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## Production nutritious juice blends containing bioactive healthy compounds

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**Abstract**

Fruit drinks are healthful drinks, where they contain vitamins, minerals and antioxidants that play important role in preventing many diseases.Blended Juice method is used to improve the nutritional value of drinks according to the kind of fruits used. The aim of this study is to preparehealthful fresh blended drinks from somefruit and vegetable, thenevaluate theirnutritional value and sensory quality. Five formulas of natural drinks blends were prepared and keptin bottles. Physico-chemical and sensory properties of the prepared drinks blends were evaluated. Total phenols, total flavonoids and antioxidant activity of fresh drink blends wasevaluated using DPPH scavenging capacities method. The overall acceptability of blended drink offormulas 1, 2, 3, 4 and 5 showed the possibility to produceblended drink characterized with its good sensory and nutritional properties. The obtained antioxidantactivity of blendeddrinkconfirmed that they could use as a source of antioxidants and as healthful drinks. Therefore, these blendeddrinkscould be used to whom suffering from obesity, blood pressure, cancer, Alzheimer's and heart diseases. The obtained five blended drinks are good source of minerals and antioxidant activity of their vitamin C, flavonoids and total phenolics contents. Therefore, it could be recommended toconsumethe obtainedblended drink toprotect human from several diseases.

**Keywords:** Fruit drinks, Nutritional value, Physiochemical, Sensory quality, Antioxidant activity

## 1. Introduction

Fruit Juices are a good source of vitamins, minerals and valuable bioactive compounds essential for human health. The health benefits associated with drinking fruit juices are related to bioactive components such as essential vitamins, minerals and polyphenolic compounds. Therefore, fruit beverages are well known for their medicinal properties[1].Recently, blending two or more fruits and vegetables juices become popular. Blending fruits Juice is the best method that could be used to improve the nutritional quality of the juice drinks. This method is able to improve vitamin and mineral in juice products according to their fruits kind that used [2].

Nowadays functional beverages are more fashionable to prevent or treat diseases[3]. Two or more fruits juice/pulp could be blended in various proportions for the preparation of nectar and mixed fruit juices. The blended juice characterized with its improved aroma, taste and nutrients of the beverages [4].Moreover, one could think of a new product development through blending in the form of a natural health drink.On the other hand, mixing of yogurtand strawberry juice characterized withits ability to repair blood lipid profile [5],where Yogurt is one of probiotics dairy products drinks which are processed through the process of fermentation. Strawberry fruit contain several phytochemical compounds such as antosianin, acid elagiat, katekin, kuaerferin and kaemferol. Antosianin is antioxidants able to avoid atherosclerosis through hamper aterogenesis process by oxidize the LDL.

Recently, consumption of carrot juice has been increased in many countries. Carrot is one of the most important juice that characterized by its high carotene, vitamins and minerals contents[6,7]. Carotene is able to exhibit free radical properties, and is effectiveness as biological antioxidant [8]. Honey is characterized by itswidely used for therapeutic effects. Honey is containing about 200 substances. Itis primarily contains fructose, glucose, fructo-oligosaccharides[9] and also contains many amino acids, vitamins, minerals

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and enzymes [10]. Furthermore, honey containing phenolics, peptides and organic acids compounds that represent important compounds in the treatment of many diseases for its antioxidant capacity. Gingerand Cinnamon has been used as a spice. Ginger characterized by its antimicrobial activity [11].

Ginger and cinnamon were used as a medicinal plant, where ginger was used for cramps, sprains, rheumatism, arthritis, muscular aches, pains, hypertension, sore throats, indigestion, helminthiasis, dementia, fever, infectious constipation, diseases and vomiting [12].Cinnamon has been employed for stomachic and carminative for gastrointestinal complaints[13]. Oats also has physiological benefits like hypoglycemic effect, hypocholestrolemic effect and has effect on reduction of cancer and hypertension. β - glucan is the main active ingredient responsible for these physiological beneficial effects. Also, it is characterized by its high levels of protein, lipids, vitamins, antioxidants, phenolic compounds and minerals. Therefore, oats is a healthy choice and beneficial to reduce the risk of diabetics, hypertension and cancer [14]. Sweet potatoeisa great source of beta-carotenethat gives a powerful antioxidant. Beta-carotene is converted to vitamin A in human body. Consuming foods rich in beta-carotene may decline the risk of developing certain types of cancer, offer protection against asthma and heart disease, and delay aging and body degeneration. Date juice concentrate (76% TSS) is good source of sugars (63% reducing sugars, 67% total sugars,), tannins (1.16%) andacidity (0.33%) [15].

