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DEVELOPMENT AND QUALITY EVALUATION OF FUNCTIONAL CARBONATED POMEGRANATE ORANGE NECTAR

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ABSTRACT

One kind of ready-to-serve beverage is nectar. In order to make it, two or more fruit juices or pulps are blended in various ratios together with water, sugars, and preservatives. Carbonation directly affects the juice's flavor and taste. It is feasible to formulate mixed fruit carbonated nectar to suit the tastes and preferences of customers. High concentrations of polyphenols, vitamin C, and antioxidants may be found in pomegranates and oranges. Obesity, diabetes, and cardiovascular disease are more conditions for which these fruits are utilized in therapy and prevention. The development of carbonated fruit nectar flavored with orange and pomegranate for value addition, as well as quality assessment, antioxidant test, and sensory analysis, were the primary goals of the current study. Carbonated pomegranate orange nectar and control in varying percentages were used to create the six treatments (T_0 to T_5). Extracts were homogenized to produce enhanced nectar, carbonation was carried out, and the resulting product was refrigerated and sealed in plastic bottles. Color measurements, anti-oxidant determination, phytochemical analysis, and physicochemical analysis were performed on the raw ingredients and the generated nectar. In terms of quality and sensory evaluation, it was determined that treatment T_3, which consists of a 15% pomegranate juice and 15% orange juice combination, was the most acceptable. 39.25–88.91 was the range of vitamin C values. TFC and TPC values calculated were in the range of 248.60-380.48mg GAE and 493.65-293.21 respectively. L*, a* and b* values of pomegranate orange nectar calculated were in the range of 38.25-54.39, 3.87-7.56 and 2.36-5.45.

Keywords: Nectar, Carbonation, Orange, Pomegranate, Phytochemical, Quality.

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1. INTRODUCTION

Every day, the demand for soft drinks rises, creating additional opportunities for the creation of beverages with significant therapeutic, health and nutraceutical benefits. Juices, drinks, and nectars made from fruit that have more nutrients and less artificial ingredients are the greatest alternatives available to customers. As per Mishra and Sangma (2017), the functional beverage industry is rapidly growing, making it one of the fastest growing in the market. Drinks rich in nutrients, minerals, carbs, and phytochemicals are fruit and vegetable juices. Drinking juices increases the body's capacity both physically and mentally. Fruit extract has more calories per gramme than vegetables (Emebu and Anyika 2011). Processors are beginning to prioritize the needs of their customers. Juice blends have been shown to be unique products with increased nutritional value, more vitamin and mineral content, and improved organoleptic properties. Fruit juice that has been blended retains its acid-to-sugar ratio, increases its vitamin and mineral content, is more palatable to consumers, and does not have the disagreeable consistency of fruit juice (Singh and Sharma 2017). Different concentrations of two or more fruit juices or pulps can be combined to create more palatable and nutritious nectar and ready-to-serve drinks (Khayum et al. 2018). A member of the *Punicaceae* family, the pomegranate (Punica granatum), is sometimes referred to as anar. (Dhineshkumar and Ramasamy 2016). In Pakistan, total pomegranate production (Punica granatum L.) is predicted to exceed of 49,000 tons, with 12,7000 hectares under cultivation (FAO 2012).

According to Samson and Singh (2017), pomegranates are rich in phytochemicals including anthocyanin, flavonoids, and ellagitannin, which offer several health advantages such as preventing cancer, diabetes, cardiovascular disease, and preserving the internal redox balance. Pomegranate juice is rich in ingredients that are physiologically active and full of nutrients. Pomegranate juice is the next most popular food to consume after fresh

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fruit (Wasila et al. 2013). Pomegranate nectar continues to be a popular product among consumers due to its less astringent and sour flavor when compared to pure pomegranate juice (Surek and Nelufer-Erdil 2014). The abundance of polyphenols in pomegranate fruit shields cells against oxidative damage. This fruit has high levels of hydrolysable tannins, phenolics, and flavonoids. By reducing hyperoxide levels and increasing catalase and glutathione reductase activity, flavonoids increase the liver's capacity to function as an antioxidant (Shukla et al. 2008). Different pomegranate components promote the body's anti-inflammatory and anti-angiogenesis cycles, preventing the onset of cancer (Albrecht et al. 2004). Due to its ability to reduce atherogenic lipoprotein profiles, enhance glucose metabolism, and increase antioxidant capacity, pomegranate extract is a valuable dietary supplement for the management and prevention of chronic metabolic disorders (Bagri et al. 2009).

