the blends had improved nutritional components as compared to the individual juices. The results showed significant differences between the blends ($p<0.01$) where the sensory evaluation showed that W5AM was mostly preferred amongst the blends for parameters like appearance, odour, taste and mouthfeel. However, the 50% watermelon and 50% apple blend (W6AM) were preferred in terms of overall acceptability. Furthermore, the 100% apple gave highly acidic drink. It was concluded that to obtain high nutritional and sensory quality drink, the 25% watermelon and 75% apple blend (W5AM) should be considered.

Keywords: Antioxidants, fruit, juices, proximate, minerals, nutrition

IINTRODUCTION

The increasing demand for higher food quality, the extension of the food trade and world food markets, over the last few decades have made available a huge variety of food products to consumers. The heightening focus of consumers on healthier diets including a lot of fruits and vegetables, has led to the evolution of the juice market which has been steadily growing across developing and developed countries (Dasenaki *et al.,* 2019).

Fruit juices are non-alcoholic liquids that are made by pressing fruits with or without the addition of sugar or carbon dioxide (CO_2) (Ibrahim *et al.,* 2017; Bhavya *et al.,* 2019). Pure (100%) fruit juices are nutrient-dense foods that contain potassium, magnesium, folate, calcium, vitamins A and C, soluble fiber, and a variety of bioactive compounds such as carotenoids and flavonoids, all of which contribute to good health (Comerford *et al.,* 2016; Li *et al.,* 2019; Wallace *et al.,* 2020). Watermelon (*Citrullus lanatus*) belongs to the Cucurbitaceae family and is native to Africa's tropical regions near the Kalahari Desert (Chomicki & Renner, 2015; Maoto *et al.,* 2019). It is widely consumed as a pleasant summer fruit, and it's refreshing abilities, appealing color, delicate taste, and high water content to quench summer thirst are highly valued by consumers (Maoto, 2019; Maoto *et al.,* 2019; Aderiye *et al.,* 2020). Watermelon's sweetness comes from a combination of sucrose, glucose, and fructose and its chemical components boost its ability to scavenge low-density lipoprotein (LDL) and high-density lipoprotein (HDL) from a cell membrane (Assis *et al.,* 2017; Aderiye *et al.,* 2020). Due to its low salt, saturated fat, and cholesterol content, research shows it aids weight loss (Maoto *et al.,* 2019). Watermelon is known to be beneficial to human health because it is a good source of vitamins B, C and E and other minerals. consumption has been linked to a variety of health benefits, including a reduced risk of heart disease, age-related degenerative illnesses, and certain types of cancer (Nasri *et al.,* 2014; Duhan *et al.,* 2020). They may also improve immune system function and slow tumor development (Maoto *et al.,* 2019). The pulp and juice of a watermelon are high in fiber and carbohydrates. The pulp and juice of a watermelon are high in fiber and carbohydrates (Campbell, 2017).

Apple (*Malus domestica*) is the most significant temperate fruit commercially, and it ranks fourth among the world's most extensively produced fruits after banana, orange, and grapes (Watpade *et al.,* 2012; Wani & Songara, 2017). Apples are low in cholesterol and high in flavonols, anthocyanins, dihydrochalcones, quercetin, catechin, tannins, and dietary fiber, particularly pectin (Ferretti *et al.,* 2014; Koutsos *et al.,* 2015). It's consumption reverses nerve cell oxidative damage and lowers diabetes risk (Meccariello & D'Angelo, 2021; Hussain *et al.,* 2021). Aside being a low-calorie fruit, apples aid in the treatment of depression, the prevention of obesity, the prevention of constipation, and the improvement of dental health (Hussain *et al.,* 2021).

The increasing demand on highly healthy food products, has made the development of highly nutritious food products. The production of fruit juice blends has made this goal/demand achievable. A combination of two or more fruits results in the combination of their essential nutrients, giving it a much better quality organoleptically and nutritionally. Although various researches has been conducted on different juice blends using more common fruits, there is only little research output on the combination of watermelon and apple juice. Thus, this present study was carried out to evaluate the nutritional quality and sensory properties of watermelon and apple juice blend.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted in the Laboratory of the Department of Horticulture, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi.

https://dx.doi.org/10.4314/swj.v19i4.37

Experiment Design
The experimental design was a Completely Randomized Design with seven (7) treatments. The treatments are the different levels of watermelon juice to apple juice.

Juice Preparation
The watermelon and apples were purchased from the market in Kumasi and transferred to the laboratory in a clean, covered bowl. In the laboratory, the watermelon and apples were thoroughly washed separately with tap water and 5% hypochlorite solution, and sliced into smaller chunks. The juice was fleshly squeezed before the formulations were made. The extraction was done using manual juice extractor (Sencor SJE 1005, China) after which the juice of watermelon and apple were blended in the different ratios.

Preparation Of Watermelon/Apple Fruit Blends
Table 1: The watermelon/apple juice blend was formulated

Sample ID	Watermelon (%)	Apple (%)
W1AM	66.67	33.33
W2AM	100	0.00
W3AM	75	25
W4AM	33.33	66.67
W5AM	25	75
W6AM	50	50
W7AM	0	100

DETERMINATION OF PHYSICOCHEMICAL PARAMETERS
pH
A digital pH meter was used to measure the juice's pH (Elico, pH meter, LI617). The pH meter was calibrated with buffers at pH 4, pH 7 and pH 10 according to Kathiravan *et al.* (2014).

