Evaluation of Beetroot Juice Blends with Carrot and Apple Juice as Healthy Beverage

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ABSTRACT

The consumption of beetroot juice may lower blood pressure (BP) and therefore reduce the risk of cardiovascular events. The aim of this study was to produce of beetroot juice blends with carrot and apple juice as healthy beverage and new product as a reduction in BP. Juices from beetroot (Beta vulgaris), carrot (Drocus carota), and apple (Mallus Pumilla Fam.) were optimized to a blended beverage which was pasteurized (90°C for 25 sec) and stored for 21 days in glass bottles at refrigerated temperature. Physic-chemical and sensory analysis was evaluated. Marginal changes in pH, total soluble solids, acidity, vitamin C and total carotenoids were observed. The highest content of total carotenoids in the beetroot, carrot, and apple juice blends of 50:20:30 (V/V/V) (T4) was found (55.03mgL-1) to be increased with increasing the proportion of carrot juice. Estimation of vitamin C content of the same sample at 21 day (30.40mg/100ml) showed high improvement in nutritional value of beetroot juice incorporated with carrot and apple juice. The mean nitrate and nitrite levels in the juices ranged from 0.005 to 0.002mg/L and 0.092 to 0.005 mg/L. during storage period; respectively. The mean overall acceptability scores of more than 8 for juice samples up to 30% apple juice incorporation indicated the commercial scope for manufacturing good and nutritious beetroot juice blended with carrot and apple juice, which will also be helpful in providing dietary requirement of beta carotene to the consumer. Heat pasteurization was effective for inactivating the microbial flora. However, the shelf life of juice was established within 21 days. The product is recommended for children, youth and elderly persons to be used within 21 days.

Keywords: *Beetroot, Carrot, Apple, Juice, Healthy beverage, Nitrate, Nitrite, Blood pressure (BP).*

INTRODUCTION

Fruits and vegetables are critical to good health, and certainly good for all age categories as it forms an important portion of a healthy diet.

Beetroot (*Beta vulgaris*) is botanically classified as an herbaceous biennial from *Chenopodiaceae* family and has several varieties with bulb colors ranging from yellow to red. Deep red-colored beet roots are the most popular for human consumption, both cooked and raw as salad or juice. Beetroot is one of the richest dietary sources of antioxidants and naturally occurring nitrates **(Maheswari *et al.*, 2013)**. The nitrates in beetroot improve blood flow through the body including the brain, heart and muscles. It increases a molecule in the blood vessels called nitric oxide which helps open up the vessels and allows more oxygen flow; it also lowers blood pressure and decreases the incidence of cardiovascular disease **(Kenjale & Ham2011)**. A number of studies have reported beetroot as a dietary inorganic nitrate with a potential for reducing blood pressure in humans **[Webb *et al.*, (2008) Bailey *et al.*, (2009) and Vanhatolo *et al.*, (2010)]**. **Coles & Clifton (2012)** also reported that after consumption of beetroot juice on a low nitrate diet, it may lowerblood pressure and therefore reduce the risk of cardiovascular event. Dietary nitrate supplementation has *also* been reported to reduce the oxygen cost of low intensity exercise in humans **(Bailey *et al.*, 2009)**.

Reports have indicated that beetroot juice has immersed nutritional, medicinal and health benefits; besides its rich supply of vitamins and minerals such as phosphorus, calcium, magnesium, Sulphur; it is also an excellent source of foliate, manganese, iron and many antioxidants **(Kanika, 2012)**. The antioxidant property helps to prevent the formation of cancerous tumors and is therefore a powerful cancer-fighting agent. Its effectiveness against colon and stomach cancer has been established through various studies **(Stephen, 2014)**. A case study of a patient who drank a quart of beetroot juice each day was reported to have effectively broken down and eliminated the cancerous tumors **(Stephen, 2014)**. **Vanhatolo *et al.*, (2010)** also reported that people who drank two cups of beetroot juice had lower blood pressure within about 60 min of drinking the juice, with a peak drop occurring 3 – 4h after ingestion. The reduction in blood pressure continued to be observed until up to 24h after the juice was consumed. The conclusion made was that one of the biggest benefits of beetroot juice is that it provides another way to combat high blood pressure without using medication **(Vanhatolo *et al.,* 2010)**. **Bobek *et al.,* (2000)** had also observed its ability to lower LDL cholesterol levels and raise HDL cholesterol levels in the body.

There is growing interest in the use of natural food colors, because synthetic dyes are becoming more and more critically assessed by the consumer. But in food processing, as compared with anthocyanins and carotenoids, betalains are less commonly used, although these water-soluble pigments are stable between pH 3 and 7. To improve the red color of tomato pastes, sauces, soups, desserts, jams, jellies, ice creams, sweets and breakfast cereals, fresh beet/beet powder or extracted pigments are used **(Koul *et al*. 2002 and Roy *et al*. 2004)**. It also contributes to consumers' health and wellbeing because it is known to have antioxidants because of the presence of nitrogen pigments called betalains, mainly comprise of red–violet-colored betacyanins (betanin,isobetanin, probetanin and neobetanin) and yellow–orange-colored betaxanthyns **(Kaur & Kapoor 2002)**.