The orange fruit, Citrus sinensis, is a member of the Citrus genus and family of *Rutaceae*. After bananas and mangos, oranges rank third in terms of commercial significance (Safdar et al. 2017). Numerous investigations have been carried out about the bioactive substances found in orange peel, juice, and fruit. It reduces the danger of oxidative damage and illnesses, among other health advantages (Jaiswal, 2020). For instance, oranges and orange juice provide a lot of folate, which lowers homocysteine levels (Zheng et al. 2017). It is stated that one orange has more than 170 phytonutrients and more than 60 flavonoids with antioxidant, anti-inflammatory, anti-tumor, and blood clot-inhibiting properties. Each of these traits supports overall health (Yi et al. 2017).

The invention states that the term "carbonated beverage" includes alcohol-based drinks that include carbon dioxide as well as drinks that have sweeteners, acidulants, and flavorings added in addition to carbon dioxide gas added to water. A carbonated beverage is made by injecting carbon dioxide gas into the liquid product prior to packaging. At 298 K, carbon dioxide has a density of 1.98 kg m^3, making it heavier than air (Abu-Reidah 2020). By matching their drinks to consumer lives, big soft drink companies, who have extensive marketing budgets and advanced distribution networks, helped to create this trend. The process of impregnating carbon dioxide gas is called carbonation. Since carbonation offers a pleasing flavor, its popularity has soared. Carbonation gives juices—or any other product - the flavor that consumers want and enjoy. According to Steen and Ashurst (2008), carbonation is the cause of the refreshing feeling and enhanced flavor in carbonated products. It was done to carbonate the juices of several fruits, including mango, guava, pomegranate, and watermelon (Dhineshkumar and Ramasamy 2016; Nale et al. 2011; Thongrote et al. 2016).

2. MATERIALS AND METHODS

The research was carried out in National Institute of Food Science and Technology, University of Agriculture, Faisalabad, Pakistan. Pomegranate and orange were purchased from the local fruit market of Faisalabad, Pakistan. All the commodities were inspected properly to eliminate any distorted or deteriorated items. To remove any foreign material and surface contamination, the pomegranate and orange were thoroughly cleaned with rinse water. Extraction of orange and pomegranate juice was done through mechanical squeezer and blender respectively. Extracted juices then filtered through muslin cloth. Pass the extracted juice through muslin cloth 1-2 times. Nectar was ready for further quality analysis. Carbonated pomegranate-orange nectar was prepared according to set recipe with the combination of 30% fruit juice. TSS was maintained at 12^{o} B and pH at 3.9 (adjusted sugar and citric acid content). The strength of sugar syrup was determined using a hand refractometer. For nectar preparation, six treatments with different concentrations were used. Fruit juice quantities were added in the amounts specified in the treatment plan, along with water, sugar, preservatives, acids and additives. At the end, carboxymethyl cellulose (CMC) in blended form, color, and flavor were added to the syrup. It was carbonated by filling into 500ml bottles. Following Table 1 ingredient concentrations were used to prepare the carbonated pomegranate orange nectar. Carbonated pomegranate orange nectar and control in varying percentages were used to create the six treatments (T_0 to T_5) showed in Table 2. Fig. 1 shows the flow diagram of step wise development of carbonated pomegranate orange nectar.

Table 1: Standard recipe of carbonated pomegranate-orange nectar

Ingredients	Concentrations (%)
Fruit content	30
Sugar	10
Citric acid	0.10
Sodium citrate	0.05
Sodium benzoate	0.12
CMC	0.06
Water	59.67

Table 2: Treatment plan

Treatments	Pomegranate juice %	Orange juice %
T_0 (Control)	-	30
T_1	25	5
T_2	2	10
T_3	15	15
T_4	10	20
T_5	5	25

T_0 was a control treatment carrying only orange juice with no other juice present in it.

