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Evaluation of some nectars supplemented with basil seeds

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ABSTRACT

Fruit drinks are considered healthy because they contain vitamins, minerals, and antioxidants that play an important role in preventing many diseases. Juice supplemented with herbs and spices can improve the nutritional value and acceptability of drinks. The present study investigated the effect of adding basil seeds to various fruit juices, including mango, guava, and orange. Different ratios of basil seeds (0.5, 1.0, and 1.5% w/vol) were added to nectars prepared from various fruits to determine the optimal concentration of basil seeds for enhancing chemical, microbiological, and organoleptic properties. The study demonstrated that the best concentration of basil seeds to improve the characteristics of the final product was 1.0% for mango and orange nectars and 1.5% for guava nectar. Therefore, basil seeds can be used to prepare a highly nutritious nectar, has acceptable sensory properties, and can be recommended as a dietary fortified product to deal with humans from various diseases.

Key words: Basil seed, Nectar, phenolic, microbiology.

INTRODUCTION

Establishing healthy dietary patterns in early childhood is essential to help prevent diet-related chronic diseases in the future and support optimal growth, development, and public health. Healthy beverage intake is crucial in early childhood because beverages can make a significant contribution to nutritional intake during this period and may serve as important sources of essential nutrients. However, many drinks contain added sugars, which can be harmful when consumed in excess. Excessive consumption of unhealthy beverages, along with insufficient intake of healthy ones in early childhood, can contribute to chronic diseases such as tooth decay (American Academy of Pediatric Dentistry (AAPD, 2019). The global market for beverages is huge. However, increased consumption of soft drinks can lead to weight gain, obesity, diabetes, and other health related diseases. This necessitates development of beverages that can also offer health benefits. In terms of nutrients, fruit drinks are significantly superior to many artificial and aerated drinks. They are also incredibly pleasant, palatable, and easily digested. (Akash *et al*., 2014).

Dry Basil seed (*Ocimum basilicum* L.) a plant in the *Ocimum* genus of the *Lamiaceae* family. is grown in various regions of Asia, Africa, and America and contains a unique mucilaginous polysaccharide. Basil seed is an aromatic herb that is extensively used to add a distinctive aroma and flavor to food, also are considered to be a super food due to Its outstanding qualities that it possesses in terms of medicinal use are due to its various chemical compositions. Several authors described basil seeds as oval, ellipsoid, and small, with dimensions ranging from 2.31 to 3.11 mm in length, 1.3 to 1.82 mm in width, and 0.99 to 1.34 mm in thickness (Calderón Bravo *et al*., 2021). In many parts of Asia, basil seeds have been frequently utilized in beverages and ice desserts manufacture for aesthetic, technological and functional purposes as well as a source of dietary fiber and bioactive compounds. (Cherian, 2019). Basil seeds are not only good source of fiber and protein, but they provide appreciable amount of minerals and phenolic compounds, also, a good source of micronutrients and have antioxidant potential which is highly beneficial for human health (Masooma, *et al*., 2017). Basil seeds contain 10.0±0.46% protein, 33.0 ± 0.61% fat, and 43.9 ± 0.22% carbohydrates (Nazir *et al*., 2017). Morocco, France, Egypt, Italy, and California are the essential exporters of *Ocimum basilicum* to the European market (Kumar *et al*., 2022). Basil seeds are rich in antioxidants and contain essential oils such as eugenol, citral, and limonene that have anti-inflammatory and antibacterial properties (Calderón Bravo *et al*., 2021). The health of humans may benefit from basil seeds. The potential of basil seeds to enhance digestion, aid in weight loss, enhance skin appearance, fortify hair, control blood sugar, calm the body, reduce tension, and strengthen bones is among their most noteworthy health advantages. Because they include cellulose and hemicellulose, basil seeds can also reduce their hydrophilic character, lower blood pressure, and enhance vision. They also have a high fiber content, lower cholesterol, lessen inflammation, and prevent other connected nutritional problems (Cherian, 2019). It also have good antioxidant potential, even better than other seeds, such as sesame, and could be used to develop new natural antioxidants or be included as ingredients to prevent oxidative deterioration in foods (Mabood *et al*., 2017). Basil seeds are a highly promising dietary supplement that is rich in additional nutrients and substances that are good for human health. Sweet basil seeds have been used in Ayurvedic medicines to improve blood circulation, anti-inflammatory, blood sugar control and to improve immunity (Afifah and Gan, 2016).

Basil seeds are used to enrich fruit-based beverages for visual and functional purposes (Naji-Tabasi and Razavi, 2017). A beverage with up to 0.3% basil seeds had good sensory properties, like that taste, texture, and acceptability; in addition, there was an increase in the fiber and protein contents and supplied a significant quantity of minerals and phenolic compounds, as compared to the control drink (Munir *et al*., 2017). The seeds are high in dietary fiber and thus, have immense potential as a functional ingredient. The gum extracted from basil seeds has been widely studied and has emulsifying, foaming, thickening, stabilizing, viscosity, and gelling properties (Naji-Tabasi and Razavi, 2017). The exocarp of basil seeds contains a layer of polysaccharides, which rapidly swell into a gum-like substance when the seeds are drowned in water. Basil seed gum (BSG) is a novel hydrophilic colloid derived from naturally occurring plants. It has outstanding functional properties that are comparable to those of several commercial gums in terms of emulsification, rheology, gelation, stability, and adsorption (Guan *et a*l., 2023). Most of the time, polysaccharides are inverted to gel, thickener, and stabilizer food products like jellies, salad dressings, and desserts to make them more stable and have more texture (Egata, 2021). Mango (*Mangifera indica* L.) is known as the king of fruits, with attractive flavor and aroma. Mango is one of the best sources of nutrients, like carbohydrates and several bioactive phytochemical compounds, namely polyphenols, carotenoids, flavonoids, and vitamins. Mango pulp accounts for 50 to 60% of the weight of the total fruit and is used to prepare various products like juice, jam, puree, and nectar. The market for mango-related products is steadily increasing, with an annual growth of 5% (APEDA (2020); National Mango Database 2020).