Carrot (Daucuscarota) is a worldwide root vegetable that is highly nutritional, and an important source of β-carotene besides its appreciable amount of vitamins and minerals often used for juice production **(Demir *et al.,* 2004)**. In recent years, a steady increase of carrot juice consumption has been reported in many countries **(Schieber *et al.,* 2002)**.

Epidemiological studies provide growing evidence that carotenoids and other antioxidants may protect humans against certain types of cancer **(Steinmetz &Potter, 1996)**, and cardiovascular diseases **(Gaziano, *et al*., 1992)**. The role carotenoids play in protecting plants and animals from excess sunlight has also been recently observed in humans (**Biesalski, *et al*., 1996)**. Therefore, a minimum of five servings a day of vegetables and fruits, especially green and yellow vegetables and citrus fruits, is recommended **(National Research Council [NRC], 1989)**. According to **Britton (1995)**, healthy adults who are not exposed to any particular oxidative stress should consume 2- 4mg β -carotene daily.

Apples (Mallus Pumilla Fam. Rosaceae), are some of the most important fruit grown in the region of suceava. Apple fruits are directly consumed in the form of fresh juice which can also use in soft drinks for jellies and jam, for flavoring paste, dried fruit, etc. **(Leahu, *et al.*, 2013)**. Apples are one of the main dietary sources of antioxidants, phenolic compounds such as flavonoids**.** Flavonoids reduce the risk of cardiovascular diseases by increasing the release of endothelial nitric oxide NO and inducing vasodilation **(Nicholas *et al,* 2010)**. Several studies have specifically linked apple consumption with a reduced risk for cancer, especially lung cancer, asthma and diabetes **(Feskanich *et al.*, 2000)**.
Among the most important constituents of apple juice are polyphenols that have the ability to increase its anti-oxidant potential. Polyphenols also affect lipid methabolism **(Akazone, 2004)** and the absorption of cholesterol (**Aprikian *et al.*, 2001)**. Some authors have suggested that apple juice can reduce some forms of cancer **(Barth *et al.*, 2005)**; however, such an effect was only found for cloudy apple juice.
Most apple juice is still consumed as clear juice, which is characterised by having a low phenolics content **(Markowski & Płocharski, 2005)** due to the clarification process which leads to dramatic changes in the profile of phenolic compounds compared to whole fruit **(Hubert *et al.*, 2007)**. Clear juice is also deprived of pectins. As a form of soluble fibre, pectic substances may play an important role in the prevention of obesity, arteriosclerosis **(Galisteo *et al.*, 2008)**, and diabetes **(Giacco *et al.*, 2002)**. Current research has shown some advantages of consuming cloudy apple juice compared to clear juice **(Markowski *et al.*, 2007; Oszmiański *et al.*, 2007)**, indicating that this product may be more beneficial to human health than clear apple juice.

Juice blending is one of the best methods to improve aroma, taste and the nutritional quality of the juice. It can improve the vitamin and mineral content depending on the kind and quality of fruits and vegetables used **(De Carvalho *et al.*, 2007)**. Apart from nutritional quality improvement, blended juice can be improved in its effects among the variables, thus it cannot depict the net effects of various parameters on the reaction rate. Moreover, one could think of a new product development through blending in the form of a natural health drink, which may also be served as an appetizer. So far, no more work has been carried out on mixed fruit juice and spiced beverage. The aim of this research is therefore to develop the various blends of beetroot juice with carrot and apple juices and determine their chemical characteristics.

MATERIALS &METHODS

The fully matured, freshly harvested beetroot, carrot and apple were obtained from the local market and washed thoroughly with clean water to remove any adhering substances. The juices were extracted from fruits immediately after purchasing.

Juice Preparation:

Carrot roots were prepared according to the method described by **(Jan & Masih 2012)**. Carrots and Apples were trimmed, then washed with tap water, after grounding, the roots were pressed on a rack and cloth press by a hydraulic press (Hafico, Germany). Juice was filtered and then concentrated to 64º Brix by a rotary - low pressure evaporator (BUCHI Rotavapor R-114 model, Fawil, Switzerland) at 60°C. Then the beetroot was cleaned with tap water, peeled and then beetroot juice was extracted using juice blender. After that the juice of beetroot, carrot, and apple juices should be blended in different ratios of 100:0:0, 80:10:10, 70:10:20, 60:10:30 and 50:20:30 respectively, shown as **Table (1)**. Then sugar (11%) and citric acid (0.1%) were added to juice properly and then mixture was filtered through muslin cloth. Three batches of juice mixture were prepared. The product was filled in glass bottles (400 ml capacity) which was sterilized at 110°C for 10 minutes, then sealed. After that bottles were pasteurized at 90°C for 25sec cooled and stored at refrigerated temperature 5 ± 1°C for 21 days.