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2.1. Chemical Analysis

A series of tests were carried out, including physicochemical analysis, vitamin C determination, phytochemical analysis, antioxidant activity determination, color measurements and sensory analysis.

2.2. Analysis of raw materials

Raw materials analysis was carried out to examine several parameters of quality. A number of tests were performed, including physicochemical, phytochemical analysis, vitamin C content determination, antioxidant activity assessment and color measurements. TSS, pH, titratable acidity, vitamin C concentration, total phenolic content, total flavonoid content, DPPH assay, FRAP and color measurements tests were performed.

2.3. Analysis of product

A series of tests were carried out, including physicochemical analysis, vitamin C determination, phytochemical analysis, antioxidant activity determination, color measurements and sensory analysis.

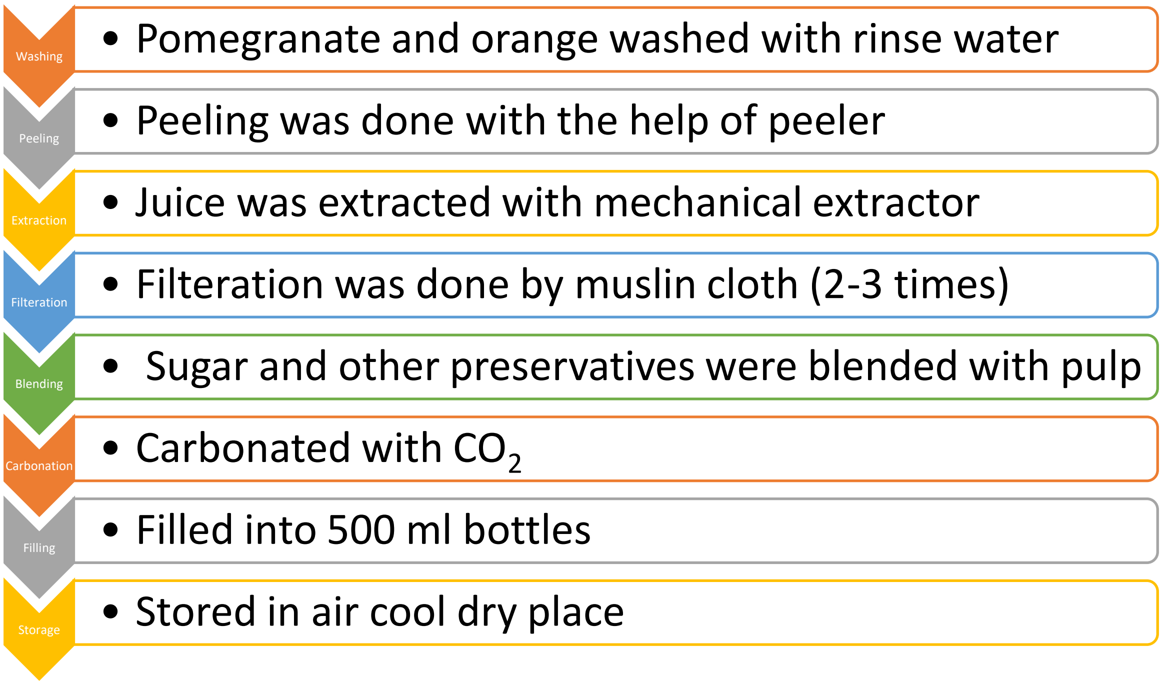

Fig. 1: Flow diagram of step wise development of carbonated pomegranate orange nectar.