Orange (*Citrus cinensis*) is an outstanding fresh fruit, widely consumed and especially prized for its aromatic flavor in addition, rich in carotenoids, flavonoids, terpenes, limonoids, and many other bioactive compounds of nutritional value. When used in technological applications, orange juice also helps enhance flavor (Miranda *et al*., 2019; Saini *et al*., 2022). On the other hand, fruit contains some amount of minerals like potassium and calcium. Moreover, is an excellent source of vitamin C that's considered a powerful natural antioxidant that helps the human body develop resistance against infectious agents and scavenge harmful, pro-inflammatory free radicals from the blood. As well the consumption of orange juice has been associated with health benefits, such as the control of low-density cholesterol and high blood pressure (United States Department of Agricultural USDA, 2018 and Hornero-Méndez *et al*., 2018).

Guava (*Psidium guajava* L.) is one of the most common, greatest essential, and popular fruits all over the world, also is an important tropical fruit tree grown mainly for its edible fruits which are eaten raw or made into purée (pulp), jam, jelly, paste, juice, syrup, chutney, among other products. It is very pleasant amongst the prevalent customers closely in all countries, this may be due to its prevalent taste and excellent statistical analysis such as aroma and taste. It's used in numerous forms such as fresh, processed such as nectar, jam, and puree. Recent studies have reported an appreciable amount of antioxidant phytochemicals including ascorbic acid, carotenoids, flavonoid and polyphenols compounds in the guava fruit which are essential dietary components (Araújo *et al*., 2015 and Flores *et al*., 2015). The main objective of the current study is to estimate the possibility of basil seeds utilization as a natural additive to improve the chemical, microbiological and sensory characteristics of some nectars (mango, guava, orange).

MATERIALS AND METHODS

MATERIALS:

Raw Materials:

For mango, guava and orange nectars preparation and basil seeds, the raw materials were procured from Horticultural Research Institute, Agricultural Research Center, Giza, Egypt.

Chemicals and reagents Folin–Ciocalteu reagent, sodium carbonate anhydrous (Na_2CO_3), gallic acid (GA), aluminum chloride ($AlCl_3$), sodium nitrite ($NaNO_2$), sodium hydroxide (NaOH), hydrochloric acid (HCl), 2,2-Diphenyl-1- picrylhydrazyl (DPPH), ascorbic acid (AA), sulfuric Acid (H_2SO_4). Citric acid, Xanthan and Sorbate were procured from El-Gomhorea, Co. for chemical and medical supplies, Cairo, Egypt. All chemicals used were analytical reagent grade. Sugar was procured from the local market.

Preparation of raw materials:

The Juice was manually extracted from mango, guava, and orange fruits. All fruits were washed with tap water and drained. Orange fruit was manually peeled and cut into half sections by knife, then extract the juice by electric Juice extractor machine (Bosch, M3500). Seeds of guava, skin and stone of mango were removed to get the pulp. Both mango and guava pulp were individually blended using a mixer (BRAUN, JB0123WH), homogenized, and filtered through a muslin cloth. Basil seeds were carefully cleaned to remove stones, stalks and dust. Seed preparation was carried out using a modified method based on previous studies (Naji-Tabasi and Razavi, 2017). Seeds were soaked in water at 50ºC for 20 min with of 50:1 water/seed ratio. frequently Stirring, then using Stainless Steel Fine Mesh Strainer, the swollen seeds were separated.

Preparation of nectars:

Nectars were manufactured as per the ratio of pulp according to (GENERAL STANDARD FOR FRUIT JUICES AND NECTARS, CXS. 247-2022) and basil seed % of the treatments used the following ingredients in Table (1). The preheated nectar product was filled into a clean and sterilized glass bottle of 200 ml and sealed. The filled bottle was pasteurized in boiling water at 85°C for 30 minutes then immediately cooled and stored at room temperature (Bal *et al.,* 2014). Physicochemical, microbiological, and sensory evaluations were periodically examined through 8 months of storage for processed nectars.

Table 1. Different proportions of ingredients for preparation nectars with Basil Seed

Fruit	Pulp %	Water %	Sugar %	Basil seed %	Citric acid %	Xanthan %	Total %
Mango control	25	63.47	11.40	0.0	0.03	0.1	100
Mango A	25	62.97	11.40	0.5	0.03	0.1	100
Mango B	25	62.47	11.40	1.0	0.03	0.1	100
Mango C	25	61.97	11.40	1.5	0.03	0.1	100
Guava control	30	59.47	10.40	0.0	0.03	0.1	100
Guava A	30	58.97	10.40	0.5	0.03	0.1	100
Guava B	30	58.47	10.40	1.0	0.03	0.1	100
Guava C	30	57.97	10.40	1.5	0.03	0.1	100
Orange control	50	41.12	8.75	0.0	0.03	0.1	100
Orange A	50	40.62	8.75	0.5	0.03	0.1	100
Orange B	50	40.12	8.75	1.0	0.03	0.1	100
Orange C	50	39.62	8.75	1.5	0.03	0.1	100

Analytical methods:

Chemical analyses:

Moisture, total solids (TS), total soluble solids (TSS), pH value, total acidity (as citric acid), total sugar, reducing sugar, non-reducing sugar, ash, ascorbic acid, crude fiber, fat and protein according to (AOAC, 2019). Total carbohydrates were calculated by difference. Total carbohydrates = 100 - (weight in grams [protein + fat + water + ash + fibre] in 100 g of food).

