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PREPARATION AND PROPERTIES OF FUNCTIONAL BEVERAGES BASED ON PROBIOTIC MILK PERMEATE WITH CARROT OR MANGO PULPS

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SUMMARY

Preparation and properties of novel beverages based on fruits pulps and probiotic milk permeate were investigated. Milk permeate was fermented with the use of 2% of a mixed starter culture (1:1:1) containing *Lactobacillus delbrueckii* subsp *bulgaricus*, an exopolyscharide (EPS) strain of *Streptococcus thermophilus* and a probiotic *Bifidobacterium longum*. Sucrose (5%) was added to the milk permeate then it divided into two portions: the 1st was kept unheated and the 2nd was heated (85°C/15min). Each portion was divided into two equal portions and mixed separately with equal volumes of carrot or mango pulp, filled in sterilized bottles and stored at ~4°C for 30 days. Prepared beverages were evaluated for vitamin C, carotenoids, total phenols, total flavonoids and anthocyanin contents and for their total antioxidant activities. Beverages were also analyzed for their physicochemical parameters, rheological, microbiological and sensory characteristics during storage. The results revealed that milk permeate to be a good source of Ca, P, Na, K and Mg contents. The total solid, ash, fat, protein, fiber contents and acidity were slightly increased, while the total carbohydrate, antioxidant activity, total phenols, total flavonoids, vitamin C, anthocyanin; and carotenoids contents and pH value were decreased during cold storage of prepared beverages. Using mango or carrot greatly increased Ca, P, Na, K, Mg, Fe, Cu and Zn contents in the produced beverages. The prepared unheated fermented beverages retained probiotic counts higher than recommended number (6 log $cfug^{-1}$) to achieve their potential beneficial effect up to the end of storage. Sensory evaluation revealed that the developed functional beverages were characterized by high acceptability.

Key word: Functional beverages, Milk permeate, Mango, Carrot, Probiotic bacteria, polysaccharides.

INTRODUCTION

Fermented dairy beverages are usually made by adding a flavoring agent to fermented milk and whey. They are characterized by high nutritional value majorly, due to the presence of protein of high biological value particularly that derived from whey (Sanmartin *et al.*, 2011).The growing production of dairy beverages worldwide can be attributed to the simple technology used in their production and the wide acceptance by consumers. Also, whey beverages can be considered as economically feasible way of whey utilization (Hernandez-Ledesma *et al.*, 2011). In addition, lactic acid bacteria (LAB) produce different inhibitory substances that can prolong the shelf life of the fermented products. In the mean time, lactose reduction, in the fermented dairy beverages is an effective way to combat lactose intolerance; a serious problem for a significant sector of consumers (Geilman *et al.*, 1992).

Probiotics are live microorganisms which when administered in adequate amounts confer a health benefit on the host (FAO/ WHO, 2002) by improving microbial balance in the host's gut flora and defenses against pathogenic microorganisms. Other species specific benefits attributed to pro-biotics include prevention of cancer, stimulation of the immune system, lowering of serum cholesterol levels, and improvement of vitamin synthesis (Heenan *et al.*, 2004). The species which are most frequently used as probiotics belong to the genera Lactobacillus and Bifidobacterium (Isolauri, 2004).

The consumption of a diet rich in fresh fruits and vegetables has been associated with a number of health benefits including potential reduction in the incidence of chronic diseases (WHO, 2003). Food several natural biologically active compounds are found in fruits and vegetables such as polyphenols, vitamin C or β-carotene, anthocyanins, and flavones. The antioxidant activities of these constituents are of great value to human health. Adequate level of antioxidants supplied with diet can induce immunological processes and increase defensive abilities of cell in a proper way (Kalt, 2005).

In addition, these photochemical exhibit potential health roles in the reduction of platelet aggregation, blood pressure, cardiovascular of disease and modulation of cholesterol synthesis and absorption (Li, 2008).

Carrot (*Dauces carrot* L) is a favourite vegetable from a long time, due to their nutritive value and culinary uses. Carrot is generally rich in antioxidants such as vitamin A, C, and E, β-carotene and polyphenols compounds (Luciano *et al.*, 2009). Mango (*Mangifera indica* L.) is one of the most important and widely cultivated fruit of the tropical and subtropical regions of the world due to its succulence, exotic flavour and delicious taste (Hooper, 1995).