2.4. Physicochemical Analysis

The prepared carbonated pomegranate-orange nectars were subjected to the following parameters TSS, pH, and titratable acidity. The pH of each treatment was measured using a pH meter following the standard method as described by AOAC (2016). Carbonated pomegranate-orange nectar TSS was determined using a digital refractometer at room temperature. A single drop was placed in a refractometer at room temperature and three readings from each treatment were recorded and their average was taken as required reading in brix. TSS are expressed in "degrees brix" (ºBrix) which is the percentage of soluble solids in a solution (Oswell et al. 2019). 5 mL of sample was placed in a 100 mL glass beaker. The volume was increased to 100ml by adding 95ml distilled water. In a separate beaker, 10ml of the above- mentioned diluted sample was taken. In the same beaker, a phenolphthalein indicator was added for color development (2 drops). Sample was titrated with alkali (0.1 N NaOH). Readings were carefully noted for each treatment. It was also noted how much 0.1 N NaOH was used for titration.
To determine total acidity calculations were made according to formula:

$$\text{Titrable acidity } (\%) = \frac{0.1 \text{ NaOH used} \times 0.0064}{\text{ml of juice used}} \times 100$$

2.5. Determination of Ascorbic Acid

The titration method was used to determine the vitamin C content in all prepared carbonated pomegranate-orange nectar (Giuffre et al. 2017). In a 100mL glass beaker, 5ml sample was taken. To make the volume up to 100mL,

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95mL oxalic acid was added to the same beaker.10mL of solution was withdrawn from the beaker after careful stirring. Pipette 15mL of oxalic acid solution into a beaker containing 10ml of solution to make a total volume of 25mL.Titration was carried out against the dye until a uniform pink color was achieved. The volume of dye used in each sample was noted and put into the formula:

$$\text{Ascorbic acid (mg/100ml)} = \frac{1 \times R \times V \times 100}{R1 \times W \times V1}$$

Where,
R= Volume of dye used in titration against V1 of solution V= Volume of solution made by 0.4% oxalic acid
RI= Volume of dye used in titration against standard W= Weight of sample taken
VI= Volume of solution taken for titration

2.6. Phytochemical Analysis

Total phenolic content and total flavonoids content of in carbonated pomegranate-orange nectars were determined.

2.7. Total Phenolic Content

Total phenolic content was measured in carbonated pomegranate-orange nectar, per the literature (Fu et al. 2011). In basic terms, 2.5 mL of diluted Folin-Ciocalteu reagent (1:10) was mixed with 0.50 mL of the dilute sample. A 2mL saturated sodium carbonate solution (about 75 grams per liter) was added after 4 minutes. The mixture's absorbance at 760 nm was measured following a 2-hour incubation period at room temperature. As a reference standard, gallic acid was utilized, and the results were expressed as milligrams of gallic acid equivalents (mg GAE) per 100 grams of wet fruit weight.

2.8. Total Flavonoid Content

The following technique was used to determine the total flavonoid content of the carbonated pomegranate-orange nectar that was made (Escobar et al. 2019). After combining the extract with 0.15 mL of sodium nitrate solution and 2 mL of distilled water, it was left for six minutes. The mixture was then given 0.15 mL of a 10% $AlCl_3$ solution, and it was left to incubate for a further 6 minutes before being given 4 percent NaOH (sodium hydroxide). Methanol was added to the reaction mixture and well mixed to raise its volume to 5 milliliters. The reaction mixture's absorbance at 510 nm was measured following a 15-minute incubation period. To express the overall flavonoid concentration of the sample extracts, catechin equivalents were utilized.

2.9. Determination of Antioxidant Activity

The antioxidant activity of carbonated pomegranate-orange nectar was determined using the following methods:

2.10. DPPH(2,2-diphenyl-1-picrylhydrazyl) assay

Using the following approach, the antioxidant activity of carbonated pomegranate-orange nectar was evaluated (Hashemi et al. 2017). The DPPH test was used to assess the antiradical or free radical scavenging activity. 4 mL of sample was obtained from each treatment individually for this purpose. 1 ml of methanolic DPPH (0.1 mM) was added to each sample, and the samples were then incubated at room temperature for almost half an hour. Using a spectrophotometer (CECIL CE7200), the absorbance at 520 nm was determined. The following formula was used to get the percentage of inhibition.

$$\text{Absorbance reduction (\%)} = [(AB-AA) / AB] \times 100$$

AB= Blank sample absorbance (time= 0 minute)
AA= Tested sample solution absorbance (time= 30 minute)