Total Titratable Acidity (TTA)
The total titratable acidity was determined using the method described by AOAC (2012). Ten (10ml) of the juice was pipetted into a conical flask and 25ml of distilled water was added. 200ml of 0.1M NaOH was poured into a burette and was titrated against the sample in the flask using phenolphthalein as indicator. The titration was done until a pink color was observed and the corresponding burette reading was taken.

$$TA = \frac{\text{Titre X blank X Normality o f base X mlequivalent o f citric acid}}{\text{Weight o f Sample}}$$

where, TA = titrable acidity (%)

Total Soluble Solids
Total Soluble Solids was determined using HI 96801 digital refractometer (NFPA, Japan) at room temperature. The fruit juice was dropped onto the illumination plate and the degree brix was then read from the LCD monitor display. The refractometer was zeroed before and in between readings to ensure consistent readings.

PROXIMATE ANALYSIS
Moisture determination
Moisture was determined according to the method of FSSAI, (2015). About 10ml of the fruit juice sample was weighed accurately into a previously dried and tared crucible and the crucible was placed in an air oven maintained at 105 ± 2°C for 4 hours (until a constant weight was attained). It was cooled in a desiccator and the weight recorded.

$$\text{Moisture (\%)} = \frac{(W2-W1)-(W2-W3)}{(W2-W1)} \text{ x } 100$$

Where,
W1 = Initial weight of crucible (g)
W2 = Weight of the crucible with sample before drying (g)
W3= Weight of crucible + dried sample (g)

Determination of Crude Protein
Crude protein content was determined using the Kjeldahl method (Okokon & Okokon, 2019). 10 ml of the fruit juice sample was measured into the Kjeldahl flask. Half a tablet of catalyst mixture (10 parts K_2SO_4 to one part of $CuSO_4$) and 25 ml of concentrated H_2SO_4 were added. The content of the flask was digested for 2-3 hours until the mixture was clear, to ensure complete breakdown of all organic matter. Then the sample was neutralized with excess NaOH and then distillation was done using 4% boric acid. The sample was titrated using Hydrochloric acid with methyl red–bromcresol green and crude protein percentage was calculated as follows:

$$\text{Crude Protein (\%)} = \frac{N \text{ x T x 10 ml x 14 x 100 x 6.2}}{1000}$$

Where:
N = Normality of HCl for sample titration.
T = Titration figure.
10 ml = weight of sample.
1000 = Number of milligrams in one gram.
14 = Equivalent weight of nitrogen.
6.25 = Protein conversion factor

Determination of Total Ash
The ash content was determined using the method described by Okokon & Okokon (2019). 10 ml of the sample was weighed into a clean and already tared crucible. Then, it was placed in a muffle furnace at 550 °C for about 4 hours until white to grey ash was obtained, then the crucible was removed from the furnace and put into a desiccator to cool, then re-weighed.

$$\text{Ash Content \%} = \frac{W2-W1}{W3} \text{ x } 100$$

where:
W1 = weight of empty crucible
W2 = weight of crucible with ash.
W3 = weight of sample

Fat Determination
The previously dried thimble was weighed and the oven dried sample was weighed into the thimble. The extraction flask was dried, cooled and weighed, then the thimble was put into the holding tube and fixed unto the condenser of the apparatus. Petroleum ether was poured into the extraction flask and the heater of the apparatus was put on; extraction was carried out for 4 hours. The extraction flask was allowed to air dry and then dried at 100 ºC for 30 min, it was cooled in the desiccator and weighed.

$$\text{Fat (\%)} = \frac{W2-W1}{Sample\ weight\ (g)} \text{ x } 100$$

Determination of Crude Fibre
The Soxhlet extraction method described by Alam *et al.* (2008) was used to determine the crude fibre. A 5 g portion of the homogenized sample was accurately weighed into a round bottom flask and 100 ml of 1.25% H_2SO_4 was added and connected to a condensing flask. The flask was heated and brought to boil, for 30 mins and the condenser was removed. A funnel with linen cloth over it was used to filter the contents of the round bottom flask. Rinsing was done

continuously until the residue was acid free. The acid digested residue was digested again using sodium hydroxide. A volume of 100 ml of sodium hydroxide was used to wash the residue back into the flask, the flask was connected to the condenser, heated and brought to boil for 30 min and the content was filtered using fishers' crucible. The crucible was dried in a pre-heated oven for about 2 hours at 110 °C and cooled in a desiccator after which it was ashed in the muffle furnace (SH-FU-5MG, Korea) at 600 °C for 30 mins.

Mineral content determination
The mineral constituents contained in the juice was analyzed using the Association of Official Analytical Chemists (AOAC) method, to determine phosphorus (P), calcium (Ca), potassium (K), iron (Fe), and magnesium (Mg) (AOAC, 1990).

Phosphorus (P) concentration Determination
5 ml of the digest of each sample was measured and put into 50 ml volumetric flasks. 10 ml of vanadomolybdate was then added to each sample and the volumes of the 50 ml volumetric flasks filled with distilled water. The flask content was thoroughly mixed by shaking and kept for 30 minutes. A yellow colour which developed was read at 430 nm wavelength on a spectrophotometer. Percentage transmittance was recorded and the absorbance level was determined. The phosphorus content was then determined using a standard curve developed from a standard phosphorus solution (AOAC, 1990).

Calcium (Ca) concentration Determination
10 ml of the extract was measured into 100 ml Erlenmeyer flask. Afterwards, 10 ml of 10 % potassium hydroxide solution was added followed by 1 ml of 30 % triethanolamine to the flask. Then, 3 drops of 10 % potassium cyanide and few drops of Eriochrome Black T indicator solution were added. The mixture was shaken to ensure homogeneity. Afterwards, the mixture was titrated with 0.02 N EDTA solutions from a red to blue end point.
Calcium (mg) = Titre value of EDTA x 0.4008

$$\% \text{ Calcium} = \frac{\text{Calcium (mg)} \times 100}{\text{Sample weight} \times \text{volume}}$$

Potassium (K) concentration Determination
The concentrations of potassium present in the three indigenous leafy vegetables were determined using the method of Flame Photometry. The air-acetylene flame was used to measure the emissions of the potassium after diluting the digest. Afterwards, a curve of calibration was drawn for concentration against potassium emission and was compared to that of a standard solution (AOAC, 1990).