Consumption of tiger nut now is steadily increased. Tiger nut characterized by its protein content and fibre, which helps in body development and repair tissues, the fibre also helps in reducing cholesterol and body weight. There are some products could obtained from tiger nut, i.e tiger nut flour, ‘‘Dakuwa’’, ‘‘kunu’’, and Tiger nut oil and some of them could be eaten as snack[16].

Also, almonds contain good nutrient. Research on the potential health benefits of almonds showed that consumption of almonds reduced the risk of chronic diseases such as coronary heart disease and type tow diabetes, weight maintenance and weight control [17]. Whole Almonds could be eaten fresh or roasted, and almond butter could be used in a wide range of food products.

Bananas have several health benefits, i.e., lowering blood pressure, lowering the risks of cancer and improving heart health [18]. Defatted milks characterized by its higher calcium content than whole milk. Therefore, skimmed milk has higher amount of bone nutrients, i.e. like protein & phosphorus if compared with whole fat milk. The present study aimed to produce and evaluate juice blends characterized with its accepted sensory and healthy properties from some fruits and vegetablesas a functional juice.

## 2. Materials and Methods

**Materials:**

Strawberry, Carrot, sweet potato and banana were obtained from local market, Dokki, Cairo, Egypt. Crème cheese (kiri), natural yogurt, milk, honey, almond, oat meal, ginger, vanilla cinnamon, cacao powder and peanut butter were obtained from spice shop and super market, Cairo, Egypt.

**Methods:**

**Five juice formulas were prepared to improve memory as follows:**

1-Strawberry Drink was prepared using 38% strawberry, 5% cream cheese, 20% yogurt, 32% milk and 5% honey.

2- Carrot and sweet potato drink were washed well. The Carrot was peeled then blanched in boiling water for 25 min. Also, sweet potato was firstly blanched for 25 min then peeled. The drink was prepared by blending 28% carrot, 28% sweet potato, 2% ginger, 1% cinnamon, 35% milk and 6% white honey.

3- Banana Drink with peanut Butter: Banana was peeled and mixed in the blender with the other ingredients as follows: 45% banana, 9% almond, 3% coco powder, 37% milk and 6% white honey.

4- Almond drink with oat meal: Almond and oat were grinded in the grinder then all the ingredients were blended together as follows: 14% sweet potato, 29% almond, 14% oat meal, 1% cinnamon, 36% milk and 6% white honey.

5- Tiger nut drink: Tiger nut was soaked in water for 14 hr then filtered and mixed in blender with the other ingredients as follows: 14% cream cheese, 38% tiger nut and 48% water.

**Physico-chemical analysis:**

Gross chemical of fruits and vegetables that used to prepare juice blends were determined according to the methods of AOAC [19] and total carbohydrate was determined by difference. Juice blends were evaluated as follows: Total Soluble Solid (TSS),was evaluated as Brix Juice blends were evaluated as follows: Total SolubleSolid(TSS) were evaluated as Brix value usingahandRefractometer (ATAGO, Japan).

Acidity was determinedas percentage of citric acid according to the method of AOAC( [19]. Brix/acid ratio was calculated for each sample. The pH value was evaluated using Hanna pH-meter HI 9021 m Germany. Vitamin C of prepared juice blends wasevaluatedusing2,6 di-chlorophenol-indophenol [19]. Viscosity was evaluated using Brookfield DV-III UTRA in centipoises (cP) unit according to the method of Ibarz*etal*[20].Color parameters (L*, a* and b*) of juice blends were evaluated using Hunter, Lab Scan XE-Reston VA, USA.The instrument was standardized using white tile (LX No. 16379): X = 72.26, Y = 81.94 and Z = 88.14 (L* = 92.46, a* = -0.86, b* = -0.16) as stated by Sapers *and* Douglas[21].

Total phenolics content of juice blends were evaluated as gallic acid equivalent (mg GAE gG1 dry weight) using the method of Folin-Ciocalteu30. Also, Flavonoids contents of juice blends were evaluated as catachine equivalents (mg CAT gG1 fruit dry weight) using AlCl3 method [22].

Antioxidant activity of prepared juice blends was evaluated using DPPH radical-scavenging assay and α-carotene-linoleic acid bleaching assay as reported by authors [23,24].

