Study of the Physiochemical, Sensorial, Microbiological, and Antioxidant Properties of Probiotic-Fortified Turnip Juice During Storage

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ABSTRACT

Flavonoids, carotenoids, antioxidants, and vitamins C and E are abundant in turnips. To evaluate their functional properties, turnip juice was subjected to chemical, physicochemical, sensory, and microbiological tests with the addition of probiotic bacteria, and with/without adding the banana juice with 5, 10, and 15% during storage periods (1, 7, and 14 days) at the refrigerator temperature (4°C). The turnip juice control is with probiotic bacteria without banana juice. The results showed that the total sugar level increased following adding banana juice but dropped with longer storage times. The protein level in turnip juice with or without banana and probiotics increased over a long time. 100 ml samples of the control and all types contained ranging between 17–21 mg of vitamin C. With more additional banana juice and longer storage periods, the folate in all types of juices decreased with11% more than in control juice. With a longer storage time and more acidity, the probiotic juice with 15% banana juice has a standard color. Sensory assessments in all products were acceptable. Flavonoids and phenolic compounds are rich in turnip juice probiotics. A microbiological examination revealed that the bacteria total count increased when added 10% or 15% of banana juice after 14 days. In conclusion, combining turnip juice and banana juice can accelerate the development of probiotics and increase their nutritional value and health benefits. Thus, the creation of commercial juices should promote the use of probiotics in products.

Keywords: *Total phenols, Total flavonoids, Microbiological analysis, color analysis, vitamin C*

INTRODUCTION

Nowadays, studies encouraged on consumed functional foods and drinks to improve human health probiotics were the highest prevalent for functional component **(Guimaraes et al., 2020).** Probiotics are defined as functional foods that are a portion of food for beneficial bacteria that improved intestinal health benefits and production of foods is first of the systems to producing useful foods **(Rafiq et al., 2016).** The feeding of probiotics is known healthy properties on the gut microbial **(Rijkers et al., 2011).** The probiotic lactic acid bacteria food prevents the cancer be causing and pathogenic bacteria **(Kwak et al., 2014).** Additionally, the feeding dairy foods may cause problems some individuals due to lactose intolerant that could be replaced of some food vegetables carrier for probiotics **(Eliane et al., 2013).** Vegetables as suitable media for the cultivation of probiotics by containing vital nutrients, vitamins, minerals, and phenolic compounds **(Pereira, and Gibson, 2002).** Vegetable juices probiotics are considered suitable for lactose intolerant people, containing vitamins and antioxidants **(Vodnar et al., 2019).** Studies previously demonstrated the benefits of probiotic foods for improving intestinal micro-flora **(Fuller 1989).** The importance of consumer probiotics products or prebiotics due to adjust the balance of the gut flora, prevent diseases in human **(Balthazar et al., 2018).**

Several of kinds turnip are economically and very vital vegetables could be used direct or manufacture, etc. in human diets worldwide so, is necessary for human nutrition and health benefits **(Sidonia et al., 2020).** The top 10 economic crops in the world were turnip vegetables had economic importance **(FAOSTAT 2011).** Turnip root is commonly known as Lift in Egypt **(Higdon et al. 2007).** Turnip roots are high in containing antioxidants such as vitamins C and E, carotenoids phenols, and flavonoids, that is considered an important role of prevent diseases **(Campbell et al., 2012).** Turnip roots are a rich source of antioxidants that activities of free radicals and damage responses to oxidation that the reducing obesity, high blood pressure diabetes, cancers, and many diseases **(Liang et al., 2006).** Types of lactic acid bacteria are probiotics that contain on Lactobacillus and Bifidobacterium **(James and**

Wang 2019). Lactic acid starters are considered to produce pectolytic enzymes; such as polygalacturonates and pectin esterase **(Wong, 1995).** During the bacteria fermentation, increased and decreased esterified pectin of vegetable puree is depolymerized that increasing the production to a better quantity and increasing carotenes of the vegetable juice **(Demir, 2000).** LAB of carrot juice could be improving the healthy beverage for vegetarians they have lactose-allergic consumers **(El-Sayed et al., 2016).**

The objective of the present study was provided products of fresh functional vegetable juices fortified with probiotic bacteria. Additionally, evaluate the influence probiotic bacteria on the physicochemical, sensory assessment and antioxidant of turnip juice fortified with probiotics during the storage periods.