Iron (Fe) and Zinc (Zn) concentration Determination
Portion of standard sample was pipetted into test cylinders and absorbance estimated at 248 nm utilizing air-acetylene fire. To determine the iron concentration, absorbance curve of calibration was then drawn against the iron concentration [17].

Magnesium (Mg) concentration Determination
10 ml of the extract of each leafy vegetable was measured into a conical flask for magnesium. Then 10 ml of ammonia buffer solution was added to the flask for magnesium. 1ml of triethanolamine solution was added to the flask and three drops of potassium cyanide was added. Eriochrome Black T was added to the flask respectively to magnesium and titrate against EDTA solution.
Magnesium in mg = Titre value of EDTA x 0.243

$$\text{Mg} = \frac{0.02 \times \text{V} \times 1000}{\text{W}}$$

Where:
V = ml of 0.02 M EDTA
0.02 = concentration of EDTA
W= weight in grams of sample extracted

Determination of Vitamin C
Vitamin C content was determined using the redox titration method. About 20 ml of the sample solution was pipetted into a 250 ml conical flask, and 150 ml of distilled water was added to it, followed by 3 drops of starch indicator. Then the sample solution was titrated with 0.005molL^{-1} iodine solution. The titration's endpoint was identified as the first permanent trace of a dark blue-black color due to the starch-iodide complex. The titration was repeated to obtain replicate results (Satpathy *et al.,* 2021).
Subsequently, the vitamin C concentration was determined as follows:
vitamin C concentration in the juices (g/100 mg) = y/b
where
b = titre (mL) from the titration of the standard vitamin C solution
y = titre (mL) from the titration of the sample solution.

SENSORY ANALYSIS
Fifty people from the Department of Horticulture at KNUST in Ghana, both staff and students, participated in the sensory analysis. The following sensory attributes were assessed: mouthfeel, appearance, taste, and overall acceptability. The panelists received the samples in spotless, clear cups, and the panel was given the samples in a random order. Between evaluations, portable water was available to rinse the mouth. The evaluation was done on a 9-point hedonic scale, with 1 denoting extremely strong disliking and 9 denoting extremely strong liking (Wichchukit & O'Mahony, 2015; Xia *et al.*, 2021).

DATA ANALYSIS
Data collected was subjected to Analysis of Variance (ANOVA) using GenStat Statistical Software Version 22.1. Differences between treatment means were separated using Least Significant Differences (LSD) at 1% probability (p<0.01).

RESULTS AND DISCUSSION
Physicochemical properties of Watermelon and Apple fruit juice blend
The physicochemical properties of the juice blend showed that the total soluble solids content ranged from 8.767-13.633 °Brix (Table 2). The total soluble solids are an important index that gives an indication of fruit juice quality. It has a correlation with the sugar content of apple and watermelon fruit, thereby giving an indication of the level of sweetness of a juice. The TSS value of the juice blends showed a significant difference (p<0.01) with W7AM (100% apple juice) having the highest total soluble solids (TSS) which conforms with the results recorded by Pokhrel *et al* (2022) showing the TSS of carrot and orange juice to be 17.10 °Brix and 14.60 °Brix respectively. Also, W2AM (100% watermelon juice) recorded the lowest (Table 2). The high content of total solids in the apple juice may be attributed to the high fibre content, however, juice blends or beverages with ºBrix less than 7 are categorized as

Science World Journal Vol. 19(No 4) 2024
www.scienceworldjournal.org
ISSN: 1597-6343 (Online), ISSN: 2756-391X (Print)
Published by Faculty of Science, Kaduna State University
https://dx.doi.org/10.4314/swj.v19i4.37

watery meaning that they contain less fibre (Frederick *et al.,* 2016). In general, a low TTA content was observed for all the juice blends, showing a significant difference between WIAM, W2AM, W3AM, W4AM (p<0.01) whereas for vitamin C, W7AM (100% apple juice) recorded the highest (17.023 mg/100 g) and W4AM (33.33% watermelon and 66.67% apple) recorded the lowest (5.867 mg/100 g) (Table 2). W2AM (100% watermelon juice), however had about twice less vitamin C content as compared to W7AM (Table 2). The results showed that the various concentrations of juice blend sample contained an appreciable amount of vitamin C needed by the body for healthy growth due to the presence of anti-oxidants. The pH ranged between 3.840-5.193 as presented in Table 2. According to Harris *et al* (2019), the pH range for fruits and vegetables is 3 to 5. The pH of 100% watermelon juice (W2AM) was less acidic as compared to that of 100% apple juice (W7AM), this is similar to that reported by Oyeleke *et al* (2013) on watermelon/pineapple juice blend.

Table 2. Physicochemical properties of Watermelon and Apple fruit juice blend

Sample ID	TSS (°Brix)	TTA (%)	Vitamin C (mg/100g)	pH
W1AM	8.767±0.058^{b}	0.045±0.000^{d}	8.810±0.000^{bc}	4.467±0.012^{d}
W2AM	7.567±0.153^{a}	0.012±0.000^{a}	7.040±0.000^{ab}	5.193±0.023^{f}
W3AM	9.267±0.116^{c}	0.019±0.000^{b}	7.630±1.022^{abc}	4.593±0.006^{e}
W4AM	12.167±0.058^{e}	0.034±0.003^{c}	5.867±1.016^{a}	4.083±0.012^{b}
W5AM	12.333±0.058^{e}	0.034±0.003^{c}	9.983±1.016^{c}	4.010±0.061^{b}
W6AM	10.067±0.058^{d}	0.032±0.000^{c}	8.220±1.022^{abc}	4.283±0.032^{c}
W7AM	13.633±0.058^{f}	0.047±0.003^{d}	17.023±1.016^{d}	3.840±0.017^{a}
CV (%)	0.8	7.1	9.3	0.7
LSD	0.153	0.004	1.507	0.051
P-value	<0.001	<0.001	<0.001	<0.001

Data are mean value of triplicate determination ± standard deviation.
Values in the same column with different superscripts are significantly different at p< 0.01
W1AM-66.67%Watermelon/33.33apple, W2AM-100%watermelon/0%apple, W3AM-75%watermelon/25%apple, W4AM-33.33%watermelon/66.67%apple, W5AM-25%watermelon/75%apple, W6AM-50%watermelon/50%apple, W7AM-100%apple.