2.11. FRAP (Ferric Reducing Antioxidant Power) assay

The carbonated pomegranate-orange nectar FRAP experiment was conducted in accordance with the protocol outlined in the literature (Fu et al. 2011). In summary, a volume ratio of 10:1:1 was used to generate the FRAP reagent using sodium acetate buffer (300 mM, pH 3.6), 10 mM TPTZ solution (40 mM HCL as a solvent), and 20 mM iron (III) chloride solution. Every day, the FRAP reagent was prepared afresh and heated in a water bath to $37^{O}C$ before to use. 3 ml of FRAP reagent were mixed with 100 µL of the diluted sample. The combination was measured at 593 nm for absorbance after 4 minutes using a Shimadzu UV-2450 UV-vis spectrophotometer (Kyoto, Japan). $FeSO_4$ solution was used to create a standard curve, and the findings were represented as µmol Fe (II)/g of fruit's moist weight.

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2.12. Color Measurement

Spectral reflectance was measured by using a spectrophotometer. The color was quantified by L*, a* and b* components, L* (lightness), a* (green red) and b* (blue-yellow) (Vikram and Sikarwar, 2018). Color Tech-PCM (3001378) was used for color assessment of each treatment. The intensity used for color assessment was noted as L*, a* and b*.

2.13. Sensory Analysis

Sensory analysis of carbonated pomegranate-orange nectar was performed by a un-trained panel on the basis of color, taste, aroma, mouthfeel and overall acceptability using a 9-point hedonic scale (Sutwal et al. 2019). Graduates from NIFSAT, UAF were provided with each sample to evaluate the nectar according to given parameters of sensory attributes. The panel was asked to select one characteristic based on their personal preferences and rate it on a hedonic scale.

2.14. Statistical Analysis

Data was obtained through statistics 10.0 software. All data was presented as means±SD and statistically analyzed using one-way analysis of variance (ANOVA) completely randomized design to test the level of significance, using a reference method as described by Montgomery (2017).

3. RESULTS AND DISCUSSION

3.1. Nectar Preparation

Fig. 2 shows image of carbonated pomegranate-orange nectars products made from pomegranate and orange extract, sugar, citric acid, CMC, and water. Pomegranate orange nectar had red and orange color compared to control orange juice, which had orange color.

Fig. 2: Carbonated pomegranate orange nectar.

3.2. Analysis of Raw Materials

Raw materials including pomegranate juice and orange juice were analyzed for TSS, pH, titratable acidity, vitamin C content, total phenolic content, total flavonoids content, DPPH assay, FRAP and color measurements. Means of orange and pomegranate juice for physicochemical, phytochemical analysis, antioxidant assay and color measurement are illustrated in Table 3. The current results of juices also showed the same trend according to (Wern et al. 2016).

Table 3: Means of physicochemical, phytochemical antioxidant activity and color measurements of pomegranate and orange juice

Parameters	Pomegranate juice	Orange juice
TSS (°Brix)	12.05±0.72	11.57±0.12
pH	3.01±0.05	3.59±0.08
Titratable acidity (%)	1.76±0.09	1.04±0.28
Vitamin C (mg/100mL)	39.03±3.1	42.85±0.05
TPC (mg GAE/100g)	59.60±0.42	61.13±0.94
TFC (mg QE/100g)	65.01±2.4	71.4±0.5
DPPH (%)	267.78±5.15	306.86±0.23
FRAP(μmol FE/100m)	292.13±7.23	403.35±7.13
L*	31.74±0.02	70.76±0.23
a*	34.02±0.05	-5.77±0.08
b*	14.11±0.04	31.92±0.02

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3.3. Physicochemical Analysis

3.3.1. Total Soluble Solids (TSS): Sugars, organic acids, vitamins, proteins pigments, phenolics and minerals are all part of a fruit's TSS. Results obtained through ANOVA indicated that results were highly significant. The highest mean value of TSS 11.83 was showed by treatment T_5 while the lowest mean value was 11.00 depicted by T_0 shown in Table 4. The increase in TSS was due to production of soluble sugar from breakdown of insoluble sugar and polysaccharide into monosaccharide and disaccharides. Current study related by the results of Pareek et al. (2015) as in which they explained total soluble solid of juice attained from Nagpur mandarin (Citrus reticulata Blanco). Jain and Khurdiya (2009) also studied the TSS in juice of Indian gooseberry and showed the same trend with that study.