Total phenols were determined using the Folin Ciocalteu method, according to *Kupina et al. (*2019*)*. Total flavonoid was determined according to the method described by Matic *et al*. (2017). The antioxidant activity of samples, an extract was studied through the evaluation of the free radical-scavenging effect on the 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical Rojas-Ocampo *et al*. (2021).

Microbial quality:

Microbiological analyses were carried out as shown by (APHA, 2015). For the microbial counts, samples were serially diluted, plated in total count agar (PCA) for total viable bacteria plate (aerobic) counts, and in acidified potato dextrose agar (PDA) for molds and yeast counts. Plates were incubated at 30 °C for 48 hr., for total plate counts & molds and yeast, respectively.

Sensory evaluation:

Different Juices and nectars were organoleptically evaluated. The sample was evaluated by ten members (ten panelists) of staff at the Department of Horticultural crops technology Research, Food Technology Research institute, Agricultural Research Center, Egypt. The sensory characteristics of color, odor, taste, appearance e and overall acceptability were evaluated with ten panelists based on 9-point hedonic rating scale with a maximum score considered as the best (Wichchukit and O'Mahony, 2014).

Statistical analyses:

Analysis of variance (ANOVA) was used the procedure of the statistical analysis system (SAS, version 9.1) program, Significant differences were evaluated at the level of (P>0.05).

RESULTS

Physico-Chemical Parameters of raw materials:

The physico-chemical parameters of raw materials (mango pulp, guava pulp and orange juice) were presented in Table (2), and the results indicated that moisture content in orange juice was higher than in mango pulp and guava pulp, which was 85.37, 82.14 and 81.85%, respectively. Whereas the higher total soluble solids content (TSS) 16.54% was noticed in mango pulp than those in orange juice and guava pulp (12.62 and 11.94%) respectively.

Table 2. Physico-chemical parameters (mean±SD) of raw materials (on fresh weight basis)

Characteristics	Mango pulp	Guava pulp	Orange juice
Moisture %	82.14 ±0.258	81.85 ±0.504	85.37 ±0.340
Total solids (TS) %	17.86 ±0.258	18.15 ±0.504	14.63 ±0.340
Total soluble solids (TSS) %	16.54 ±0.078	11.94 ±0.42	12.62 ±0.318
Total Sugars %	14.09 ±0.387	8.37 ±0.333	10.30 ±0.427
Reducing Sugars %	6.02 ±0.473	3.38 ±0.048	7.80 ±0.098
Non reducing sugars %	8.07 ±0.727	4.99 ±0.289	2.50 ±0.355
Ascorbic acid mg/100gm	41.63 ±0.741	256.65 ±0.437	65.05 ±0.464
Total acidity% (as citric acid)	0.53 ±0.061	0.46 ±0.041	1.38 ±0.043
pH value	4.25 ±0.118	4.32 ±0.032	3.61 ±0.021

The sugars content of the fruits used in the study also varied, the data in Table (2) indicated a substantial difference in total sugars, reducing sugars and non-reducing sugars contents which ranged from 8.37 to 14.09, 3.38 to 6.02 and 4.99 to 8.07, respectively. Guava has much higher quantities of ascorbic acid (vitamin C) than most fruits. Guava pulp had the maximum content of ascorbic acid followed by orange juice while the minimum content was in mango pulp which were 256.65, 65.05 and 41.63 mg/100gm, respectively. The quantity of organic acids in the fruit has a direct impact on its titratable acidity. The most prevalent organic acid in fruits is citric acid, which is crucial for preserving the fruit's quality.

Nutritional composition of raw materials:

Fruit crops contribute to the diets of several persons globally and are highly cherished due to their nutritional value. The nutritional composition of mango pulp, guava pulp and orange juice data were recorded in Table (3). Results indicate that protein fat and crude fiber contents ranged from 0.19 to 0.47, 0.17 to 0.53 and 1.57 to 2.09%, respectively.

Table 3. Nutritional composition (mean±SD) of raw materials (on fresh weight basis)

Component	Mango pulp	Guava pulp	Orange juice	Basil seeds
Moisture %	82.14 ±0.258	81.85 ±0.504	85.37 ±0.340	6.20±0.205
Protein %	0.47 ±0.153	0.23 ±0.014	0.19 ±0.010	15.42 ±0.365
Fat %	0.53 ±0.048	0.36 ±0.014	0.17 ±0.012	9.72 ±0.490
Crude Fiber %	1.82 ±0.104	1.57 ±0.112	2.09 ±0.090	18.25 ±0.734
Ash %	0.60 ±0.046	0.67 ±0.037	0.45 ±0.019	6.14 ±0.422
Total carbohydrate%	14.44 ±0.126	15.32 ±0.421	11.73 ±0.398	44.27 ±0.497

The basil seeds benefits are mainly associated with their nutritional value. The data in the same table illustrated that basil seeds have high protein and fat contents 15.42 and 9.72%, respectively. (Table 3) appears that basil seeds are a good source of total carbohydrate and fiber 44.27 and 18.25%, respectively. The results showed that the basil seeds are a good source of ash content 6.14% while it ranged from 0.45 to 0.67 for other materials.