**Sensory evaluation:**

Sensory evaluation of all blended juice samples was tested through taste, odor, color, mouth feel, appearance and overall acceptability as stated by Hussein and Shedeed [25].

**Statistical analysis:**

All results were analyzed statisticallyusing SPSS software program. The obtained results presented as Mean value ± Standard Deviation. Means values were compared using analysis of variance (one-way ANOVA), followed by LSD test ($p<0.05$).

## 3. Results and discussion

**Chemical composition of raw materials:**

All raw materials were evaluated chemically as shown in Table 1. The higher moisture content in tested samples ranged between 91.66 - 70% for strawberry, banana, carrot, sweet potato, natural yogurt and milk. While moisture of cream cheese and white honey decreased to 38.65 and 25%. The lowest moisture ranged between 15.06 -3.95% in peanut butter, almond, oat meal gingercinnamon coco powder date and tiger nut. Almond, peanut butter and cream cheese characterized their higher protein content, where they reached to 32.62, 25.8 and 20.50%, respectively. The higher fat content was noticed in peanut butter, cream cheese and tiger nut, where they ranged between 49.2 - 31.15%. Fiber was maximized in cinnamon (33%) and oat meal (11.13%), while tiger nut, date, peanut butter, ginger, strawberry and coco powder ranged between 5.85 - 2.90%. The higher carbohydrate was found in white honey (73.35%) followed with ginger (69.47%), oat meal (66.46%), coco powder (62.47%), tiger nut (54.36%) and almond (49.9%). The previous results agreed with those found by authors El-Shebiny*etal* [26, 27, 28].

**Table (1): Chemical composition of raw samples (on wet basis)**

| Samples | Component (%) | | | | | |
|---|---|---|---|---|---|---|
| | Moisture | Protein | Fat | Ash | Fiber | Carbohydrate |
| Strawberry | 91.66 | 2.39 | 0.13 | 0.40 | 2.90 | 5.43 |
| Banana | 70.00 | 1.44 | 0.29 | 3.60 | 0.40 | 24.27 |
| Carrot | 86.00 | 0.90 | 0.20 | 1.10 | 1.20 | 10.60 |
| Sweet potato | 70.54 | 1.21 | 0.09 | 0.89 | 1.88 | 25.39 |
| Peanut Butter | 6.5 | 25.8 | 49.2 | 3.7 | 3.9 | 16.1 |
| Almond | 9.3 | 32.62 | 3.3 | 4.8 | 0.44 | 49.9 |
| Oat meal | 10.74 | 13.87 | 6.85 | 1.69 | 11.13 | 66.46 |
| Ginger | 15.06 | 5.30 | 3.72 | 3.55 | 2.90 | 69.47 |
| Cinnamon | 5.1 | 3.5 | 4.0 | 2.4 | 33.0 | 52.0 |
| Coco powder | 5.12 | 6.80 | 12.65 | 6.41 | 2.64 | 62.47 |
| Cream Cheese | 38.65 | 20.50 | 32.45 | 4.40 | - | 4.00 |
| Natural yogurt | 86.66 | 3.22 | 1.89 | 1.07 | - | 8.00 |
| Milk | 84.20 | 3.9 | 5.22 | 0.7 | - | 5.98 |
| White honey | 25.00 | 0.56 | 0.31 | 0.48 | 0.30 | 73.35 |
| Date | 7.1 | 6.4 | 0.5 | 3.6 | 5.6 | 32.99 |
| Tiger nut | 3.95 | 4.89 | 31.15 | 3.75 | 5.85 | 54.36 |