3.4. pH

Highly significant results were obtained in accordance with Miguel et al. (2004). The pH values calculated were in the range of 3.14-3.65 shown in Table 4. T_5 treatment showed the highest pH value. Findings are compared for pH in lime juice was studied by Ziena (2000).

3.5. Titratable Acidity

Titratable acidity (TA) had a maximum mean value of 0.67 for treatment T_5, and a minimum mean value of 0.34 for treatment T_0. Fasoyiro et al. (2005) also looked at comparable values of several fruit-flavored drinks and found a similar pattern. They also provided an explanation of the titratable in their study. The inverse link between titratable acidity and pH was further upon. Pomegranate orange nectar had acidity ranged from 0.34-0.67 shown in Table 4.

Table 4: Physicochemical, phytochemical and antioxidant content of carbonated pomegranate orange nectar

	TPC	TFC	FRAP	DPPH	Vit. C	pH	TSS	TA
T_0	493.21±0.01^b	248.60±0.05^f	53.37±0.02^f	65.23±0.02^f	39.25±0.02^f	3.65±0.02^a	11.03±0.06^e	0.34±0.02^d
T_1	500.65±0.04^a	311.47±0.02^e	56.77±0.01^e	67.47±0.02^e	47.15±0.03^e	3.57±0.02^a	11.20±0.06^d	0.44±0.02^c
T_2	489.39±0.03^c	333.25±0.04^d	60.56±0.02^d	69.35±0.03^d	55.45±0.02^d	3.46±0.05^b	11.37±0.08^c	0.50±0.02^b
T_3	483.26±0.02^d	348.58±0.01^c	63.96±0.02^c	71.47±0.02^c	66.34±0.02^c	3.34±0.04^c	11.59±0.03^b	0.56±0.01^b
T_4	480.23±0.02^e	365.36±0.02^b	67.90±0.02^b	74.58±0.02^b	73.18±0.03^b	3.23±0.02^d	11.70±0.04^{ab}	0.62±0.02^a
T_5	477.24±0.05^f	380.48±0.03^a	73.47±0.02^a	76.89±0.03^a	88.91±0.02^a	3.14±0.03^d	11.83±0.03^a	0.67±0.01^a

Values (Mean±SD) bearing different superscipts in a column differ significantly (P<0.05).

3.6. Ascorbic Acid Content

39.25–88.91 was the range of values that were computed shown in Table 4. The ascorbic acid mean value ranged from 39.25 for treatment T_0 to 88.91 for treatment T_5, out of the six treatments (T_0, T_1, T_2, T_3, T_4, T_5). of ascorbic acid. According to research by Ordonez-Santos and Vazquez-Riascos (2010), processing has an impact on the amount of vitamin C and lycopene in pink guava nectar. Results by Masamba and Mndalira (2013) also revealed this pattern.

3.7. Phytochemical Analysis

3.7.1. TPC and TFC: Fruits and fruit products include phenolics which are important bio-actives. Total phenolic contents in a product define its redox potential. The higher the total phenolic compounds mean higher the antioxidant activity of particular product as the properties of phenolic contents allows them to act as antioxidant (Patthamakanokporn et al. 2008). Treatments for TPC were found to be very significant based on ANOVA results. The estimated TPC values were within the range of 493.65-293.21. The research Wern et al. (2016) found that the total phenolic content followed the same pattern. TFC results obtained through ANOVA indicated that treatments were significant. TFC values calculated were in the range of 248.60-380.48. According to Yuan and Baduge's (2018) study, which examined the phytochemicals' role in citrus liquids' antioxidant capacity, the results displayed a similar pattern. TPC and TFC values are shown in Table 4.