Sensory Evaluation

The beetroot, carrot and apple juice blends after preparation was subjected to sensory evaluation using a twenty-member panelist. The organoleptic qualities evaluated were: Taste, odor, color, mouth feel and overall acceptability. The juice samples were served in clear glasses to individual panelist. The order of presentation of samples to the panel was randomized, potable water was provided to rinse the mouth between evaluations to avoid transfer of sensory attributes from one sample to the other. Each sensory attribute was scored on a 9 – point Hedonic Scale which ranged from 9 – 1 (liked extremely and disliked extremely), respectively according to the method of **Iwe (2010)**.

Physical and chemical analyses

Total soluble solids (TSS), pH, total acidity and ascorbic acid content were determined as quality indexes. General parameters were measured following the official methods **AOAC (2005)**: TSS content was measured using Abbe refractometer (Japan) at 20 ºC with value being expressed as Brix. pH was determined at 20ºC using a digital pH meter (WTW Inolab pH-L1, Germany) calibrated with pH 4 and pH 7 buffer solutions. Total acidity was measured by titration with 0.1 N NaOH solutions and calculated as g citric acid /100 ml juice. Ascorbic acid was determined by visual titration, using 2, 6-dichlorophenol indophenol method and expressed as mg/100ml juice. Total and reducing sugars were determined according to **Ranganna (1999)**. Apparent viscosity of juice samples was measured directly using Brookfield Digital Rheometer, Model DVIII Ultra (SC4-21 spindle). The viscometer was operated at 10 rpm. The sample was placed in a small sample adapter and a constant temperature water bath was used to maintain the desired temperature (25˚C± 1).

Total Carotenoids were determined spectrophotometrically (UV-Spectrophotometer, Spectronic® Genesys™ 2 Instruments, made in USA) as the method of **Ranganna (1999)**.

Phenolic compounds of samples of beetroot, carrot and apple juices were determined by the method described **Yuan & Chen (1999)**.

Potassium (K), calcium (Ca), magnesium (Mg), sodium (Na), phosphorus (P) nitrate (NO3) and nitrite (NO2) levels were determined by atomic absorption according to **Chukul & Chinka (2014).** All results were expressed in mg l^{-1} juice.

All the analysis was determined of three replicates after processing and during storage for 21days, one-week interval.

Statistical analysis:

Analyzed by one-way analysis of variance (ANOVA) and analysis were carried using Microsoft Excel data analysis **Jumde *et al.*, (2015)**.

RESULTS & DISCUSSION

Sensory Evaluation

The sensory evaluation of the blends prepared from beetroot juice, carrot juice and apple juice are shown in following **Figure 1** that show the mean sensory score and the significant difference among quality attributes of the blended juice. The evaluations were done on all the data for color, taste, odor, mouth feel and overall acceptability. There is no significant difference between all samples except T4 sample; it has the highest degrees in taste, odor, mouth feel and overall acceptability due to panel testers' perfection. The best results were obtained for the beetroot, carrot, and apple juice blends of 50:20:30 (V/V/V) proportion with 14 brix TSS.

Physical and chemical Analysis

***Total Soluble Solids*:** The Total sugar (Brix°) is the sugar content of an aqueous solution. One-degree brix is 1 g of sucrose in 100 g of solution and represents the strength of the solution as percentage by weight **(Robbert *et al.*, 1991)**. The TSS increased with gradual passage of storage time, which might be due to hydrolysis of polysaccharides into monosaccharide and oligosaccharides. The minimum increase (14 Brix° to 15 Brix°) in TSS was recorded inT_0 and T_4 treatment, **(Table 2)**. Similar results were also reported by **Ankush Jumde *et al.* (2015)** in juice blends and **Jan and Masih (2012)** found an increasing trend in total soluble solids during storage at ambient and low temperature in lime - aonla and mango-pineapple spiced RTS (Ready-to-Serve) beverages.

Titratable Acidity

The total titratable acidity measures the ionic strength of a solution; this determines the rate of chemical reaction. The addition of beetroot juice to carrot and apple juice reduced the titratable acidity while pH value increased. Acidity values for all the samples was not significant (p>0.05) changed by storage as shown in **Table (3)**.

pH

pH is one of the main quality characteristics that describe the stability of bioactive compounds in fruit juice **(Sanchez-Moreno *et al.*, 2006)**. From the **Table 4** it is cleared that pH of all samples was not significant (p>0.05) affected by storage. It proved that the samples maintained good quality during storage since pH is one of the main quality characteristics that describe the stability of bioactive compounds and quality of fruit juices **(Sanchez-Moreno *et al.*, 2006)**. It was observed that the maximum pH (4.32) was recorded in the sample T0. Most beverages or juice has their pH ranges between 3.4 and 4.32 **(Pearson, 1995)**.