Proximate Composition

The moisture content had values ranging between 88.35 – 94.10% (Table 3). All the combinations of the juice blends were significantly differences (p<0.01). Results for W2AM showed that 100% watermelon juice had more moisture, whereas W7AM (100% apple) had the least moisture content (88.35%) (Table 3). According to Akusu *et al* (2016) and Benton &Young (2019), the acceptable range for fruit and vegetable juices is between 80 and 95 percent. The juice blends' crude protein content was low, ranging from 0.073% to 0.043%, with significant differences observed at W1AM, W2AM, and W3AM, but not at W4AM and W7AM, W5AM, or W6AM. According to a study by Emelike *et al.,* (2015), fresh beetroot juice has a low protein content and fruit juices are not good sources of protein. The combination of juice with more watermelon content had a higher protein content as compared to those with more apple content (Ijah *et al.,* 2015; Okwunodulu *et al.,* 2022).

The highest ash content was observed in watermelon (33.33%) and apple (66.67%), (0.319%) and lowest in apple only (0.231%) (Table 3). Samples W3AM, W5AM, W6AM, and W7AM had values of 0.261, 0.252, 0.235, and 0.231%, respectively, and there was no statistically significant difference between them. The fat content of the fruit juice blends was low; however, it was lowest in the 100% apple juice and 100% watermelon juice samples which is common for fruits (Awolu *et al.,* 2018; Aderinola *et al.,* 2019; Acham *et al.,* 2020). There was no significant difference (p>0.01) amongst the juice blends except between watermelon (66.67%) and apple (33.33%) and watermelon (33.33%) and apple (66.67%), watermelon (25%) and apple (75%) and watermelon (50%) and apple (50%).

Table 3. Proximate composition of Watermelon and Apple fruit juice blend

Sample ID	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Crude Fibre (%)
W1AM	92.78±0.121^{e}	0.276±0.003^{b}	0.054±0.001^{b}	0.273±0.005^{e}	0.122±0.002^{bc}
W2AM	94.10±0.139^{f}	0.233±0.008^{a}	0.073±0.003^{d}	0.165±0.003^{b}	0.103±0.003^{ab}
W3AM	92.96±0.115^{e}	0.261±0.006^{ab}	0.069±0.000^{c}	0.222±0.004^{c}	0.097±0.006^{ab}
W4AM	90.80±0.196^{c}	0.319±0.016^{c}	0.045±0.000^{a}	0.288±0.011^{e}	0.117±0.023^{bc}
W5AM	86.27±0.381^{a}	0.252±0.007^{ab}	0.051±0.001^{b}	0.252±0.009^{d}	0.113±0.006^{b}
W6AM	91.67±0.115^{d}	0.235±0.024^{a}	0.053±0.001^{b}	0.242±0.003^{d}	0.083±0.006^{a}
W7AM	88.35±0.271^{b}	0.231±0.003^{a}	0.043±0.001^{a}	0.133±0.003^{a}	0.143±0.012^{c}
CV (%)	0.2	0.8	2.2	2.7	9.5
LSD	0.373	0.153	0.002	0.011	0.019
P Value	<0.001	<0.001	<0.001	<0.001	<0.001

Data are mean value of triplicate determination ± standard deviation.
Values in the same column with different superscripts are significantly different at p< 0.01
W1AM-66.67%Watermelon/33.33apple, W2AM-100%watermelon/0%apple, W3AM-75%watermelon/25%apple, W4AM-33.33%watermelon/66.67%apple, W5AM-25%watermelon/75%apple, W6AM-50%watermelon/50%apple,

W7AM-100%apple.

Mineral Composition of Watermelon/Apple Fruit Juice Blend

Table 4 represents some of the mineral composition of the watermelon and apple juice blend. There was a general increase of mineral for juice blends that had higher watermelon content (W1AM, W2AM, W3AM) (Table 4). Significant differences (p < 0.01) in Ca, P, Mg, and K contents were found across samples.

Table 4. Mineral composition of Watermelon and Apple juice blend

Sample ID	Calcium (mg/L)	Phosphorus (mg/L)	Magnesium (mg/L)	Potassium (mg/L)
W1AM	403.30±3.20[d]	132.80±2.05[d]	146.88±2.88[e]	991.10±22.6[b]
W2AM	324.08±4.00[c]	174.20±1.76[e]	93.60±2.40[d]	1178.40±8.14[c]
W3AM	404.90±3.20[d]	108.30±4.25[c]	67.52±4.54[c]	1180.70±2.26[c]
W4AM	324.08±2.40[c]	79.70±0.89[ab]	69.60±6.24[c]	953.10±0.94[a]
W5AM	164.31±4.11[c]	84.10±3.56[b]	45.44±2.46[a]	1194.20±4.52[c]
W6AM	330.48±1.60[a]	68.80±1.67[a]	56.16±4.40[b]	970.10±0.67[ab]
W7AM	244.06±2.40[b]	98.80±10.30[c]	93.60±1.44[c]	959.50±4.52[a]
CV (%)	1.0	4.3	4.6	0.9
LSD	5.435	8.05	6.654	16.52
P-value	<0.001	<0.001	<0.001	<0.001