**Table (2): Physicochemical properties of the prepared juice blends.**

| Parameter | Formula 1 | Formula 2 | Formula 3 | Formula 4 | Formula 5 |
|---|---|---|---|---|---|
| Moisture (%) | 80.15 ± 0.25 | 82.45 ± 0.34 | 82.17± 0.45 | 81.44 ± 0.32 | 39.91± 1.25 |
| Ash (%) | 0.34 ± 0.09 | 0.29 ± 0.01 | 0.56 ± 0.03 | 1.12 ± 0.05 | 2.96± 1.22 |
| Protein (%) | 2.87 ± 0.02 | 2.14 ± 0.04 | 4.92 ± 0.21 | 4.64 ± 0.18 | 6.97± 1.15 |
| Fat (%) | 1.32 ± 0.02 | 1.19 ± 0.02 | 6.11 ± 0.02 | 4.22 ± 0.02 | 27.20± 0.02 |
| Fiber (%) | 0.90 ± 0.65 | 2.16 ± 0.52 | 2.13 ± 0.33 | 3.86 ± 0.29 | 5.83± 1.83 |
| Total carbohydrates | 14.42±0.31 | 11.77 ± 0.42 | 4.11 ±0.17 | 4.72 ±0.29 | 17.13±0.33 |
| pH | 4.63 ± 0.18 | 4.41 ± 0.36 | 4.15 ± 0.42 | 4.25 ± 0.19 | 4.13 ± 1.01 |
| Acidity (%) | 3.20 ± 0.15 | 3.26 ± 0.20 | 3.47 ± 0.12 | 3.70 ± 0.11 | 3.35± 0.13 |
| TSS (%) | 16.60 ± 0.22 | 17.20 ± 0.19 | 18.15 ± 0.17 | 15.50 ± 0.18 | 18.70± 1.11 |
| TSS/ Acidity | 5.19 ± 0.21 | 5.28 ± 0.13 | 5.23 ± 0.11 | 4.19 ± 0.22 | 5.58± 1.11 |
| TS (%) | 20.11± 0.14 | 20.19 ± 0.11 | 16.15 ± 0.13 | 18.19 ± 0.29 | 19.21± 2.19 |
| Viscosity (cp) | 256.00 ± 2.11 | 900.00 ± 1.56 | 257.33 ± 2.13 | 685.66 ± 3.05 | 132.33± 3.11 |
| Vitamin C(mg/100gm) | 111.37± 0.25 | 54.19 ± 0.45 | 73.56 ± 0.32 | 77.92 ± 0.60 | 54.35 ± 0.40 |

**Physicochemical characteristics of juice blends:**

The physicochemical characteristics of juice blends of 5 formulas were summarized in Table 2. Total solids (TS) of all tested juice samples ranged between 16.15 - 20.19 Brix. These values accepted with the standard TSS values of juice products which range between 10-20 Brix. The pH values of juice blends ranged between 4.13-4.63. Also, acidity (% as citric acid) and TSS/acidity ratio of all juice samples ranged between 3.20 - 3.47% and 4.19 - 5.58, respectively. These results are similar to that required for juice. The Brix value and pH recorded for different juice blends are within the recommended ranges for juice to hinder microbial growth and maintain keeping the juice quality as stated by Aina andAdesina[29]. Furthermore, all studied juice samples were accepted as a juice product where its viscosity ranged between 132.33 - 900 cp. Juice of different formulas was characterized with its high vitamin C and fiber contents which ranged between 54.19 - 111.37 mg/100g) and (0.90 - 5.83 %), respectively.

**Total phenolic, total flavonoids and antioxidant activity of different juice blends:**

Antioxidant compounds (i.e. phenolics compounds) in food play a major role as a health protecting factor. Total phenols measured as gallic acid equivalent (GAE) ug/100g of juice and total flavonoids measured as catechen equivalent (ug CAT/100g) were assayed in different juice blends. Table 3 showed that the higher total phenolic contents (571.67ug GAE/100g) was found in formula 2, followed by juice blend of formula 1 (258.33ug GAE/100g) then formula 3 (246.67ug GAE/100g) followed by formula 4 (181.67ug GAE/100g) and the last one was formula 5 (151.67ug GAE/100g).On the other hand, total flavonoids contents in juice blends was detected only in formula 2, where it reached to 26.67 ug CAT/100g.

Free radical scavenging (DPPH) is one of the mechanisms for measuring the antioxidant activity. Table 3 shows the concentration of the compound required to scavenge the DPPH radical (ug/g). For the DPPH radical, juice prepared from formula 2of carrot and sweet potato drink had the highest DPPH value (686.84 ug/g) followed with formula 1 of strawberry drink (427.63 ug/g), while the lowest DPPH was found in formula 5 of tiger nut drink (331.75 ug/g). The obtainedresults agreed with those found by Wolfe & Liu [30] who stated that citrus and apple fibers have better quality due to the presence of associated bioactive compounds, such as flavonoids, poly phenols and carotenes.