Ascorbic acid

The vitamin C values obtained for beetroot, carrot and apple juice blends T0, T1, T2, T3 and T4 were 37.51, 30.51, 34.33, 36.21 and 39.80 mg/100ml of juice respectively (**Table 5)**. No significant difference ($P \leq 0.05$) was observed between values of ascorbic acid (vitamin C) content for all juice samples until 14th day, and significantly decreased in all samples at 21th, which was probably due to the fact that ascorbic acid being sensitive to oxygen, light and heat was easily oxidized in presence of oxygen by both enzymatic and non-enzymatic catalyst **(Mapson, 1970**). However, maximum ascorbic acid (30.40mg/100 ml juice) was recorded for beetroot juice blended with carrot and apple juice in ratio 50:20:30(v/v/v) at 21st day.

Total sugar and reducing sugar

Total sugar content of juice did not show significant difference (P>0.05) during storage for 21 days. The reducing sugars content in the juice increased apparently at the end of storage, which might be due to hydrolysis of polysaccharides in to monosaccharide and oligosaccharides. The minimum increase (6.48 to 8.83%) in reducing sugar content was recorded in T4 treatment, these results agreement with **(Bhardwaj & Mukherjee 2010)** as show in **Table 6**. **Dhaliwal and Hira (2004)** reported that pasteurization and storage of carrot-spinach and carrot-pineapple blended juice for 6 months showed minor variations of pH values, total acidity, total solids and total sugars.

Viscosity

The viscosity of the beetroot, carrot and apple juice blends T0, T1, T2, T3 and T4 were 140, 380, 720, 650 and 780 (cP), respectively as shown in **Table 7**. The reliability of carrot and apple expressed in viscosity is essential part for the quality of juice blends. The viscosity of juice has no significant difference (p<0.05) during storage up to 14 days, however there was significant decreased after 21st day as shown in **Table 8** the data obtained agreed with **Markowski *et al* (2009)**. In the viscosity, correlation is expected between the sugar content, total solid and the viscosity of the juice since a fluid with more sugar is thicker and has a higher viscosity (**Greenwood *et al.*, 2006)**

Total Carotenoids

Total Carotenoids of the juices didn't have any significant difference during storage with the advancement of storage period, which was probably due to the samples were stored at refrigerated temperature 5 ± 1°C for 21 days**,** the results of **Table 8** were agreement with **Soni *et al* (2014)**.

Phenolic compounds:

Phenolic compounds are widely distributed in plants; they have been shown as the main contributors to the antioxidant activity of most of foods and beverages **(Balasundram *et al.*,**

2006). These compounds possess numerous biological properties such as antioxidant and free radical scavenging activities which can prevent cancers, cardiovascular diseases, inflammation, Alzheimer's disease, diabetes and other oxidative stress-induced diseases **(Klimczak *et al.*, 2007 and Rodriguez-Roque *et al.*, 2015).**

The results of phenolic compounds identification are shown in **Fig (2)** show twelve mainly peaks of phenolic compounds which were determined quantitatively. The peaks were assigned to pyrogallol, chlorogenic. epi-catechein, oleuropein, caffeic, ferulic vanillic, protocatchuoic dihydroxy benzoic acid, catechin, salycilic acid and gallic acid.

It could be seen from the results that pyrogallol showed the highest amounts (69.51 to 42.86) mgL^{-1} for T_0 at zero time and T_4 at 21^{st} day, respectively. It could be noticed that chlorogenic increased in T_2, T_3, and T_4 due to presence apple juice in these samples.

All phenolic compounds decreased during the storage. The decrease in polyphenols could mainly be resulted from oxidation of these compounds and polymerization with proteins **(Liu *et al.*, 2014)**. Also, **Fairouz Saci, *et al.*, (2015)** found a decrease in total phenolic in carrot and mango juices after 90 days storage at 25°C and 35°C, by 36.05%, 42.61% and 28%, 41.64%, respectively.

Minerals

Nutritionally, mineral elements are of great importance to the body. Some like calcium, phosphors, and magnesium, are important constituents of bones and teeth. As soluble salts, mineral elements like sodium, potassium, magnesium and phosphorus help to control the composition of body fluid and cells **(Chukul & Chinka, 2014)**.

The elements Ca, Mg, K, Fe, Zn, NO_3 and NO_2 were quantified for each juice sample. The measured contents for each element are summarized together with the averaged contents in **Figs. (3 and 4)**. Potassium was the most abundant with, on average, 228.4 to 121.1 mg per L, respectively. Manganese, iron and calcium were medium abundant with 33.08, 16.05 and 16.02 mg per L, whereas the contents of zinc was below 6 mg per L of juice **(Fig. 3)**. Beetroots are a rich in calcium, magnesium, phosphorus, potassium, and sodium. Also, smaller amounts of iron, zinc, copper, manganese, and selenium **(Kumar 2015)**.