MATERIALS & METHODS

Materials

Turnip (*Brassica rapa* s) and banana **(***Musa cavendish***)** were purchasing in Market Abo-Ahmed by Zagazig, Egypt. They were washed carefully; both ends were removed, then peeled by knife and cut longitudinally into stocks. The stocks were blanched in water at minute for tenderization the turnip. Mixture (Moulinex blender-LM France) was used to extract the juice.

Ethanol (95%), methanol, citric acid, sodium-meta-bisulfite, Na_2CO_3, sodium hydroxide, phenolphthalein, potassium iodide, sodium thiosulfate, starch, chloroform, acitic acid and hydrochloric acid were bought from El-Gomhoria Company for Chemicals Zagazag, Egypt.

Folin-ciocalteu reagent, gallic acid, tween 20, TBA (thiobarbituric acid), phosphatidyylcholine, potassium chloride, iron chloride, TCA (trichloroacetic acid), DPPH (2,2-diphenyl-1-picrylhdrazyl) and butylated hydroxyl anisole (BHA) were bought from Sigma Chemical Company, Egypt.

Starter cultures of experimental

Lactobacillus acidophilus ssp. acidophilus (EMCC 1027) and *L.delbrueckii ssp. bulgaricus* (EMCC 1102) and *Bifidobacterium ssp. bifidum* were obtained from the Egyptian Microbial Culture Collection of Cairo MIRCEN (EMCC), Faculty of Agriculture, Ain Shams University, Egypt.

METHODS

Preparation of culture probiotic

All bacteria inoculations into 10 ml MRS soup were immunized at 37°C for 24 hours. The cultures were formed at 37°C separately for 24 hr., in de Man, Rogosa, and Sharpe MRS soup (Difco Laboratories, Detroit, MI, USA) to reach nearly 106 cfu/ml as inoculate before inoculation into turnip juice at 0.5% (V/V). Enumeration of the cells was performed by plating serial dilutions of bacterial suspensions on MRS agar plates, incubating at 37ºC, and counting the colonies after 48 hr. The immunization by L. acidophilus and *L.bulgaricus and Bifidobacterium ssp. bifidum* was done at the rate of 105-107 cfu/ml, and lacto fermented juices were treated and became ready for use.

Preparation of turnip juices

Turnip was washed carefully in tap water and removed yield and then cut into slices and juicing by vegetable juicer adding ml pectinase enzymes of juice added with banana juice at a ratio of 5%, 10% and 15% after peeling of banana and juicing by vegetable juicer for three samples while the one samples founding without additions was control sample. All juices pasteurization at 80°C for15 min and immediately cold at 4°C were assayed according to **(El-Sayed et al., 2016).**

Physiochemical examination

Determination of protein and reducing sugars contents

The protein and carbohydrate contents in turnip juices were determined by the method described in AOAC (2005). Changes in reducing sugar contents were analyzed according to **Miller (1959)**, calorimetrically. The color concentrations were experimented with in a UV spectrophotometer (Jenway-UV–VIS Spectrophotometer) at 575 nm.

Determination of vitamin (C) content and folate

Determination of ascorbic acid (vitamin) contented by a 2,6-dichlorophenol indophenol mixture (Fluka, Deisehofen, Germany) by the method described in **AOAC, (2005).**

Determination of pH-value and titratable acidity: Changes in PH-value were determined by a glass electrode of a digital pH meter (Model Mettler Toledo, Switzerland) **(AOAC, 2005).** Titratable acidity was measured on based lactic acid percentage according to the method described by **(AOAC, 2005).**

Determination of total soluble solids (TSS): Changes in values in total soluble solids were evaluated using the refractometric way, with an Abbe refractometer and revised to the corresponding reading at 20°C **(AOAC, 2005).**

Viscosity assay: Viscosity was evaluated in turnip juice samples by a Brookfield digital viscosity (Model DV- II+VISCOMETER, Spindle-00). Using spindle number (2) with speed from 3 to 50 rpm at 10°C. Viscosity was evaluated according by **Sin et al. (2006).**

Total phenols compounds were analyzed through the Folin-Ciocalteu reagent by methods **(Singleton and Rossi, 1965),** which is created by spectrophotometer on determining at 760 nm.