Total phenolic and flavonoid compounds contents and Antioxidant activity of raw materials:

The total phenolic, flavonoid contents and antioxidant activity are summarized in Table 4. The results revealed that there were significant differences among the values obtained for different raw materials. Data shows that guava pulp had the highest content of total phenolic and total flavonoid compounds (232.09 and 61.83 mg/100g), followed by orange juice and mango pulp. while basil seeds had the lowest content (48.29 and 5.15mg/100g).

Table 4. Total phenolic, total flavonoid contents and antioxidant activity (mean±SD) of raw materials

Component	Mango pulp	Guava pulp	Orange juice	Basil seed
Total phenolic compound mg/100gm (as GAE)	63.06^{c}±0.624	232.09^{a}±0.688	126.85^{b}±0.699	48.29^{d} ±0.342
Total flavonoids compound mg/100gm (as CE)	16.76^{b}±0.210	61.83^{a}±0.293	15.55^{c}±0.261	5.15^{d}±0.149
Antioxidant Activity% (DPPH)	61.42^{b}±970	48.34^{d}±870	52.47^{c}±850	71.26^{a}±810

Means within a raw showing the same letters (a,b,c) are not significantly different (P≤0.05) in the same parameter.

Phenolic compounds and antioxidants activity (DPPH) of nectar fortified by basil seeds:

Data in Table (5) indicated a similar gradually significant increase in total phenols and total flavonoids content according to treatments and the data showed that there were significant differences among the values obtained for different treatments of juices supplementing by basil seeds. The results indicated that guava nectar treatments by different percentages of basil seeds had the highest value of total phenolic and total flavonoid compounds which ranged from 71.19 to 72.18 and 17.16 to 17.76 mg/100g, respectively, followed by orange nectar which ranged from 63.97 to 64.82 and 8.95 to 10.36 mg/100g, respectively, while mango nectar had the lowest value which ranged from 17.48 to 18.49 and 4.49 to 5.12mg/100g, respectively. This may be due to the variations in the ascorbic acid and phenolic compounds contents. Vitamin C is regarded as the main inducer of antioxidant activity. Guava fruits are very rich in ascorbic acid followed by orange juice (see Table 1) besides, the initial content of total phenolic and flavonoid compounds of the raw juices (Table 4).

Table 5. Total phenolic, total flavonoid compound contents and antioxidant activity (mean±SD) of nectars fortified by Basil Seeds

Treatments	Total phenolic compounds mg/100gm as GA	Total flavonoids Compounds mg/100gm as CE	Antioxidant activity % (DPPH)
Mango Con	17.48^{c}±0.155	4.49^{c}±0.245	26.25^{d}±0.770
Mango A	17.85^{bc} ±0.280	4.62^{bc} ±0.130	39.52^{c}±0.570
Mango B	18.12^{ab} ±0.166	4.87^{ab}±0.220	43.85^{b}±0.932
Mango C	18.49^{a}±0.197	5.12^{a}±0.160	45.68^{a}±0.850
Guava Con	71.19^{c}±0.348	17.16^{b}±0.205	18.26^{d}±0.940
Guava A	71.51^{bc} ±0.121	17.22^{b}±0.195	32.54^{c}±0.870
Guava B	71.85^{ab}±0.159	17.52^{ab}±0.135	37.68^{b}±0.970
Guava C	72.18^{a}±0.295	17.76^{a}±0.250	43.13^{a}±0.990
Orange Con	63.97^{c}±0.305	8.95^{c}±0.295	16.28^{d}±0.600
Orange A	64.18^{ab}±0.251	9.28^{bc}±0.345	35.48^{c}±0.900
Orange B	64.52^{ab}±0.246	9.54^{b}±0.290	40.67^{b}±0.830
Orange C	64.82^{a}±0.513	10.36^{a}±0.180	47.57^{a}±0.930
LSD at 0.05	0.652	0.534	0.540

Means within a column showing the same letters (a,b,c) are not significantly different (P≤0.05) .

The impact of the addition of basil seed was significant when comparing the treatments with the control sample. Table (5) illustrates the scavenger inhibition of DPPH radicals. There were some significant differences in antioxidant activity in relation to concerning basil seed ratio. The highest antioxidant activity percentage was in treatment number C (1.5% w/v basil seed), and the lowest was for the control samples without basil seed, which was significant in comparison to other samples. The results indicated that adding basil seeds significantly increased the inhibition of DPPH and thus antioxidant activity. This might be due to the phenolic content of basil seeds, which play an encouraging role and promote the scavenger role.

Effect of storage periods on pH and total acidity of nectars fortified by basil seeds:

Data in Table (6) revealed the effect of storage periods on pH and total acidity of nectars supplemented by basil seeds and the results appeared that there were significant differences between the values obtained for different treatments of nectars and through storage period.