Sample ID	Iron (mg/L)	Copper (mg/L)	Zinc (mg/L)
W1AM	164.90±2.25[c]	36.89±1.84[a]	65.30±5.03[b]
W2AM	66.30±2.25[a]	127.23±2.73[e]	91.20±3.14[c]
W3AM	67.50±2.07[a]	96.90±3.38[c]	66.00±2.65[b]
W4AM	165.80±4.54[c]	76.04±1.18[b]	71.30±6.73[b]
W5AM	111.80±8.04[b]	156.77±1.62[f]	71.80±9.56[b]
W6AM	162.60±6.15[c]	96.58±3.43[c]	74.30±1.26[b]
W7AM	259.70±6.43[d]	103.87±1.82[d]	41.30±4.10[a]
CV (%)	2.2	2.4	7.7
LSD	0.002	4.254	9.30
P Value	<0.001	<0.001	<0.001

Data are mean value of triplicate determination ± standard deviation
Values in the same column with different superscripts are significantly different at p< 0.01
W1AM-66.67%Watermelon/33.33apple, W2AM-100%watermelon/0%apple, W3AM-75%watermelon/25%apple, W4AM-33.33%watermelon/66.67%apple, W5AM-25%watermelon/75%apple, W6AM-50%watermelon/50%apple, W7AM-100%apple.

The watermelon/apple fruit juice blend contains both macro and micro-minerals, which are essential nutrients for the body. Macro-minerals are needed in larger amounts and play major structural roles. Calcium and phosphorus function as electrolytes. There was a significant difference (p<0.01) among the various fruit juice blend for Iron and copper. W7AM (100% apple juice) recorded the highest iron content whereas W2AM (100% watermelon juice) had the highest zinc and copper content (Table 4). Apples only had the highest form of iron which could be attributable to several factors, including the type of fruit, its ripeness, and the soil in which it was grown. The iron in fruits, including apples, is in the form of non-heme iron (Sun *et al.*,2024). This type of iron is not as easily absorbed by the body as heme iron, which is found in animal products (Zeidan *et al.,* 2024). However, consuming vitamin C alongside non-heme iron can enhance its absorption. The exact amounts of zinc and copper in watermelon can vary based on several factors, including the variety of the watermelon, the soil it was grown in, and its stage of ripeness.

Table 4: Mineral composition for watermelon and apple juice blend
Data are mean value of triplicate determination ± standard deviation
Values in the same column with different superscripts are significantly different at p< 0.01
W1AM-66.67%Watermelon/33.33apple, W2AM-100%watermelon/0%apple, W3AM-75%watermelon/25%apple, W4AM-33.33%watermelon/66.67%apple, W5AM-25%watermelon/75%apple, W6AM-50%watermelon/50%apple, W7AM-100%apple.

 https://dx.doi.org/10.4314/swj.v19i4.37

SENSORY PROPERTIES OF WATERMELON/APPLE BLEND

The mean sensory scores of the watermelon/apple juice blend samples are presented in Figure 1a and 1b. The statistical analysis revealed that there were significant differences ($p<0.01$) between all the juice blends for appearance/colour with W7AM having the highest mean of 5.90, meaning that the appearance of the 100% apple juice was most preferred as compared to the others. This was followed by W5AM which recorded a mean of 4.30. Odour showed no significant difference ($p>0.01$) amongst the samples. W1AM recorded the highest mean of 3.90, whiles W2AM and W3AM gave the least mean of 3.20. The statistical analysis for the taste recorded no significant difference in the preference for all samples of the juice blend, however, W2AM (100% watermelon juice) recorded the highest mean score of 3.75 and W4AM recorded the least of 2.95. In general, all samples, except W3AM and W4AM, attained similar sensory acceptance. However, W6AM which comprised of 50% watermelon and 50% apple juice was the most preferred juice.