The present work was carried out to study physico-chemical properties of beverages prepared from milk permeate enriched with carrot and mango pulps. Also, the nutriational values of these beverages were evaluated by determination of their antioxidants, total phenolics, total flavonoids, vitamin C, carotenoids and anthocyanin.

MATERIALS AND METHODS

Materials:

Milk permeate was obtained from the ultrafiltration of buffalos milk using Carbosep, UF unit (SFEC, France) at the Animal Production Research Institute, Agriculture Research Center. *Lactobacillius delbrueckii* subsp *bulgaricus* DSM 20080, *Bifidobacterium longum* DSM 20088 and the exopolysaccharides (EPS) producing strain *Streptococcus thermophilus* ASCC 1275 were kindly obtained from the Institute of Microbiology, Federal Research Center for Nutrition and Food, Kiel, Germany. Commercial grade sugar cane, carrot (*Dauces carrot* L) and mango (*Mangifera indica* L.) were purchased from the local market. The chemical composition, antioxidant activity, total phenolics and total flavonoids of raw materials used for manufacture of the tested functional beverages are presented in Table (1).

Methods:

1. Preparation of fruit pulp:

Carrot and mango were washed thoroughly, carrot was peeled while, the stones of mango were removed and the flesh was cut into "small pieces". The prepared fruits flesh were then blanched at 80°C for 10 min. The blanched materials were transferred separately to a blender and homogenized to form a homogeneous pulp paste, packed in plastic bags, sealed and stored frozen at -20°C until used (Gupta, 1998).

2- Fermentation of milk permeate:

Milk permeate was warmed up to 40°C, sucrose was added at the ratio of 5g/100 ml, heated to 85°C for 15 min and then rapidly cooled. The sweetened milk permeate was inoculated with 2% of mixed (1:1:1) starter culture: *Lb. delbrueckii* subsp *bulgaricus*, *Bif. longum* and *Str. thermophilus*, incubated at 42°C until the pH was decreased to 5 and rapidly cooled to ~4°C (Aumara 2000).

3. Preparation of the functional beverages:

Preliminary experiments were carried out to select the best formulation for the target beverages when fermented permeate (25, 50 and 75%), was mixed with fruit pulp (75, 50 and 25%), respectively and sensory evaluated. Mixing equal quantities of the fermented permeate and fruit pulp gave beverages that ranked the highest sensory scores, which were chosen for further study.

Table (1): Chemical composition and antioxidant activity of raw materials used in prepared functional beverages.

Components	Carrot pulp	Mango pulp	Milk permeate
Total solids %	11.12 b	15.92 a	5.68c
Ash %	0.71 a	0.65 b	0.26c
Fat %	0.48 a	0.40 a	0.10b
Protein %	1.01 a	0.90 b	0.22c
Total sugars %	8.11b	12.80 a	5.01c
Fiber %	1.03 c	0.90 b	ND
Titratable acidity % (as lactic acid)	0.19 b	0.51a	0.09 c
pH values	6.17 b	4.28 c	6.44 a
Antioxidant activity (mg $100g^{-1}$)	11.04 b	90.54 a	10.95 c
Total phenols (mg $100g^{-1}$)	10.00 b	75.20 a	ND
Total flavonoids (mg $100g^{-1}$)	2.01 b	9.52 a	ND
Ascorbic acid (mg $100g^{-1}$)	10.37 b	39.05 a	ND
Anthocyanin (mg $100g^{-1}$)	0.23 a	ND	ND
Carotenoids (mg $100g^{-1}$)	30.12 a	5.21 b	ND

ND = Not detected

Fermented milk permeate (FMP) was divided into two equal portions; the first was kept unheated and the second was heated (85°C/15min). Functional beverages were prepared as follows:

Aliquots of 4 kg of each unheated (C1) and heated (C2) FMP were kept as control. Aliquots of 2 kg of each unheated (T1) and heated (T3) FMP were mixed separately with equal volume of carrot pulp. Also, 2 kg portions of unheated (T2) and heated (T4) fermented permeates were mixed separately with equal volume of mango pulp. The prepared beverages were filled into sterilized bottles, stored at ~4°C and were analyzed chemically, microbiologically and sensory evaluated when fresh and after 10, 20 and 30 days of storage. Also, the apparent viscosity of the fresh beverages was measured. The experiment was repeated three times and all analyses were carried out in duplicate.