Table 6. Effect of storage periods on pH and total acidity of nectars fortified by basil seeds

Storage periods	Mango Con	Mango A	Mango B	Mango C	Mango Con	Mango A	Mango B	Mango C
	pH value				T. acidity			
0	4.11^{Ab}	4.16^{Ab}	4.17^{Ab}	4.28^{Aa}	0.534^{Ba}	0.418^{Ab}	0.401^{Ab}	0.397^{Ab}
4	4.02^{ABc}	4.11^{ABb}	4.14^{Ab}	4.24^{ABa}	0.545^{ABa}	0.421^{Ab}	0.412^{Ab}	0.402^{Ab}
8	3.95^{Bc}	4.08^{Bb}	4.14^{Aab}	4.18^{Ba}	0.560^{Aa}	0.428^{Ab}	0.425^{Ab}	0.415^{Ab}
Storage periods	Guava Con	Guava A	Guava B	Guava C	Guava Con	Guava A	Guava B	Guava C
0	4.19^{Ac}	4.23^{Abc}	4.29^{Ab}	4.49^{Aa}	0.520^{Aa}	0.485^{Ab}	0.427^{Ac}	0.406^{Ac}
4	4.19^{Ab}	4.17^{Ab}	4.25^{Ab}	4.48^{Aa}	0.518^{Aa}	0.502^{Aa}	0.438^{Ab}	0.408^{Ac}
8	4.12^{Ab}	4.15^{Ab}	4.16^{Ab}	4.45^{Aa}	0.526^{Aa}	0.509^{Aa}	0.442^{Ab}	0.413^{Ac}
Storage periods	Orange Con	Orange A	Orange B	Orange C	Orange Con	Orange A	Orange B	Orange C
0	3.76^{Ac}	3.88^{Ab}	3.93^{Ab}	4.17^{Aa}	0.597^{Ba}	0.539^{Cb}	0.525^{Cb}	0.436^{Cc}
4	3.74^{Ac}	3.81^{Bbc}	3.85^{Ab}	4.08^{ABa}	0.595^{Ba}	0.586^{Ba}	0.560^{Bb}	0.469^{Bc}
8	3.72^{Ab}	3.78^{Bb}	3.82^{Ab}	3.97^{Ba}	0.680^{Aa}	0.616^{Ab}	0.606^{Ab}	0.550^{Ac}

Means within a column showing the same letters (A, B, C) are not significantly different (P≤ 0.05) in the same parameters.
Means within a raw showing the same letters (a,b,c) are not significantly different (P≤0.05) in the same parameters.

Results in Table (6) revealed that the control treatments had a low pH value at zero time of storage. On the contrary, the pH value increased while titrable acidity decreased with an increase in the basil seed ratio for A, B, and C nectars treatments. Furthermore, the data showed a decrease in pH value and an increase in titratable acidity trend during extending the storage period for every nectar's treatment after 8 months of storage. Titratable acidity values increased from the minimum value at zero time until they reached the maximum value at the end of the storage period for all treatments. However, no significant differences were observed in mango and guava treatments (A, B, and C). While orange treatments had significant differences in acidity during storage periods.

The Microbiogical quality of Nectars fortified by Basil Seeds:

Concerning results in Table (7), the results showed that a few numbers of total bacteria, yeast and molds detected during storage periods for treatments and were within acceptable limits as per the guidelines for microbiological quality of ready to eat foods (CFS., 2014).

Table 7. Effect of Basil Seeds addition on Total bacteria count and yeast & molds (log CFU/mL) in nectars during storage periods:

log CFU Total viable bacteria count (TVC) and yeast & molds (YM)								
Treatm	TC0	TC3	TC6	TC8	YM0	YM3	YM6	YM8
Mango Treatments								
Mango Co	2.34^{Ac}	2.38^{Abc}	2.42^{Ab}	2.58^{Aa}	1.46^{Ab}	1.41^{Ab}	1.57^{Aab}	1.69^{Aa}
Mango A	2.28^{Bd}	2.31^{Bc}	2.35^{Bb}	2.44^{Ba}	1.33^{Bb}	1.30^{ABb}	1.41^{ABb}	1.66^{Aa}
Mango B	2.22^{Cd}	2.24^{Cc}	2.33^{Bb}	2.36^{Ca}	1.27^{BCbc}	1.23^{BCc}	1.31^{BCb}	1.51^{Ba}
Mango C	2.15^{Dd}	2.19^{Dc}	2.25^{Cb}	2.28^{Da}	1.17^{Cab}	1.15^{Cb}	1.18^{Cab}	1.35^{Ca}
Guava Treatments								
Guava Co	2.43^{Ac}	2.51^{Ab}	2.53^{Ab}	2.66^{Aa}	1.60^{Ad}	1.70^{Ac}	1.74^{Ab}	1.81^{Aa}
Guava A	2.40^{Ac}	2.45^{Ab}	2.49^{Ba}	2.51^{Ba}	1.49^{Bd}	1.62^{Ac}	1.72^{Ab}	1.79^{Aa}
Guava B	2.40^{Ad}	2.42^{Ac}	2.46^{BCb}	2.49^{Ba}	1.43^{BCb}	1.44^{Bb}	1.63^{Ba}	1.70^{Ba}
Guava C	2.22^{Bb}	2.29^{Bab}	2.43^{Ca}	2.45^{Ca}	1.39^{Cb}	1.41^{Bb}	1.45^{Cb}	1.57^{Ca}
Orange Treatments								
Orange Co	2.35^{Ac}	2.37^{Abc}	2.39^{Ab}	2.45^{Aa}	1.81^{Ac}	1.84^{Ab}	1.88^{Aa}	1.92^{Aa}
Orange A	2.33^{Ab}	2.36^{Ab}	2.37^{Ab}	2.42^{Ba}	1.76^{Bc}	1.80^{Bb}	1.86^{Aa}	1.88^{Ba}
Orange B	2.28^{Bc}	2.31^{Bc}	2.37^{Ab}	2.40^{BCa}	1.67^{Cd}	1.73^{Cc}	1.79^{Bb}	1.83^{Ca}
Orange C	2.20^{Cd}	2.26^{Cc}	2.33^{Bb}	2.38^{Ca}	1.60^{Dc}	1.64^{Db}	1.68^{Cab}	1.69^{Ca}