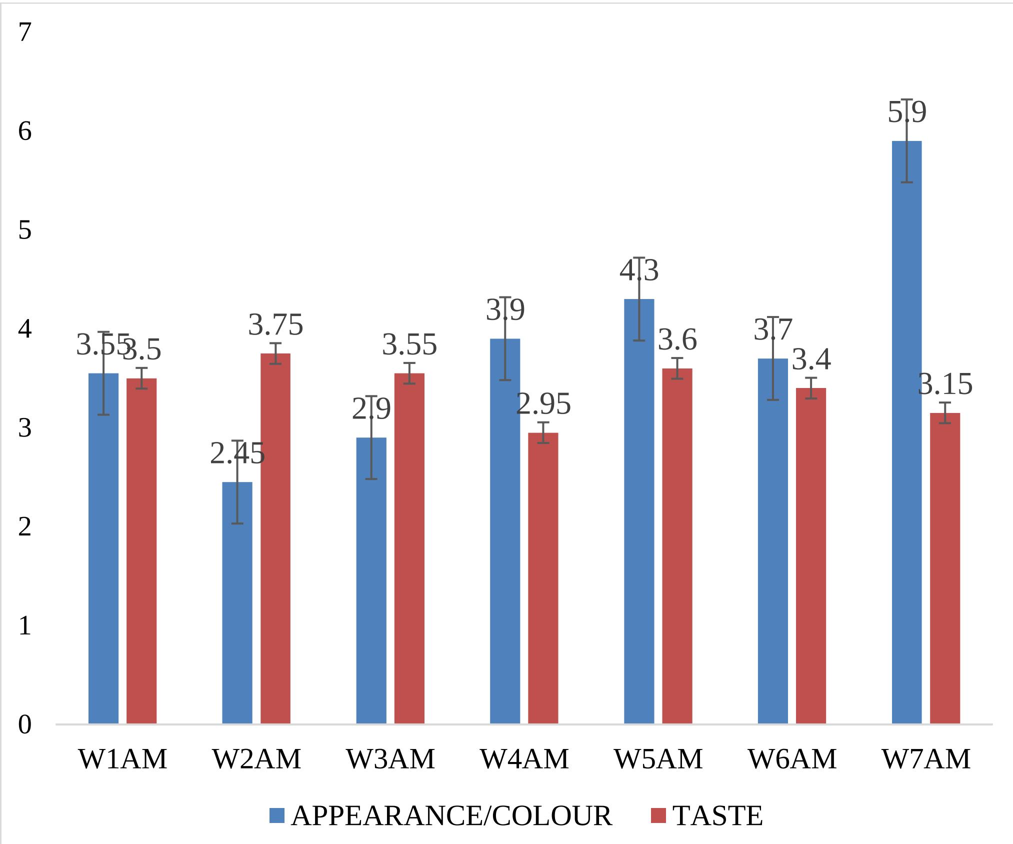

Figure 1a: Sensory properties of watermelon/apple juice blend
W1AM-66.67%Watermelon/33.33apple, W2AM-100%watermelon/0%apple, W3AM-75%watermelon/25%apple, W4AM-33.33%watermelon/66.67%apple, W5AM-25%watermelon/75%apple, W6AM-50%watermelon/50%apple, W7AM-100%apple.

The evaluation was done using a 9-point hedonic scale, with 1 denoting extremely strong liking and 9 denoting extremely strong disliking (Wichchukit & O'Mahony (2015) and Xia *et al* (2021).

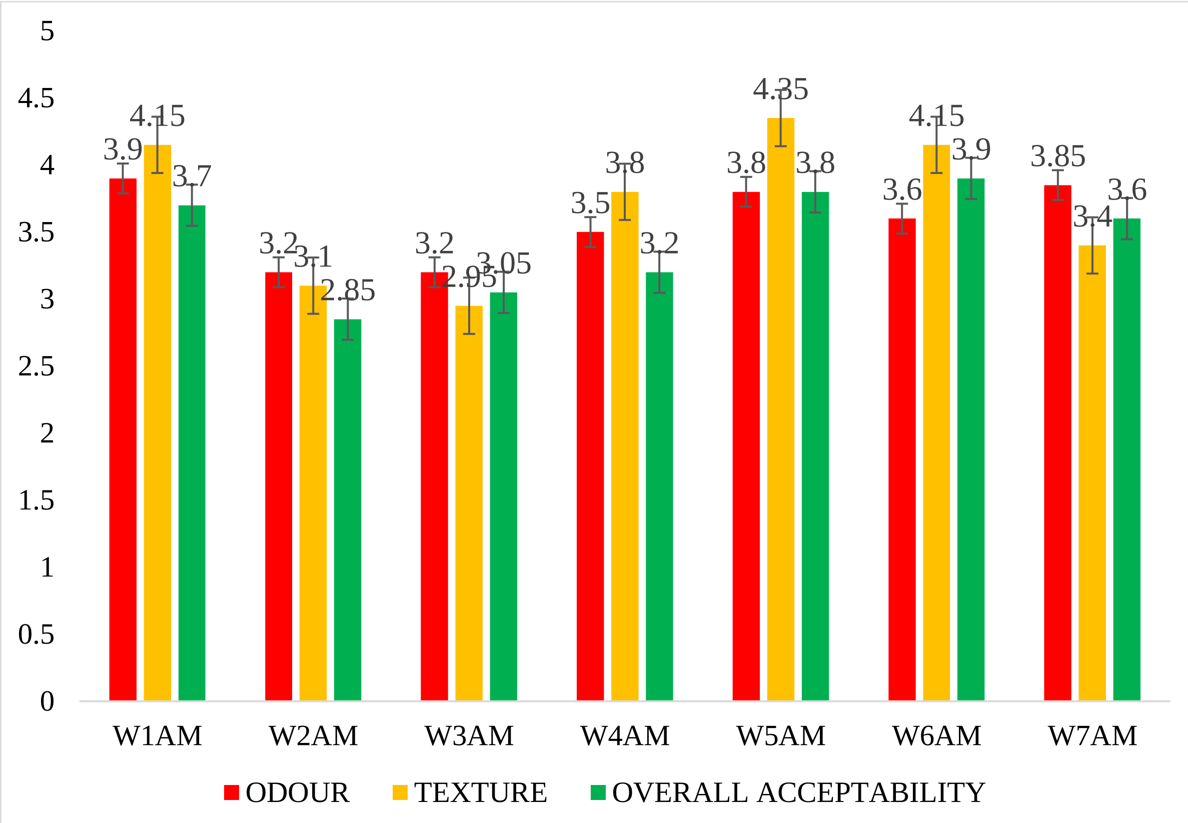

Figure 1b: Sensory properties of watermelon/ apple juice blend
W1AM-66.67%Watermelon/33.33apple, W2AM-100%watermelon/0%apple, W3AM-75%watermelon/25%apple, W4AM-33.33%watermelon/66.67%apple, W5AM-25%watermelon/75%apple, W6AM-50%watermelon/50%apple, W7AM-100%apple.

Conclusion

The study showed that 66.67% watermelon and 33.33% apple blend (W4AM) as well as the 25% watermelon and 75% apple blend (W5AM) recorded the highest value for total soluble solids (12.167 °Brix, 12.333 °Brix) and titratable acidity (0.034%, 0.034%) respectively. W5AM blend also recorded the highest vitamin C content (9.983 mg/100 g). The results showed significant differences between the blends ($p<0.01$) where the sensory evaluation showed that 100% apple was mostly preferred amongst the blends for parameters like appearance, odour, taste and mouthfeel. However, the 50% watermelon and 50% apple blend (W6AM) was preferred in terms of overall acceptability. Furthermore, the 100% apple gave highly acidic drink. It was concluded that to obtain high nutritional and sensory quality drink, the 25% watermelon and 75% apple blend (W5AM) should be considered.