The results from this study show that all the fruit juices analyzed contained detectable amount of nitrate and nitrite **(Fig. 4)**. The mean nitrate and nitrite levels in the juices ranged from 0.005 to 0.002mg/L and 0.092 to 0.005 mg/L. during storage period; respectively. The concentration of nitrate in the samples fall below that's acceptable daily intake (ADI) which is set at 5mg/kg body weight **(WHO, 1978)**. However, the risk to human with respect to methaemoglbinaemia and conversion of nitrate to nitrite in oral cavity and stomach leading to the possible formation of nitrosamines cannot be ignored. The level of ascorbic acid determined in juices was shown in **Table (5).** Ascorbic acid addition is common in manufacture of beverages, especially fruit juices. Ascorbic acid is used extensively in food industries not only for its nutritional value, but for it's in any functional quality as antioxidant inhibitor of N-nitrosamine formation through reduction of nitrate to nitrogen oxide will not be able to react with amines to form nitrosamines. **Okafor and Nwogbo (2005)**

The presence of nitrates and nitrites in food is associated with an increased risk of gastrointestinal cancer and, in infants, methemoglobinemia. Despite the physiologic roles for nitrate and nitrite in vascular and immune function, consideration of food sources of nitrates and nitrites as healthful dietary components has received little attention **(Hord *et al*., 2009)**.

CONCLUSION

` Beetroot is one of the richest dietary sources of antioxidants and naturally occurring nitrates. The nitrates in beetroot improve blood flow through the body including the brain, heart and muscles. It increases a molecule in the blood vessels called nitric oxide which helps open up the vessels and allows more oxygen flow; it also lowers blood pressure and decreases the incidence of cardiovascular disease. As beetroot juice is very potent, do not consume too much, especially if your body is not yet accustomed to it. For a beginner, start with the juice of half a medium-sized beetroot once a week, slowly increasing to one whole beetroot a week. we suggest to mix it with other juices. The present study showed that blending of apple and carrot juices to beetroot juice could enhance their nutritional quality and development of new products. It was concluded that the best sensory evaluation score and good acceptance during storage results were obtained for the beetroot, carrot, and apple juice blends of 50:20:30 (V/V/V).

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Table (1) Prepare juice blends as following blending ratios

S.no	Juice	Blending ratios (%)	Treatment symbol
1	Beetroot: Carrot: Apple	100:0:0	T0
2	Beetroot: Carrot: Apple	80:10:10	T1
3	Beetroot: Carrot: Apple	70:10: 20	T2
4	Beetroot: Carrot: Apple	60:10:30	T3
5	Beetroot: Carrot: Apple	50:20:30	T4

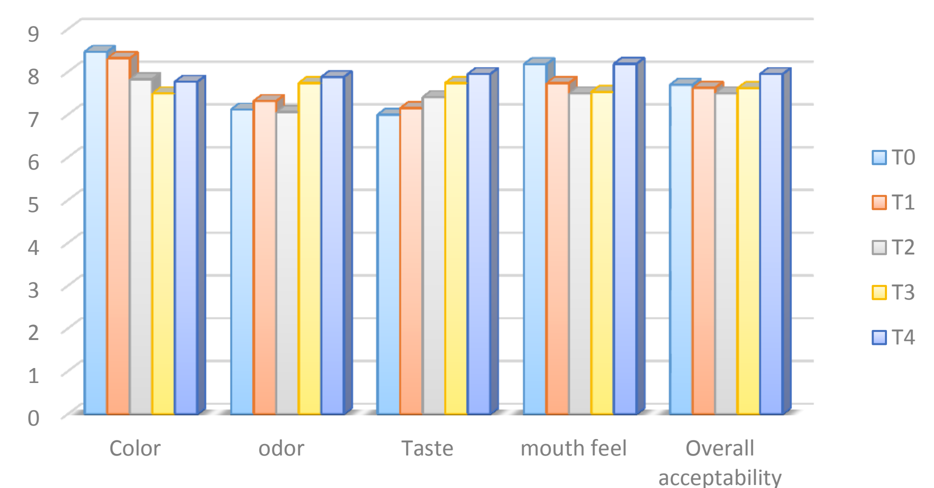

Figure 1: The sensory analyses of blended beetroot juice, carrot and apple

Table(2) Total soluble solids

Treatments	0 days	7th day	14th day	21st day
T_0	14	14	14.5	15
T_1	13	14	14	14
T_2	12	12	13.5	14.5
T_3	13.5	15	15	15.5
T_4	14	14	14	15

Table (3) Changes in titratable acidity (g/100ml) during storage day

Treatments	0 days	7th day	14th day	21st day
T_0	0. 10 [a]	0. 11 [a]	0.12 [a]	0.12 [a]
T_1	0.11 [a]	0.12 [a]	0.12 [a]	0.13 [a]
T_2	0.14 [a]	0.14 [a]	0.14 [a]	0.14 [a]
T_3	0.22 [a]	0.22 [a]	0.23 [a]	0.23 [a]
T_4	0.23 [a]	0.23 [a]	0.24 [a]	0.24 [a]

[abc] Means with different superscripts along the same row are significantly different at 5% (P < 0.05) level of probability

Table 4 Changes in pH during storage day

Treatments	0 days	7th day	14th day	21st day
T_0	4.32 [a]	4.30 [a]	4.30 [a]	4.30 [a]
T_1	3.49 [a]	3.48 [a]	3.48 [a]	3.47 [a]
T_2	3.95 [a]	3. 94 [a]	3.93 [a]	3. 93 [a]
T_3	3.43 [a]	3.43 [a]	3.43 [a]	3.42 [a]
T_4	3.38 [a]	3.37 [a]	3.37 [a]	3.36 [a]