Total flavonoids compounds were measured by the colorimetric according to method presented by **Luximon-Ramma et al. (2005).**

Antioxidant capacity

Changes in antioxidant capacity of juice samples were expressed by the spectrophotometric technique as defined by **(Hegazy and Ibrahium, 2013).**

Color analysis and sensory evaluation

The color of turnip juice samples was determined by **Hunter (1958),** spectropolarimeter (Tristimulus Color Machine) with CIE lab color scale (Hunter, Lab Scan XE, Germany) according to the method described by **(Hunter,1958).**

The sensory examined of the samples were evaluated according to **Min et al. (2003**). Fifteen panelists were carefully chosen (Staff of Faculty of Agriculture, Food Science Department, Zagazig University, Egypt). Parameters were color, odor, flavor, texture, and overall acceptability which was determined as the total mean score of all the sensory parameters. An organoleptic evaluation was carried out by a 9-point hedonic scale with a degree from 1(representing very poor) to 9 (representing very good acceptability).

Microbiological examinations

The microbiological investigation of samples of turnip juice was the standard plate method after incubation. Cell counts were planned of 10-6 cfu/ ml and plated in double dishes of the samples according to **(Vinderola et al., 2000).** Also, the possibility of probiotic cultures was evaluated during the storage periods by using the exposed way **(Pereira et al., 2011).**

Statistical analysis

Assessments were completed in triplicate, by method **Steele and Torrie (1996).** The results were analyzed by one-way ANOVA alteration investigation joint with the least significant difference (LSD) in IBM SPSS V 25.0 at the equal probability of P≤ 0.05.

RESULTS & DISCUSSION

Effect of protein and carbohydrate contents on probiotic turnip juice during storage period

The changes in protein content of probiotic turnip juice during storage in Table (1A). The protein content in the turnip juice probiotic was increased than an initial fresh juice and the optimum protein for probiotic turnip juice production was after 14 days with significant differences in all samples presented, which raised the value of protein content because of the activity of probiotic bacteria and their metabolites. The results were similar to the results **Rafiq et al., (2016),** who presented that the probiotic carrot juice was highest in protein might be due to activity of probiotic bacteria.

The carbohydrate content in the probiotic turnip juice was slightly lower than in the fresh turnip juice Table (1B). The data appeared an increase in the rate of carbohydrate content for juice probiotic and a lessening in the rate of carbohydrates than the fresh turnip juice although all samples were significantly different. The sugar content of samples decreased slowly although, bacteria probiotic needs sugar for growth. Carbohydrate content of non-reduced dropping in all turnip juice probiotics is because of bacterial growth and organic acids production. These data are similar to the results of **Eş et al., (2018),** who studied the basic carbon in vegetable juices during adding to produce lactic acid.

Changes in vitamin C and folate content of probiotic turnip juice during storage

As the Table (2), displayed changes in vitamin C content presented that, the changed in the level of vitamin C during storage were slightly reduced. The control and all treated samples contained (17- 21) mg of vitamin C per 100 ml of juice. The results showed vitamin C is an unbalanced content and disposed to oxidation and breakdowns easily and reduces gradually during storage **(Kashudhan et al., 2017).** The phenolic ingredients compounds are consumed with oxygen (Porto et al.,2018). Reducing storage temperature is donated to the protection of vitamin C **(Miranda et al., 2019).**

The folate content in probiotic turnip juice during storage is a gradual decrease in all samples might be due to the increased utilization of folate for growth that could be non-digestible food ingredients. **Margaretha et al., (2004),** described the concentration folate during pre-treatment and fermentation with the purpose of advance the folate preservation. Turnip roots have a highly amounts of folate that decreases vascular disease, cancer, and neural tube flaw risk **(Czarnowska and Gujska, 2012).**

pH and acid value and its effects on probiotic turnip juice during storage

The effects in pH during the storage period of probiotic turnip juice by *L. acidophilus*, *L. bulgaricus*, *and Bifido bifidum* (1:1), showed in Table (3). The turnip juice required an initial pH rate of 4.7 and the end of 4.2 in the control sample (C) after 14 days. The increased storage period of turnip juice decreased pH with different significance. The lowest pH values were 3.7 pH an initial and the end at 3.7pH turnip juice containing 15% banana juice (S3) after 14 days. The data of acid values for turnip juice was opposite that the turnip juice containing 15% banana juice (S3) after 14 days was the highest value (0.41) by different significant. The optimum acid values for probiotic turnip juice production were after 14 days for S3. The pH value drops slowly in juice probiotics and the acid value increased slowly content because of the making of organic acids. The results agree with **Shah et al., (1995)** described that acid production post-incubation by lactic acid bacteria, affected the cell possibility of probiotic bacteria. Also, **Fan et., al. (2020)** showed that *Lactobacillus Plantarum* has highest the pH and lowest from 5.03 to 3.62. Oxidation activity slightly reduced during the cell count of lactobacillus fermentation (48 hours at 30 °C), **Huynh et al., (2014)** estimated that the pH decreased because the growth of these microbes might stimulate cellulolytic and release of phenols.