Recommendations

We recommend that in a future study, shelf-life of the juice should be conducted, and technology transferred to SMES. Additionally, due to the high cost of the importation of apples we recommend that other available fruits like pineapple, mango and orange could be substituted with apples.

Conflict of Interest

The authors declare no conflict of interest for this work.

REFERENCES

Aderinola, T. A., & Abaire, K. E. 2019. Quality acceptability, nutritional composition, and antioxidant properties of carrot-cucumber juice. *Beverages*, *5*(1), 15.

Aderiye, B. I., David, O. M., Fagbohun, E. D., Faleye, J., & Olajide, O. M. 2020. Immunomodulatory and phytomedicinal properties of watermelon juice and pulp (*Citrullus lanatus* Linn): A review. *GSC Biological and Pharmaceutical Sciences*, *11*(2), 153-165.

Acham, I. O., Eke, M. O., & Edah, J. (2020). Physicochemical, microbiological and sensory quality of juice mix produced from watermelon fruit pulp and baobab fruit pulp powder. *Croatian journal of food science and technology*, *12*(1), 48-55.

Ajay, V. (2018). Food Safety Standards and its Growing Role in Recent Times in India. *IMPACT: International Journal of Research in Humanities, Arts and Literature*, *6*(2), 135-140.

AOAC. 1990. Official Methods of Analysis of the Association of Official Analytical Chemists, Vol. II, 15th ed. Sec.985.29. The Association: Arlington, VA.

Akusu, O. M., Kiin-Kabari, D. B., & Ebere, C. O. (2016). Quality characteristics of orange/pineapple fruit juice blends. *American Journal of Food Science and Technology*, *4*(2), 43-47.

Alam, N., Amin, R., Khan, A., Ara, I., Shim, M. J., Lee, M. W., & Lee, T. S. 2008. Nutritional analysis of cultivated

https://dx.doi.org/10.4314/swj.v19i4.37

mushrooms in Bangladesh–*Pleurotus ostreatus*, *Pleurotus sajor-caju, Pleurotus florida* and *Calocybe indica*. *Mycobiology*, *36*(4), 228-232.

AOAC (*2012*) Official Method of Analysis Association of Analytical Chemists. 19th Edition, Washington DC, 121-130

Assis, R. P., Arcaro, C. A., Gutierres, V. O., Oliveira, J. O., Costa, P. I., Baviera, A. M., & Brunetti, I. L. 2017. Combined effects of curcumin and lycopene or bixin in yoghurt on inhibition of LDL oxidation and increases in HDL and paraoxonase levels in streptozotocin-diabetic rats. *International Journal of Molecular Sciences*, *18*(4), 332.

Awolu, O. O., Okedele, G. O., Ojewumi, M. E., & Oseyemi, F. G. 2018. Functional jam production from blends of banana, pineapple and watermelon pulp. *International Journal of Food Science and Biotechnology*, *3*(1), 7-14.

Benton, D., & Young, H. A. 2019. Role of fruit juice in achieving the 5-a-day recommendation for fruit and vegetable intake. *Nutrition Reviews*, *77*(11), 829-843.

Bhavya, S. S. S., Yadav, K., & Kumari, S. 2019. Preparation and quality evaluation of health beverage from pineapple juice blended with beetroot and orange juice. *Energy*, *209*, 50kcal.

Campbell, C. L., Wagoner, T. B., & Foegeding, E. A. (2017). Designing foods for satiety: The roles of food structure and oral processing in satiation and satiety. Food Structure, 13, 1-12.

Chomicki, G., & Renner, S. S. 2015. Watermelon origin solved with molecular phylogenetics including L innaean material: another example of museomics. *New Phytologist*, *205*(2), 526-532.

Comerford, K. B., Ayoob, K. T., Murray, R. D., & Atkinson, S. A. 2016. The role of avocados in complementary and transitional feeding. *Nutrients*, *8*(5), 316.

Dasenaki, M. E., Drakopoulou, S. K., Aalizadeh, R., & Thomaidis, N. S. 2019. Targeted and untargeted metabolomics as an enhanced tool for the detection of pomegranate juice adulteration. *Foods*, *8*(6), 212.

Duhan, N., Barak, S., & Mudgil, D. 2020. Bioactive lipids: Chemistry & health benefits. *Biointerface Res. Appl. Chem*, *10*(6), 6676-6687.

Emelike, N. J. T., Hart, A. D., & Ebere, C. O. 2015. Influence of drying techniques on the sensory properties, physicochemical and mineral composition of beetroot juice. *IOSR Journal of Environmental Science, Toxicology and Food Technology*, *9*(12-2), 20-26.

Ferretti, G., Turco, I., & Bacchetti, T. 2014. Apple as a source of dietary phytonutrients: bioavailability and evidence of protective effects against human cardiovascular disease. *Food and Nutrition Sciences*, *2014*.

Frederick, S., Moses, G., & Leticia, A. P. 2016. Quality evaluation and sensory profile of mixed fruit juice from cabbage and orange. *Asian Journal of Agriculture and Food Sciences (ISSN: 2321–1571)*, *4*(04).

FSSAI (2015) Fixation of MRL. http://www.fssai.gov.in/ Accessed 25 December 2023.

Harris, J., Chisanga, B., Drimie, S., & Kennedy, G. 2019. Nutrition transition in Zambia: Changing food supply, food prices, household consumption, diet and nutrition outcomes. *Food Security*, *11*, 371-387.