[abc] Means with different superscripts along the same row are significantly different at 5% (P < 0.05) level of probability

Table 5 Changes in ascorbic acid (mg/100ml) content during storage day

Treatments	0 days	7th day	14th day	21st day
T_0	37.51 [a]	36.90 [a]	35.93 [a]	29.59 [b]
T_1	30.51 [a]	29.85 [a]	28.98 [a]	25.94 [b]
T_2	34.33 [a]	33.38 [a]	30.43 [a]	27.52 [b]
T_3	36.21 [a]	35.52 [a]	35.20 [a]	29.19 [b]
T_4	39.80 [a]	37.95 [a]	36.20	30.40 [b]

[abc] Means with different superscripts along the same row are significantly different at 5% (P < 0.05) level of probability

Table 6 changes in total sugar (%) and reducing sugars (%) content during storage day

Treatments	%Total sugar				%Reducing sugars			
	0 days	7th day	14th day	21st day	0 days	7th day	14th day	21st day
T_0	8.13 [a]	8.44 [a]	8.43 [a]	9.08 [a]	5.66 [b]	6.21 [b]	6.81 [b]	9.36 [a]
T_1	7.88 [a]	8.21 [a]	8.58 [a]	8.67 [a]	4.94 [b]	5.81 [b]	6.12 [b]	7.02 [a]
T_2	8.98 [a]	9.01 [a]	9.09 [a]	9.10 [a]	5.86 [b]	6. 04 [b]	6.90 [b]	9.10 [a]
T_3	10.25 [a]	10.34 [a]	10.51 [a]	10.95 [a]	6.95 [b]	7.25 [b]	7.76 [b]	10.47 [a]
T_4	9.19 [a]	10.70 [a]	10.83 [a]	10.99 [a]	6.48 [b]	6.70 [b]	7.91 [b]	8.83 [a]

[abc] Means with different superscripts along the same row are significantly different at 5% (P < 0.05) level of probability

Table 7 changes in apparent viscosity (cp) content during storage day

Treatments	0 days	7th day	14th day	21st day
T_0	140 [a]	140 [a]	130 [a]	110 [b]
T_1	380 [a]	370 [a]	360 [a]	330 [b]
T_2	720 [a]	710 [a]	700 [a]	670 [b]
T_3	650 [a]	640 [a]	630 [a]	600 [b]
T_4	780 [a]	760 [a]	750 [a]	710 [b]

[abc] Means with different superscripts along the same row are significantly different at 5% (P < 0.05) level of probability

Table 8 changes in total carotenoids (mg/l) content during storage day

Treatments	0 days	7th day	14th day	21st day
T_0	18.33 [a]	18.23 [a]	17.78 [a]	17.02 [a]
T_1	26.25 [a]	26.50 [a]	25.65 [a]	25.22 [a]
T_2	37.14 [a]	37.18 [a]	37.19 [a]	37.23 [a]
T_3	40.85 [a]	40.94 [a]	39.60 [a]	39.88 [a]
T_4	55.03 [a]	53.35 [a]	53.85 [a]	52.25 [a]

[abc] Means with different superscripts along the same row are significantly different at 5% (P < 0.05) level of probability

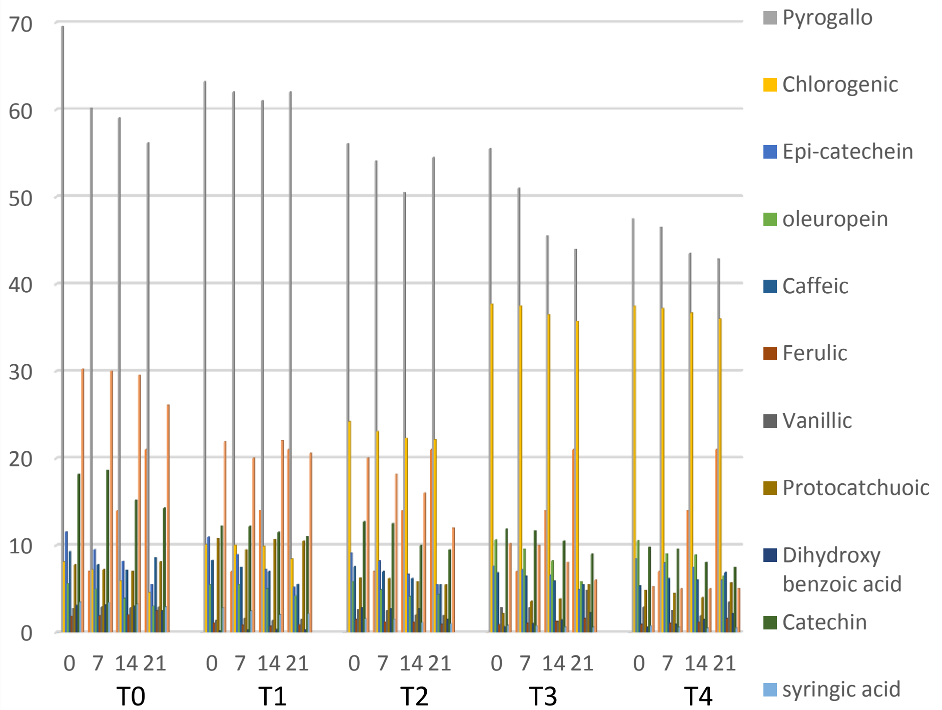

Fig.2 . Phenolic compounds content of beetroot, carrot and apple juice blends during storage