Total soluble solids (TSS) ratio and viscosity (centipoise)

Table (4) showed the determination in total soluble solids (TSS) of the probiotic turnip juice. The results demonstrated an increase in (TSS%) for controlling fresh turnip juice without additions in all storage periods compared with turnip juice probiotic. While turnip juice probiotic samples lowered after 14 days especially turnip juice probiotics containing 15% banana juice (S3) due to their sugar consumption the main causing of TSS decrease during storage. These results agree with **Di Cagno et al., (2011)** who showed Lactic acid produced in vegetable juice through the fermentation of sugars by probiotics and estimated the value of soluble solids, hence slight differences in the sugar and organic acid rate produced by fermentation**.**

In addition, Table (4) demonstrated the viscosity values of the probiotic turnip juice of S3 was (990 cps), S2 was (980 cps) at zero times however a significant difference was observed compared to the control sample (950 cps). The viscosity was regularly increased during the storage period to reaching a highest point after 14 days S3 was (985 cps), S2 was (972cps) and the lowest level was observed in control samples (932) cps. These data are in similar to **Costa et al., (2017)** who showed that, the fruit juices fermented with *Lactobacillus species* to produce polysaccharides due to rising the viscosity of the final product and ingredients of the juice. Also, these results are stable with those reported by **Huisint (1996),** who designated that, the rising viscosity of the fresh turnip juice during storage might be causing the highest bacteria load, molds and yeasts, that led to spoilage of the juice and increase its viscosity.

Antioxidant content

The results in the total phenolics, flavonoid compounds contents, and antioxidant activity of turnip juice probiotic during storage is exposed in Table (5). There was no significant difference ($p< 0.05$) between TPC contents for both turnip juice samples. It could be noted that turnip juice probiotic containing 15% banana juice (S3) had the highest level of total phenolics, total flavonoids, DPPH, and the lowest level of IC50 at (206.11 mg/100, 12.91 mg/100, 83.92% and25.31mg/ml) respectively compared to the control fresh turnip juice without additions. **Ali and Naz (2017),** reported that the phenolics content, flavonoids content, DPPH and IC50 in turnip pulp were 4.051 (mg/g), 2.889 (%),5.095 (mg/ml) and IC50 5.114±0.0125 (mg/ml), respectively. **Kaur and Kapoor (2002),** found that total phenolic content in turnip was 127.0 mg/100g. **Pontonio et al., (2019)** estimated that fermented pomegranate juice increased the antioxidant activity by more than40% compared to unfermented pomegranate juice. **Dimitrovski et al., (2015),** showed that increased antioxidant compounds, such as polyphenols are raised causing the fermentation by the LAB. On the other hand, **Batista et al. (2011)** submitted that the turnip phenolic concentration due to natural insecticides serves to advance the resistance beside different parasites and diseases. These results are in similar to **Cristina et al., (2019)** who described the development of the probiotic bacteria in the juice was significantly and improved all phenols compounds specifically flavonoid compounds.

Effect of probiotic turnip juice on color qualities during storage

Table (6), presents the L*, a*, and b* color values through the storage period. lightness (L*) values were the highest in all samples at 7 days of storage while after 14 days lowest expect S3 (100.69) highest. Greenness (a*) rats were the lowest for all samples of turnip juice probiotic at 7 days of storage compared with the control sample turnip juice fresh. While at 14 days highest value in samples (turnip juice fresh) was C 1.21. Yellow-ness (b*) values were the highest in samples with Turnip juice probiotic containing 15% banana juice (S3) at 7 and 14 days of storage compare with all samples. Metabolism of bacteria needs to be carotenoids that affect fermentation conditions such as temperature and pH. The data agree with **Kun et al. (2008),** who showed that the storage period due to lowing in b-carotene that oxygen in headspace caused the degradation of b-carotene. **Bonsai et al., (2013),** indicated that color, known as the freshness of the product, and the quality of the storage conditions have benefited the consumers. These results decide with **Ahmed et al., (2020),** who explained the differences' in color standards of probiotic dairy drinks through storage may be causing the variations in pH as by increased acidity and growing the bacteria cultures.