Means within a column showing the same letters (A, B, C) are not significantly different (P≤ 0.05) for treatments.
Means within a raw showing the same letters (a,b,c) are not significantly different (P≤ 0.05) for storage.

Sensory Evaluation of Nectars fortified by Basil Seeds:

Sensory evaluation is considered an important analytical method in the context of the development of the food processing industry. Measurement of sensory properties of food has become more or less the basis for predicting the acceptance of a product by consumers. The sensory evaluation of mango, guava and orange nectars is illustrated in Table (8). All treatments had good sensory acceptability in some attributes color, odor, taste, appearance and overall palatability the mean scores attributed by panelists were higher than 6 in all evaluated sensory attributes. The results showed that there were significant differences among control, mango, guava, and orange treatments through storage periods. The results presented in Table (8) showed that control samples of all juice had the highest score of their characteristics at zero time. However, after 6 months of storage, the highest score for all attributes and overall palatability were obtained from the mango and orange treatments (1.0 % w/v basil seed) followed by the others. Whereas the guava sample (1.5 % w/v basil seed) had the highest scores.

Table 8. Effect of processing and storage period on sensory evaluation of nectars fortified by Basil Seeds.

Storage period	Ma Co (0.0)	Ma A (0.5)	Ma B (1.0)	Ma C (1.5)	Or Co (0.0)	Or A (0.5)	Or B (1.0)	Or C (1.5)	Gu Co (0.0)	Gu A (0.5)	Gu B (1.0)	Gu C (1.5)
	Color											
0	9.55^{aA}	8.8a^{AB}	8.9^{aAB}	8.7^{aC}	9.25^{aA}	8.1^{aB}	8.2^{aB}	8.1^{aB}	9.15^{aA}	8.6^{aA}	8.7^{aA}	8.8^{aA}
4	8.75^{bA}	7.9ab^{BC}	8.3^{abAB}	7.4^{bC}	8.15^{bA}	7.0^{bB}	7.8^{aA}	7.7^{aA}	7.0b^{B}	7.3^{bB}	7.6^{bB}	8.3^{abA}
8	6.6c^{B}	7.2b^{AB}	7.95^{bA}	7.1^{bB}	6.4^{cC}	6.8^{bBC}	7.7^{aA}	7.3^{aAB}	6.1^{cC}	6.5^{cBC}	6.9^{bB}	7.9^{bA}
	Odor											
0	9.1^{aA}	8.7^{aA}	8.9^{aA}	8.5^{aA}	9.25^{aA}	8.6^{aA}	8.7^{aA}	8.6^{aA}	9.4^{aA}	8.5^{aB}	8.6^{aB}	8.6^{aB}
4	8.3^{aA}	7.5^{bA}	8.4a^{bA}	7.7^{bA}	8.7^{aA}	7.5^{bC}	8.4^{aAB}	7.9^{aBC}	8.5^{bA}	7.9^{abA}	8.0^{abA}	8.3^{abA}
8	6.9^{bB}	7.1^{bB}	8.0b^{AB}	7.3^{bA}	6.6^{aB}	7.0^{bAB}	7.6^{bA}	6.8^{bB}	6.8^{cB}	7.2^{bAB}	7.4^{bAB}	7.8^{bA}
	Taste											
0	9.5^{aA}	9.1^{aAB}	9.2^{aAB}	8.6^{aB}	9.35^{aA}	9.0^{aA}	9.1^{aA}	8.1^{aB}	9.2^{aA}	8.3^{aB}	8.9^{aAB}	9.0^{aA}
4	8.0^{bB}	8.3^{bAB}	8.8^{aA}	8.1a^{AB}	8.0^{bA}	7.8^{bAB}	8.3^{bA}	7.4^{abB}	7.8^{bAB}	7.5^{bB}	7.8^{bAB}	8.3^{bA}
8	7.2^{cB}	7.7^{bAB}	8.0^{bA}	7.4b^{AB}	7.3^{cAB}	6.6^{cC}	7.9^{bA}	7.0^{bBC}	7.1^{bAB}	6.6^{cB}	6.9^{cB}	7.8^{bA}
	Appearance											
0	9.5^{aA}	9.0^{aA}	9.1^{aA}	9.1^{aA}	9.3^{aA}	8.5^{aB}	8.7^{aAB}	8.3^{aB}	9.6^{aA}	8.9^{aB}	9.0^{aAB}	9.2^{aAB}
4	8.2^{bA}	7.8^{bA}	8.3^{bA}	7.6^{bA}	7.9^{bAB}	7.3^{bBC}	8.2^{aA}	7.0^{aC}	8.0^{bAB}	7.1^{bC}	7.3^{bBC}	8.3^{bA}
8	7.0^{cB}	6.9^{cB}	8.0^{bA}	6.5^{cB}	6.8^{cB}	6.8^{bB}	8.0^{aA}	6.3^{aB}	7.6^{bAB}	6.6^{bC}	6.9^{bBC}	7.9^{bA}
	Overall acceptability											
0	9.41^{aA}	8.90^{aB}	9.03^{aAB}	8.73^{aB}	9.29^{aA}	8.55^{aB}	8.68^{aB}	8.28^{aB}	9.33^{aA}	8.58^{aB}	8.80^{aB}	8.90^{aAB}
4	8.31^{bAB}	7.88^{bBC}	8.45^{bA}	7.70^{bC}	8.26^{bA}	7.40^{bB}	8.18^{abA}	7.50^{bB}	7.83^{bB}	7.45^{bB}	7.68^{bB}	8.30^{abA}
8	6.92^{cB}	7.23^{cB}	7.99^{cA}	7.08^{cB}	6.78^{cB}	6.80^{cB}	7.80^{bA}	6.85^{cB}	6.90^{cB}	6.73^{cB}	7.03^{cB}	7.85^{bA}