Hussain, S. Z., Naseer, B., Qadri, T., Fatima, T., & Bhat, T. A. 2021. Apples (Pyrus Malus)— Morphology, Taxonomy, Composition and Health Benefits. In *Fruits Grown in Highland Regions of the Himalayas: Nutritional and Health Benefits* (pp. 17-34). Cham: Springer International Publishing.

Hussain, S. Z., Naseer, B., Qadri, T., Fatima, T., & Bhat, T. A. 2021. *Fruits Grown in Highland Regions of the Himalayas*. Cham, Switzerland: Springer International Publishing.

Ibrahim, I., OA, A., Muazu, Y. U., Aminu, B., & Isa, Y. 2017. Mix Juice Made from Fruits (Watermelon, Coconut) and Vegetable (Carrot) Elicits Alternative Nutrients Intake. *Mediterranean Journal of Basic and Applied Sciences MJBAS*, *1*(1).

Ijah, U. J. J., Auta, H. S., & Aransiola, S. A. 2015. Microbiological and some sensory attributes of watermelon juice and watermelon-orange juice mix.

Kathiravan, T., Nadanasabapathi, S., & Kumar, R. 2014. Standardization of process condition in batch thermal pasteurization and its effect on antioxidant, pigment and microbial inactivation of Ready to Drink (RTD) beetroot (Beta vulgaris L.) juice. *International Food Research Journal*, *21*(4).

Koutsos, A., Tuohy, K. M., & Lovegrove, J. A. 2015. Apples and cardiovascular health—is the gut microbiota a core consideration? *Nutrients*, *7*(6), 3959-3998.

Li, M., Ho, K. K., Hayes, M., & Ferruzzi, M. G. 2019. The roles of food processing in translation of dietary guidance for whole grains, fruits, and vegetables. *Annual review of food science and technology*, *10*, 569-596.

Maoto, M. M. 2019. *Effects of maturity and processing on quality properties of the watermelon (Citrullus lanatus) fruit juice* (Doctoral dissertation).

Maoto, M. M., Beswa, D., & Jideani, A. I. 2019. Watermelon as a potential fruit snack. *International Journal of food properties*, *22*(1), 355-370.

Meccariello, R., & D'Angelo, S. 2021. Impact of polyphenolic-food on longevity: an elixir of life. An overview. *Antioxidants*, *10*(4), 507.

Nasri, H., Baradaran, A., Shirzad, H., & Rafieian-Kopaei, M. 2014. New concepts in nutraceuticals as alternative for pharmaceuticals. *International journal of preventive medicine*, *5*(12), 1487.

Okokon, E. J., & Okokon, E. O. 2019. Proximate analysis and sensory evaluation of freshly produced apple fruit juice stored at different temperatures and treated with natural and artificial preservatives. *Global journal of pure and applied sciences*, *25*(1), 31-37.

Okwunodulu, I., Oriala, M., Ndife, J., & Nwachukwu, A. (2022). Feasibility of Fortification of Pine-apple, Orange and Paw-paw Juice Blends with Food Grade Plant ash. *Indonesian Food Science and Technology Journal*, *6*(1), 31-39.

Oyeleke, G. O., Ojo, A., Ajao, F. D., & Adetoro, R. O. 2013. Development and analysis of blended pineapple-watermelon ready-to-drink (RTD) juice. *Journal of*

Environmental Science, Toxicology and Food Technology, *4*(6), 22-24.

Oyeleke, G. O., Ojo, A., Ajao, F. D., & Adetoro, R. O. 2013. Development and analysis of blended pineapple-watermelon ready-to-drink (RTD) juice. *Journal of Environmental Science, Toxicology and Food Technology*, *4*(6), 22-24.

Pokhrel, P. R., Boulet, C., Yildiz, S., Sablani, S., Tang, J., & Barbosa-Canovas, G. V. 2022. Effect of high hydrostatic pressure on microbial inactivation and quality changes in carrot-orange juice blends at varying pH. *LWT*, *159*, 113219.

Satpathy, L., Pradhan, N., Dash, D., Baral, P. P., & Parida, S. P. 2021. Quantitative determination of vitamin C concentration of common edible food sources by redox titration using iodine solution. *Letters in Applied NanoBioScience*, *10*(3), 2361-2369.

Wallace, T. C., Bailey, R. L., Blumberg, J. B., Burton-Freeman, B., Chen, C. O., Crowe-White, K. M., ... & Wang, D. D. 2020. Fruits, vegetables, and health: A comprehensive narrative, umbrella review of the science and recommendations for enhanced public policy to improve intake. *Critical reviews in food science and nutrition*, *60*(13), 2174-2211.

Wani, F. A., & Songara, M. 2017. Production and Marketing of Apple in Himachal Pradesh: An Empirical Study. *International Journal of Research Culture Society*, *1*(10), 34-40.

Watpade, S., Raigond, B., Thakur, P. D., Handa, A., Pramanick, K. K., Sharma, Y. P., & Tomar, M. 2012. Molecular detection of latent Apple chlorotic leaf spot virus in elite mother plants of apple. *Indian Journal of Virology*, *23*, 359-363.

Wichchukit, S., & O'Mahony, M. (2015). The 9-point hedonic scale and hedonic ranking in food science: some reappraisals and alternatives. *Journal of the Science of Food and Agriculture*, *95*(11), 2167-2178.

Xia, R., Wang, L., Xin, G., Bao, X., Sun, L., Xu, H., & Hou, Z. 2021. Preharvest and postharvest applications of 1-MCP affect umami taste and aroma profiles of mushrooms (*Flammulina velutipes*). *Lwt*, *144*, 111176.

Zeidan, R. S., Martenson, M., Tamargo, J. A., McLaren, C., Ezzati, A., Lin, Y., & Anton, S. (2024). Iron homeostasis in older adults: balancing nutritional requirements and health risks. *The Journal of nutrition, health and aging*, *28*(5), 100212.