Effect of probiotic turnip juice on sensory evaluation during storage

Sensory evaluation of results for probiotic turnip juice during the storage period is shown in Table (7). The presented results presented that, all samples were changes significantly in the odor, flavor, texture, and overall acceptability of probiotic turnip juice during storage. While color scores had not significant in all treatments after 14 days of storage. The total acceptability of all juices of probiotic turnip was decreased differently. These results similar to **Ellendersen et al., (2012)** who exposed that adding to probiotic with juices is product acceptability of consumers. **Francesca et al., (2021)** observed that acidity, as the acid sense in found products excites by consumer. The consumer quality for choosing vegetables not only concerns the nutritional aspects but comprises the sensorial considerations for numerous indicators. The current study demonstrates that could be developed more types of vegetable juices by lactic acid fermentation. These results agree with **Gardner et al. (2001) and Vamanu, (2015),** they reported lactic acid bacteria can be found in the gut system and are useful and good health.

Microbiological analysis of probiotic turnip juice during storage

The microbial activity on probiotic turnip juice during was evaluated in Table (8). The results showed that the initial probiotic concentration was 22.5±0.57 log CFU/mL. After 14day fermentation, observed that the probiotic concentration was increased to 28±1 log CFU/mL during storage periods, although there was significant change in all samples. Probiotic bacteria due to the reduction of nutrients (sugar) and is accompanied by an increase in lactic acid. These results un agreement with **Fan et al., (2020).** who reported that the highest cell concentration of probiotics in the mixed vegetable juice during fermentation was 9.13 ± 0.19 log

CFU/mL. **Nazzaro et al., (2008**) observed that the nutrient in the vegetable juice is basic for metabolism and reproduction of the microorganism. These results similar to **Rosa et al., (2001),** they reported that the number of bacteria gradually increased for vegetable juice fermentation.

CONCLUSION

Vegetables are naturally rich in phenolic compounds, flavonoids, and vitamins. Vege-table juice could be used for the delivery of probiotics. The consumption of turnip juice probiotics has beneficial health and nutritive value and changes chemicals, physical and sensory prefer benefits of the optimal quality. On the other hand, turnip juice probiotic was the approved potential for production and the overall acceptability was high significantly. Turnip juice probiotic is functional juice and healthy foods that could be presented as probiotic products.

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Table (1A) Effect of protein contents on probiotic turnip juice during storage period

Samples	Crude Protein (% of D.W)		
	First d	**7d**	**14d**
Cont.	1.94±0.04^{d}	2±0.1^{b}	2.09±0.09^{b}
S1	2.22±0.02^{c}	2.31±0.3^{ab}	2.41±0.4^{ab}
S2	2.52±0.02^{b}	2.63±0.03^{ab}	2.75±0.05^{ab}
S3	2.86±0.06^{a}	2.97±0.03^{a}	3.05±0.05^{a}

Values with different superscript letters in the same column are significantly different at P≤0.05. ***Cont.*** *Control fresh turnip juice without additions* ***S1****: Turnip juice probiotic containing 5% banana juice,* ***S2:*** *Turnip juice probiotic containing 10% banana juice* ***S3****: Turnip juice probiotic containing 15% banana juice*

Table (1B) Effect of carbohydrate contents on probiotic turnip juice during storage period

Sam-ples	Crude Carbohydrate (% of D. W)								
	Reduced sugars			Non-Reduced sugars			Total sugars		
	First d	7d	14d	First d	7d	14d	First d	7d	14d
Cont.	2.2±0.2^{b}	2.26±0.06^{c}	2.32±0.3^{c}	1.2±0.2^{a}	1.08±0.08^{b}	0.99±0.04^{b}	3.4±0.1^{c}	3.34±0.04^{c}	3.31±0.3^{c}
S1	3.34±0.3^{a}	3.39±0.1^{b}	3.51±0.2^{ab}	0.78±0.02^{ab}	0.71±0.01^{a}	0.44±0.04^{a}	4.12±0.06^{b}	4.1±0.1^{b}	3.95±0.1^{b}
S2	3.6±0.1^{a}	3.81±0.1^{a}	3.96±0.1^{a}	1.04±0.04^{ab}	0.75±0.05^{a}	0.5±0.02^{a}	4.64±0.1^{a}	4.56±0.06^{a}	4.46±0.1^{a}
S3	3.72±0.2^{a}	3.98±0.1^{a}	4.15±0.15^{a}	1.09±0.09^{b}	0.75±0.05^{a}	0.51±0.03^{a}	4.81±0.1^{a}	4.73±0.1^{a}	4.66±0.1^{a}