Means within a column the showing the same letters (a, b, c) are not significantly different (P≤ 0.05) for storage.
Means within a raw showing the same letters (A, B,C) are not significantly different (P≤ 0.05) for treatments.

DISCUSSION

Previous research has shown that the data in Table (2) appeared that guava pulp has the lowest value of total acidity (0.46%) followed by mango pulp (0.53%) while the highest value (1.38%) was in orange juice, meanwhile, the pH values of the raw materials (mango pulp, guava pulp and orange juice) varied from 3.61 to 4.32.in this concept, Veeranjaneya *et al*. (2021) reported that the moisture, total sugars and total acidity of mango pulp contents were 83.4 6, 14.98, 1.6 and 0.7 gm/100gm respectively. Meanwhile, the content of moisture, TSS, titratable acidity, ascorbic acid and pH value of guava pulp were 85.82, 9.70, 0.44%, 230.0 mg/100gm and 4.21, respectively, nearly to the results according to Moussa and El-Gendy (2019). On the other hand, Rowshon *et al*. (2016) found that orange juice content was 86.43, 16.0, 10.11, 8.72%, 55.44 mg/100gm, 0.19% and 3.89 for moisture, TSS, total sugars, reducing sugars, ascorbic acid, total acidity, and pH value, respectively. The differences in the content value may be due to the diversity in variety, agricultural and climate conditions.

These findings are consistent with Maldonado-Celis *et al*. (2019) mango fruit has a high nutritional value and health benefits due to its important components, providing fiber, micronutrients as carbohydrates 10–32%, proteins 0–5% and, lipids 0.75% to 1.7%. The United States Department of Agriculture, Agricultural Research Service (USDA., 2018) showed that the total carbohydrates, protein, and dietary fiber content were 11.89, 0.94 and 2.50 g/ 100g, respectively. Aly *et al*. (2022) reported that guava puree contains 15.32, 1.36 and

0.73% for total carbohydrates, crude fibers and ash, respectively. Meanwhile, orange juice contains 0.07, 0.05, 0.14 and 0.73 % of protein, fat, crude fiber and ash, respectively (Rowshon *et al*., 2016). The results of basil seeds agreed with (Shahrajabian *et al*., 2020; Calderón Bravo *et al*., 2021) who found that the composition of basil seeds ranged from 10.0 to 22.5; 9.7 to 33; 4.7 to 8.9; 40.1 to 63.8 and 7.11 to 36.2 for protein, lipid, ash, carbohydrate, and fiber. This variability can be attributed to the moment of harvest, climate, and storage conditions (Khaliq *et al*., 2017). Basil seeds are a good source of polyunsaturated fatty acids and have a high nutritional quality (Calderón Bravo *et al*., 2021). These findings suggested that basil seeds are a good source of proteins, which are valuable for human health from a nutritional point of view.

The overestimation of total phenolics by the Folin-Ciocalteu reagent method is due to the fact that reducing agents, such as ascorbic acid, reducing sugars, specific amino acids may interfere with the results (Ghosh *et al*., 2021). Regarding the antioxidant activity, the basil seeds recorded 71.26 followed by mango pulp and orange juice which were 61.42 and 52.47%, respectively, whereas guava pulp had the lowest antioxidant activity (48.34 %). So, Mercado-Mercado *et al*. (2020) reported that the antioxidant activity depends on the type of phenolic compounds in addition to the type and the location of hydroxyl groups. Therefore, Bhebhe *et al*. (2016) reported that, the antioxidant activity value is not always connected with the total phenolic content. There was a negative correlation between phenolic content and DPPH radical scavenging activity. On the contrary positive correlation between the quantity of phenolic compounds and antioxidant activity as reported by (Choe *et al*., 2014; Sofia *et al*., 2016). The scavenging activity of basil seeds ranged from 57.35 to 84.59% according to the concentration and solvents (Al-Snafi, 2021).

The antioxidant capacity (AOA) and total phenolic content (TPC) of basil seeds were determined by various research groups and the results indicated that the AOA and TPC ranged from 34.20 to 96.849% and 63.780 to 7857.6 µg GA/g, respectively (Calderón Bravo *et al*., 2021). The Nutritional composition of basil seed showed that it contained antioxidants (22.27%), total phenol (50.25 mg) and flavonoids (30 µg) (Akshatha *et al*., 2019). Mango and orange juices contain 42.03 and 80.34 mg/100ml, 23.82 and 17.93 mg/100ml, and 28.18 and 56.36 % for total phenolic, total flavonoids and Antioxidant activity, respectively (Saad, 2017). Guava puree contains 335.40, 210.50 mg/100g and 83.4% total Phenols, total flavonoids and antioxidant activity, respectively (Aly *et al.,* 2022).