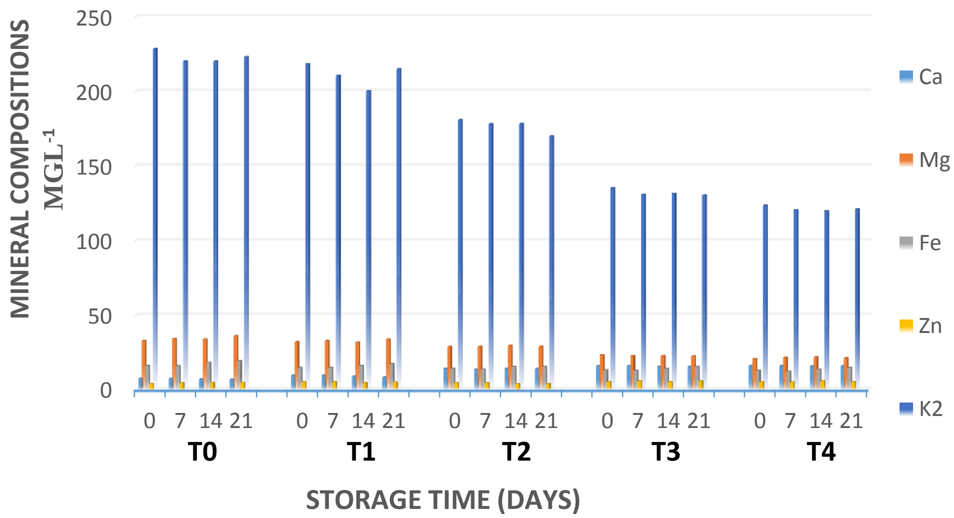

Fig.3 . Mineral Compositions of the the beetroot, carrot and apple juice blends

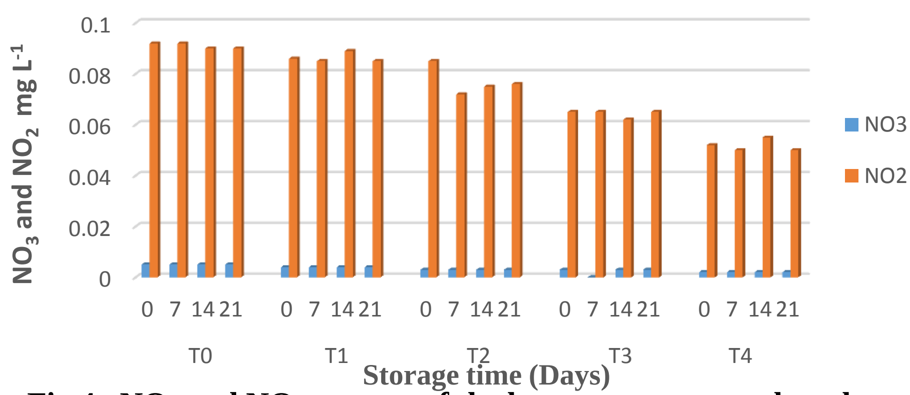

Fig.4 . NO_2 and NO_3 content of the beetroot, carrot and apple

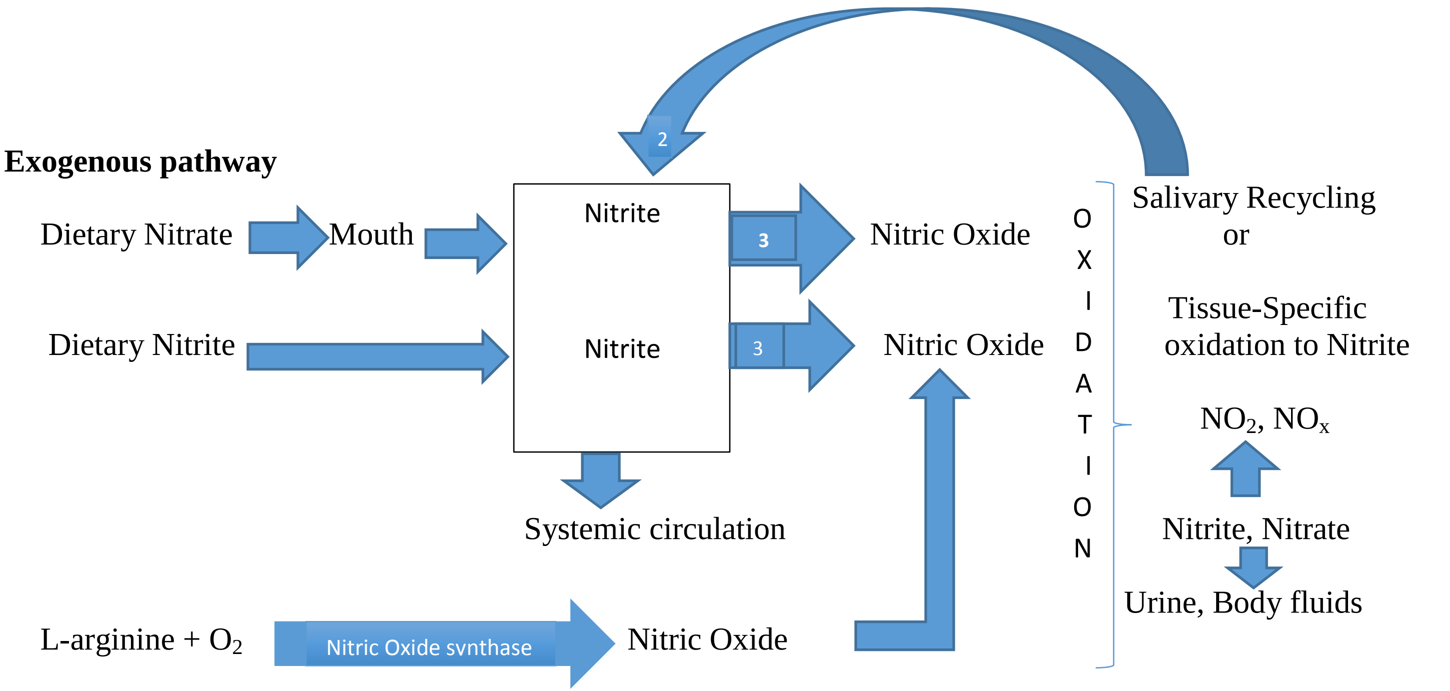

FIGURE (5) *A schematic diagram of the physiologic disposition of nitrate, nitrite, and nitric oxide from exogenous (dietary) and endogenous sources. The actions of bacterial nitrate reductases on the tongue and mammalian enzymes that have nitrate reductase activity in tissues are noted by the number 1. Bacterial nitrate reductases are noted by the number 2. Mammalian enzymes with nitrite reductase activity are noted by the number 3.*

تقييم عصيرالشمندر المخلوط بعصير الجزر والتفاح كمشروب صحي

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الملخص العربى

استهلاك عصير الشمندر قد يخفض ضغط الدم وبالتالي يقلل من امراض القلب والاوعيه الدمويه. الهدف من هذه الدراسة انتاج عصير من الشمندر المخلوط بعصير الجزر والتفاح كمشروب صحي ومنتج جديد له تأثير مخفض للضغط. تم عمل مخاليط من عصير الشمندر والجزر والتفاح بالدرجه المثلى وتم تخزينها على درجة حرارة الثلاجه في