Values with different superscript letters in the same column are significantly different at P≤0.05. ***Cont.*** *Control fresh turnip juice without additions* ***S1****: Turnip juice probiotic containing 5% banana juice,* ***S2:*** *Turnip juice probiotic containing 10% banana juice* ***S3****: Turnip juice probiotic containing 15% banana juice*

Table (2) Changes in vitamin C and folate contents of probiotic turnip juice during storage

Sam-ples	Vit. C mg/ 100ml juice			Folate µg/ 100 ml juice		
	First d	7d	14d	First d	7d	14d
Cont.	21.12±0.12^{a}	20±0.2^{a}	19.43±0.03^{a}	90.32±0.3a	89.46±0.06a	89±0.1a
S1	19.05±0.05^{b}	18.46±0.06^{b}	18.14±0.14^{b}	85.23±0.23b	83.25±0.25b	83.04±0.04b
S2	18.24±0.04^{c}	18±0.1^{c}	17.85±0.05^{c}	84.04±0.04c	82.45±0.05c	82.12±0.12c
S3	17.83±0.33^{c}	17.12±0.12^{d}	17.01±0.01^{d}	82.45±0.05d	81.13±0.13d	80.79±0.09d

Values with different superscript letters in the same column are significantly different at P≤0.05. ***C.*** *Control fresh turnip juice without additions* ***S1****: Turnip juice probiotic containing 5% banana juice, S****2:*** *Turnip juice probiotic containing 10% banana juice* ***S3:*** *Turnip juice probiotic containing 15% banana juice*

Table (3) Effect of pH and acid value during turnip (*Brassica rapa*) juice storage

Samples	pH			Acid Value		
	First d	**7d**	**14d**	**First d**	**7d**	**14d**
C.	4.7±0.03[a]	4.3±0.01[a]	4.2±0.01[a]	0.33±0.002[c]	0.36±0.001[c]	0.37±0.001[d]
S1	4.5±0.05[b]	4.3±0.01[a]	4.1±0.1[a]	0.35±0.005[b]	0.36±0.001[c]	0.38±0.005[c]
S2	4.2±0.01[c]	4.1±0.1[b]	4±0.1[ab]	0.37±0.001[a]	0.38±0.005[b]	0.39±0.001[b]
S3	4.2±0.01[c]	3.9±0.1[c]	3.7±0.05[c]	0.37±0.001[a]	0.4±0.001[a]	0.41±0.001[a]

Values with different superscript letters in the same column are significantly different at P≤0.05.
***C.** Control fresh turnip juice without additions **S1**: Turnip juice probiotic containing 5% banana juice, **S2:** Turnip juice probiotic containing 10% banana juice **S3**: Turnip juice probiotic containing 15% banana juice*

Table (4) Effect of TSS ratio and viscosity on probiotic turnip juice during storage

Samples	**TSS mg/ 100ml juice**			**Viscosity (cps)**		
	First d	**7d**	**14d**	**First d**	**7d**	**14d**
Cont.	7±1.7 b	13±1.7 a	14±1.5 a	950±1 [d]	940±0.5 [d]	932±2 [d]
S1	9±1.5 a	12±1.5 b	11.5±1.5 b	970±1 [c]	965±2 [c]	960±2 [c]
S2	9±1.5 a	11.5±0.5 c	11±0.5 b	980±1 [b]	977±1 [b]	972±2 [b]
S3	9±1 a	11±0.5c c	10.5±0.5 c	990±1 [a]	988±2 [a]	985±2 [a]

Values with different superscript letters in the same column are significantly different at P≤0.05.
***C.** Control fresh turnip juice without additions **S1**: Turnip juice probiotic containing 5% banana juice, **S2:** Turnip juice probiotic containing 10% banana juice **S3**: Turnip juice probiotic containing 15% banana juice*

Table (5) Effects of total phenolics, flavonoids compounds (TPC) and antioxidants activity of probiotic turnip juice probiotic during storage