Basil has numerous healthy advantages and safe as a natural food additive. In addition to being used for their potential to treat and prevent a variety of illnesses (Filip, 2017). Galdino et al. (2023) showed a relationship between vitamin C levels and the antioxidant activity of eleven tropical fruits. The study found that the addition of basil seed ratios to the varied nectars affects the content of total extracted polyphenols. The results indicated that adding basil seeds significantly increased the inhibition of DPPH and thus antioxidant activity. This might be due to the phenolic content of basil seeds, which play an encouraging role and promote the scavenger role.

Tracking the change in the pH and total acidity of juices is one of the important factors that may be affected by chemical or microbiological changes. Also, is one of the most important parameters to evaluate the quality and shelf life of fruit juices (Alejandro *et al.,* 2023). The pH is an integral factor of the product and in food preservation. It plays a very significant role in the occurrence of chemical interactions as well as being a selective and microbiological presence. Along with the acidity of the fundamental elements of food flavor, it specifies the accuracy of the industrial process that will be used, directly affecting how well the product will be preserved. Though the increase in titrable acidity reflects a decreased pH, the titrable acidity determines the acid taste in the nectars whereas the pH determines its susceptibility to microbial spoilage (Aishwarya *et al*., 2023). These results agreed with the investigation reported by Bal *et al*. (2014) and Wang *et al*. (2022) who reported that the increase in acidity during extended the storage period may be due to the breakdown of pectin into pectenic acid and organic acids being converted into carbohydrates or oxidized. The results are also in conformity with the findings of Romila *et al*. (2021) who reported that the increased acidity of nectar during storage may be due to the formation of organic acids due to the decomposition of ascorbic acid as well as the gradual decrease in pectin content. It might be due to the conversion of sugar into acid by virtue of some enzymatic action.

Fundamental plants found a variety of compounds that can affect microbial growth, reproduction, or basic cellular functions. These include phenols, polyphenols, micronutrients, essential oils, and other compounds. These compounds are mainly found in various herbs. Basil is considered a natural preservative and shows high potential to inhibit bacterial growth and prolong the shelf-life of food (Dostalova *et al*., 2014).

Concerning the total viable count, yeast and molds of all treatments, normal counts were detected. There are significant changes in the total viable count, yeast and molds between control of mango, guava, orange and other treatments. Also, a significant difference was observed throughout the experiments in all treatments during storage periods. The total viable counts of microorganisms were inhibited with an increase in the levels of basil seeds. These may be related to an increase in the level of basil seeds content from antioxidant and antimicrobial properties the results are in conform with Hadba *et al.* (2022). Basil seed gum has several biological properties such as antibacterial, prebiotic, antioxidant and prolonging the shelf-life (Kumar *et al*., 2022).

Concerning the sensory evaluation, the results showed that fortified nectars by basil seeds enhanced the palatability and quality characteristics. Kumar *et al*. (2022) reported that basil seed is used in preparing functional foods to preserve their stability, texture, taste, and other organoleptic characteristics.

CONCLUSION

Basil seeds are a good source of micronutrients and possess potential antioxidants, which are highly beneficial for human health. The current study evaluated the effect of adding basil seeds on the phenolic compounds, antioxidant activity, microbiological, and sensory characteristics of mango, guava, and orange nectars. The results showed that nectars containing basil seeds had acceptable characteristics and inhibited microbiological growth. Finally, this study clearly concludes that the addition of basil seeds at concentrations of 1.0–1.5% can produce a palatable product with high quality and nutritional value.

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تقييم بعض المشروبات المدعمة ببذور الريحان

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تعتبر مشروبات الفاكهة من المشروبات الصحية لأنها تحتوي على فيتامينات ومعادن ومضادات الأكسدة التي تلعب دوراً هاماً في الوقاية من العديد من الأمراض. يمكن استخدام العصير المدعم المصنوع من الأعشاب والتوابل لتحسين القيمة الغذائية والقابلية. أجريت هذه الدراسة بغرض دراسة تأثير إضافة بذور الريحان الى مجموعة من عصائر الفاكهة المختلفة (المانجو، الجوافة و البرتقال) كلا على حدة ، وقد أضيفت بذور الريحان بنسب مختلفة (0,5 ، 1,0 و 1,5% وزن / حجم) لاختيار أفضل تركيز يمكن اضافته من حيث جودة تأثيره على الصفات الكيميائية، الميكروبيولوجية والحسية الخاصة بتلك المشروبات المعدة منها ، وقد اتضح من النتائج المتحصل عليها بأن أفضل النتائج هي إضافة بذور الريحان بنسب 1,0 % (وزن/حجم) لكل من مشروب المانجو والبرتقال، 1,5% (وزن/حجم) لمشروب الجوافة والتي أدت الى تحسين صفات المنتج النهائي . ولذلك يمكن استخدام بذور الريحان لإنتاج مشروب ذو قيمة غذائية عالية، وله خصائص حسية مقبولة، ويمكن التوصية به كمكمل غذائي لمواجهة عديد من الأمراض المختلفة.

الكلمات المفتاحية: بذورالريحان، مشروبات، الفينولات، ميكروبيولوجى