**Table (3): Total phenol and flavonoid contents and antioxidant activity of juice formulas.**

| Parameter | Formula 1 | Formula 2 | Formula 3 | Formula 4 | Formula 5 |
|---|---|---|---|---|---|
| Total phenols (ug GAE/100g) | 258.33 | 571.67 | 246.67 | 181.67 | 151.67 |
| Total flavoinoids (ug CAT/100g) | ND | 26.67 | ND | ND | ND |
| Antioxidant activity | | | | | |
| DPPH (ug/g) | 427.63 | 686.84 | 406.32 | 400.99 | 331.75 |

**Color Quality**

Color characteristic is one of the major parameters that affect the quality of the final product. Data in Table 4 represent color attributes of the five juices blends (formula 1 to formula 5). Color parameters of tested juice samples showed that formula 4 of almond drink with oat was lighter than other tested juice samples, where it had the highest lightness (L* = 70.30) and yellowness (b* = 17.56). While lightness (L*) value was minimized in formula 3 of banana drink with peanut butter, where it decreased to 45.55. The highest redness (a*) value was found in formula 1 (22.26) of strawberry drink,followed by formula 2 (carrot drink plus potato) and 3 (banana drink plus peanut butter), where they were 14.52 and 12.84, respectively. The highest yellowness value (b*) was also found in formula 2 of carrot and sweet potato drink (35.63) followed by formula 3 of banana drink plus peanut butter (24.12) and formula 5 of tiger nut drink (20.87). Table 4 showed also that, mixing different raw materials of different formulaimproved lightness (L*), redness (a*) and yellowness (b*) of all tested samples. This result could be due to the higher polyphenolic and flavonoid compounds and their antioxidant activities in raw materials as mentioned before.

**Table (4): Hunter color parameter of raw materials as well as their juice product**

| Parameter | Formula 1 | Formula 2 | Formula 3 | Formula 4 | Formula 5 |
|---|---|---|---|---|---|
| L* | 61.87 | 67.48 | 45.55 | 70.30 | 61.42 |
| a* | 22.26 | 14.52 | 12.84 | 6.03 | 7.64 |
| b* | 8.03 | 35.63 | 24.12 | 17.56 | 20.87 |
| Saturation | 23.66 | 38.48 | 18.16 | 18.57 | 22.22 |
| a/b | 2.77 | 0.41 | 0.53 | 0.347 | 0.37 |
| ΔE* | 66.24 | 77.68 | 49.04 | 72.71 | 65.32 |

**Sensory Properties:**

Sensory Properties of juice has a great importance to evaluate consumer attitudes and their influence on food choice and acceptability. Therefore, juice samples of different formulas were evaluated sensorial and presented in Table 5. The obtained mean panel score and statistical analysis showed that, juice of formula 2 (carrot plus sweet potato) characterized with its highest score in all the parameters (color, taste, odor, mouth feel, appearance and Overall acceptability), followed by formula 3, formula 4 and formula 5. The least accepted one was formula 1 of strawberry drink.

**Table (5): Sensory properties of different juice formula.**

| Parameter | Formula 1 | Formula 2 | Formula 3 | Formula 4 | Formula 5 | LSD (0.05%) |
|---|---|---|---|---|---|---|
| Color (10) | 7.77c ±0.19 | 9.22a ±0.21 | 8.75b ±0.23 | 8.35b ±0.19 | 8.42b ±0.13 | 0.70 |
| Taste (10) | 7.73c ±0.11 | 9.65a ±0.14 | 8.77b ±0.16 | 8.63b ±0.15 | 8.78b ±0.22 | 0.78 |
| Odor (10) | 6.20c ±0.11 | 9.35a ±0.15 | 7.70b ±0.14 | 7.52b ±0.11 | 7.66b ±0.15 | 1.13 |
| Mouth feel (10) | 6.62c ±0.12 | 8.79a ±.19 | 7.39b ±0.13 | 7.66b ±0.17 | 7.79b ±0.21 | 1.00 |
| Appearance (10) | 7.70c± 0.11 | 9.72a ±0.16 | 7.81b ±0.25 | 7.72b ±0.32 | 7.69b ±0.17 | 0.90 |
| Overall acceptability (10) | 7.66c ±0.22 | 9.64a ±0.15 | 8.58b ±0.19 | 8.42b ±0.09 | 8.67b ±0.11 | 1.19 |

## 4. Conclusion

From the previous result it could be concluded that, all tested formulas characterized with its chemical contents and bioactive healthy compounds. Moreover, all formula was accepted through sensory evaluation parameters. Therefore, it could be recommended to produce such juice blends as a nutritious healthy functional drink.

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