3.8. Determination of Antioxidant Activity

3.8.1. DPPH and FRAP: One of the many analytical techniques created to assess the antioxidant potential in biological materials is the (DPPH) radical-scavenging test. The ANOVA results for DPPH showed that the treatments were extremely significant. The estimated DPPH values fell between 65.23 and 76.89. Lourith et al. (2009) presented the same DPPH results from their concordance investigation. FRAP values were according to Thaipong et al. (2006) research in which antioxidant activity of guava extract was determined using FRAP assay. The range of FRAP analysis was 53.37-73.39. Both FRAP and DPPH showed significant results. FRAP and DPPH values for T_5 treatment was 73.39 µmol Fe/100mL and 76.89 % shown in Table 4. Control treatment showed the lowest reading in both cases.

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3.9. Color Measurement

Color is now frequently measured objectively using a device that measures transmittance and/or reflectance, commonly referred to as a colorimeter. The L* value shows the lightness of sample. The a* value shows the redness of sample. The b* value shows the yellowness of sample. L*, a* and b* showed significant results. L*, a* and b* values of pomegranate orange nectar calculated were in the range of 38.25-54.39, 3.87-7.56 and 2.36-5.45 shown in Table 5. The results from this study were parallel with the study of Cortes et al. (2008).

Table 5: L* , a* and b* value of carbonated pomegranate orange nectar

	L*	a*	b*
T_0	38.25±0.03f	3.87±0.07e	5.45±0.02a
T_1	42.47±0.02e	7.56±0.02a	2.36±0.02f
T_2	46.52±0.03d	5.69±0.02b	2.87±0.01e
T_3	49.25±0.01c	4.75±0.02c	3.47±0.02d
T_4	52.58±0.02b	4.47±0.02d	4.28±0.02c
T_5	54.39±0.02a	3.94±0.02e	4.84±0.02b

Values (Mean±SD) bearing different letters in a column differ significantly (P<0.05).

3.10. Sensory Analysis

Performa carrying 9-points scale of each attribute to be tested was filled by the evaluators. Sensory attributes to be evaluated were color, taste, aroma, mouth feel and overall acceptability. On the basis of these attributes samples from each treatment were ranked accordingly. Sensory analysis of nectar showed highly significant results and values shown in Table 6. Current study was related to the findings of Renuka et al. (2009) and Perez and Sanz (2001).

Table 6: Sensory analysis of carbonated pomegranate orange nectar

Treatment	Color	Taste	Aroma	Mouth feel	Overall acceptability
T_0	7.16±0.02e	6.55±0.02f	6.77±0.01f	6.77±0.01d	6.69±0.02f
T_1	7.23±0.02d	7.74±0.02c	7.07±0.02e	7.47±0.02c	7.45±0.02c
T_2	8.57±0.01a	8.13±0.02b	8.14±0.02b	8.13±0.02b	7.74±0.02b
T_3	7.41±0.02c	8.67±0.02a	8.57±0.01a	8.62±0.03a	8.57±0.01a
T_4	7.50±0.01b	7.49±0.02d	7.17±0.03d	7.46±0.04c	7.15±0.02d
T_5	6.60±0.02f	6.65±0.04e	7.41±0.02c	6.84±0.02d	6.76±0.02e

Values (Mean±SD) bearing different letters in a column differ significantly (P<0.05).

4. CONCLUSION

Soft drink consumption is rising daily, creating more opportunities for the creation of beverages with significant health, medical, and nutraceutical advantages. In order to create more palatable and nutritious nectar and ready-to-serve drinks, different ratios of two or more fruit pulps or juices were combined. Because of their improved flavor, nutritional value, and medicinal significance, pomegranate and orange mixed fruit carbonated nectar has a major effect on organoleptic qualities. The creation of a very nutritious carbonated pomegranate orange nectar served as the foundation for the research. Results from quality analyses including sensory, vitamin C, DPPH, and FRAP were noteworthy. Significant outcomes were also shown by the total flavonoid and phenolic contents. In terms of quality and sensory evaluation, it was determined that treatment T_3, which consisted of 15% pomegranate juice and 15% orange juice, was the most acceptable. Based on the findings of this study, it is reasonable to draw the conclusion that it is feasible to formulate mixed fruit carbonated nectar that will meet the tastes and preferences of consumers.

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