زجاجات زجاجيه لمدة ٢١ يوم وذلك بعد البسترة على درجة حرارة ٩٠ °م /٢٥ث. وقد تم عمل تحاليل كيميائيه وطبيعيه وحسيه وقد وجد تغييرات غير محسوسه في pH والحموضه والجوامد الكليه وفيتامين C والكاروتينات الكليه وكان اعلى محتوى من الكاروتينات في عينة (T4) والتي تتمثل في مخلوط الشمندر، الجزر، والتفاح بنسب ٥٠:٢٠: ٣٠ (ح/ح/ح) ٥٥,٠٣ ملجم لكل لتر وهذه الزياده ترجع لوجود الجزر. وكان اعلى محتوى لفيتامين C لنفس العينه بعد ٢١ يوم ٣٠,٤٠ ملجم لكل ١٠٠مل وهذا يعمل على تحسين القيمه الغذائيه للعصير. متوسط مستوى النترات والنيتريت يتراوح ما بين ٠,٠٠٢ الي ٠,٠٠٥ ملجم لكل لتر و ٠,٠٠٥ الي ٠,٠٩٢ ملجم لكل لتر على التوالي خلال فترة التخزين. كانت درجات القبول الكليه في التقييم الحسي للعينه T4 اعلى من ٨ وذلك لوجود عصير التفاح بنسبة ٣٠% وهذا يدل على ان اضافة التفاح كان جيدا على النطاق التجاري وايضا من الناحيه التغذويه كذلك اضافة عصير الجزر لعصير الشمندر كان مهما لتوفير المتطلبات الغذائيه من البيتاكاروتين للمستهلك. كانت بسترة العصير لها تأثير فعال لايقاف نشاط الميكروبات بالاضافه لاطالة فترة الصلاحيه لمدة ٢١ يوم. نوصي بتناول هذا المنتج للاطفال و الشباب وكبار السن خلال ال٢١ يوم.

الكلمات المفتاحية: عصير الشمندر والجزر والتفاح – المشروب الصحي – النترات – ضغط الدم