Samples	TPC mg/100 turnip juice			TFC mg/100 turnip juice		
	First d	7d	14d	First d	7d	14d
Cont.	205±0.5[a]	204.2±1.2[a]	203.91±1.01[a]	13.03±1[a]	12.9±0.4[a]	12.5±0.5[a]
S1	207±1.5[a]	205.46±1.02[a]	205±0.5[a]	12.85±0.8[a]	12.71±0.2[a]	12.31±0.31[a]
S2	207.85±0.8[a]	205.85±0.8[a]	204.83±0.23[a]	12.83±0.8[a]	12.62±0.6[a]	12.02±0.12[a]
S3	209.14±1[a.a]	207.41±0.41[a]	206.11±0.11[a]	13.25±0.25[a]	13.05±1.05[a]	12.91±0.09[a]
	% Scavenging activity			SC50		
Cont.	79.57±1[a]	80.15±0.15[b]	80.88±0.8[a]	27.12±0.1[b]	26.58±0.5[a]	26.41±0.41[a]
S1	78.1±1.05[a]	80.05±0.15[b]	81.94±1.04[a]	27.86±0.06[ab]	26.71±0.2[a]	26.04±0.14[a]
S2	78.1±1.05[a]	81.45±0.45[ab]	82.45±0.45[a]	27.85±0.05[ab]	26.14±0.14[a]	25.81±0.31[a]
S3	76.5±1.5[a]	83.73±0.2[a]	83.92±0.9[a]	29.12±0.12[a]	25.89±0.11[a]	25.31±0.31[a]

Values with different superscript letters in the same column are significantly different at P≤0.05.
***C.** Control fresh turnip juice without additions* ***S1**: Turnip juice probiotic containing 5% banana juice*
***S2:** Turnip juice probiotic containing 10% banana juice* ***S3**: Turnip juice probiotic containing 15% banana juice*

Table (6) Effect of probiotic turnip juice on color qualities during storage

Color	Zero-Time			7-Days			14-Days		
	*L**	*a**	*b**	*L**	*a**	*b**	*L**	*a**	*b**
C	44.96±1.3a	0.95±0.2c	16.65±0.9 [b]	93.13±0.9c	0.97±0.1c	3.02±0.3 [d]	92.04±1.2c	-1.21±0.4c	0.87±0.2 [d]
S1	39.94±0.5c	2.65±0.3 [b]	17.13±0.5a	89.35±0.9 [d]	-1.33±0.1 [b]	6.05±0.2c	85.94±1.2 [d]	-1.9±0.1c	5.07±0.5c
S2	37.6±1.2 [d]	5.16±0.4a	16.33±0.8 [b]	97.81±1.1b	3.68±0.3a	15.69±1 [b]	97.72±1.5b	2.36±0.5 [b]	12.47±0.5 [b]
S3	40.45±1.8 [b]	4.53±0.5a	17.86±0.4a	99.87±1.2a	3.47±0.7a	18.65±1a	100.69±0.9a	3.52±0.1a	18.67±0.8a

Values with different superscript letters in the same column are significantly different at P≤0.05. ***C.** Control fresh turnip juice without additions* ***S1**: Turnip juice probiotic containing 5% banana juice,* ***S2:** Turnip juice probiotic containing 10% banana juice* ***S3**: Turnip juice probiotic containing 15% banana juice*

Table (7) Effect of probiotic turnip juice on sensory evaluation during storage on sensory evaluation

	Sensory Evaluation				
Samples	**Color**	**Odor**	**Flavor**	**Texture**	**Overall acceptability**
1C	8.8±1.3a	7.4±0.8b	7.2±1.3a	7.6±1.8b	7.4±1.5a
1S1	8.2±0.8a	7.6±1.1b	7±1.8a	7.8±1.6b	7±1.8b
1S2	7.4±2.1b	8.4±1.3a	7.2±2.4a	8.6±0.5a	7.4±2.3a
1S3	7.6±1.9b	8.4±1.3a	7.2±2.4a	8.2±1.9a	7.6±2.5a
2C	8.4±1.5a	7.2±0.4c	6.2±1.4c	7.6±1.3c	8±1c
2S1	7±1.8c	7.8±0.8b	6.6±2.3c	8±1.2b	8.8±0.8ab
2S2	7.8±1.6b	8.2±0.4a	7.2±1.9b	8.4±1.5a	8.4±0.8b
2S3	7.6±1.6b	8.2±0.8a	7.8±1.3a	8.4±1.5a	9±0.7a
3C	9.75±0.5a	8±0.8b	8±0.1b	8.5±0.5b	8±0.8c
3S1	9.5±0.5a	8.75±0.9a	8.25±0.9b	9.5±0.5a	8.75±0.9b
3S2	9.5±0.5a	8.75±0.5a	8.75±1.2a	9.5±0.5a	9±1.5a
3S3	9.25±0.5a	9±0.8a	8.75±1.2a	9.75±0.5a	9.25±0.9a

Values with different superscript letters in the same column are significantly different at P≤0.05. ***C.*** *Control fresh turnip juice without additions* ***S1****: Turnip juice probiotic containing 5% banana juice* ***S2:*** *Turnip juice probiotic containing 10% banana juice* ***S3****: Turnip juice probiotic containing 15% banana juice*

Table (8) Effects of microbial activity on probiotic turnip juice during storage

Samples	(T.C) Zero-Time $\times 10^{-3}$	(T.C) After 7-Days $\times 10^{-5}$	(T.C) After 14-Days $\times 10^{-6}$
Cont.	22.5 ± 0.5^{ab}	24 ± 1^{c}	23.5 ± 0.5^{b}
S1	23.5 ± 0.5^{a}	25.5 ± 0.5^{b}	23.5 ± 0.5^{b}
S2	22.5 ± 0.5^{ab}	25.5 ± 0.5^{b}	26.5 ± 0.5^{a}
S3	22 ± 0.5^{b}	27 ± 1^{a}	28 ± 1^{a}

Values with different superscript letters in the same column are significantly different at P≤0.05.
C. *Control fresh turnip juice without additions* ***S1****: Turnip juice probiotic containing 5% banana juice,* ***S2:*** *Turnip juice probiotic containing 10% banana juice* ***S3****: Turnip juice probiotic containing 15% banana juic*

دراسة الخصائص الفيزوكيميائيه والحسيه والميكروبيه ومضادات الاكسدة لعصير اللفت خلال فترات التخزين

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الملخص العربي

الفلافونويد والكاروتينات ومضادات الأكسدة والفيتامينات C و E وفيرة في اللفت. لتقييم الخواص الوظيفية ، خضع عصير اللفت لاختبارات كيميائية وفيزيائية كيميائية وحسية وميكروبيولوجية مع إضافة بكتيريا بروبيوتيك ، ومع / بدون إضافة عصير الموز بنسبة 5 و 10 و 15٪ خلال فترات التخزين (1 ، 7 و 14 يومًا) عند درجة حرارة الثلاجة (4 درجات مئوية). عصير اللفت الضابط كان مع بكتيريا بروبيوتيك بدون عصير. أظهرت النتائج ارتفاع مستوى السكر الكلي بعد إضافة عصير الموز ولكنه انخفض مع فترات التخزين الأطول. مع مرور الوقت ، يزداد مستوى البروتين في عصير اللفت والبروبيوتيك مع أو بدون الموز. 100 مل من العينات وجميع الأنواع العصير احتوت على 17-21 ملجم من فيتامين ج. مع المزيد من عصير الموز الإضافي وفترات التخزين الأطول ، انخفض حمض الفوليك في جميع أنواع العصائر بنسبة 11% مقارنة بالعصير الضابط. مع وقت تخزين أطول وحموضة أكثر ، فإن عصير البروبيوتيك الذي يحتوي على 15٪ من عصير الموز كان له لون قياسي. التقييمات الحسية في جميع المنتجات كانت مقبولة. مركبات الفلافونويد والفينول كانت غنية بالبروبيوتيك عصير اللفت. أظهر الفحص الميكروبيولوجي أن العدد الكلي زاد عند إضافة 10٪ أو 15٪ من عصير الموز بعد 14 يوم. في الختام ، يمكن أن يؤدي الجمع بين عصير اللفت وعصير الموز إلى تسريع تطوير البروبيوتيك وزيادة قيمتها الغذائية وفوائدها الصحية. وبالتالي ، يجب أن يشجع إنشاء العصائر التجارية على استخدام البروبيوتيك في المنتجات.

الكلمات المفتاحية : الفينولات الكلية – الفلافونويد الكلية –التحليلات المكروبيولوجية –تحليلات اللون – فيتامين C