Chemical analysis:

The total solids, fat, ash, total protein, total sugars, crude fiber and ascorbic acid contents were determined according to the methods described by AOAC (2000). Titratable acidity and pH values were determined according to BSI (2010). Carotenoids were determined according to Harvey and Catherine (1982). Minerals content were determined according to AOAC (2000) using Perkin-elmer, 2380 Atomic absorption spectrophotometry. Antioxidant activity, total phenolic, flavonoids and anthocyanin contents were determined according to the methods described by Prieto *et al.* (1999), Shiri *et al.* (2011), Bor *et al.* (2006) and Cordenunsi *et al.* (2002), respectively.

Microbiological examinations:

Lactic acid bacteria (LAB), yeasts and moulds and colifrom bacterial counts were enumerated according to Elliker *et al.* (1956), IDF (1990) and APHA (1992), respectively. *Lb. delbrueckii* subsp. *bulgaricus*, *Str. thermophilus* and *bifidobacterium* sp. were enumerated according to the methods described by Ryan *et al.* (1996) and Martin and Chou (1992), respectively.

Sensory evaluation:

The sensory evaluation of beverages was done by a taste panel of 10 experienced panelists from the staff-members of Food Science Department, Faculty of Agriculture, Moshtoher, Benha Univ. The samples were evaluated for taste, odour, body and texture, appearance, sweetness, acidity and colour out of 20, 20, 20, 10, 10, 10 and 10 score points (Fellers *et al.*, 1986 and Bodyfelt *et al.*, 1988).

Measurement of viscosity:

The apparent viscosity (mPa.s) of the prepared beverages was measured using a

Brookfield viscometer Model DV11 + Pro (Brookfield unit, MA, USA) at 25°C with a rotation speed of 60 rpm.

Statistical analysis:

Statistical analysis for the obtained data was carried out according to the methods of Clarke and Kempson (1997).

RESULTS AND DISCUSSION

Physicochemical composition:

Table (2) shows the physicochemical composition of the prepared functional beverages during storage up to 30 days at ~4°C. The total solids, ash, fat and protein contents increased slightly in all treatments during the storage periods. Generally, there were significant differences ($P \leq 0.05$) in all these parameter between beverages from different treatments during the storage. The slight increase of total solids during storage may be attributed to the loss of some moisture content during the cold storage. These results are in accordance with that of Hashmi *et al.* (2011) and Atallah (2015).

Table (2): Physicochemical composition of the prepared functional beverages during storage periods at ~4°C.

Treatments	Total solids%	Ash %	Fat %	Protein %	Total carbohydrates%	Acidity %	pH	Fiber %
Fresh								
C1	9.10dA	0.27cC	0.11bA	0.37cB	7.59fA	0.85bD	4.20fA	ND
C2	9.15dA	0.28cC	0.12bA	0.39cB	7.68eA	0.75fD	4.49aA	ND
T1	13.11aA	0.33bC	0.21aA	0.50bB	11.12bA	0.88aD	4.18eA	0.45cA
T2	12.62bA	0.38aC	0.23aA	0.53aB	9.89dA	0.84cD	4.24dA	0.49bA
T3	13.22aA	0.33bC	0.22aA	0.50bB	11.20aA	0.84dD	4.25cA	0.46cA
T4	12.77bA	0.39aC	0.23aA	0.54aB	10.00cA	0.76eD	4.39bA	0.55aA
10 days								
C1	9.30dA	0.29cB	0.11bA	0.38cB	7.50fB	0.90bC	4.12fB	ND
C2	9.27dA	0.31cB	0.12bA	0.39cB	7.61eB	0.77fC	4.40aB	ND
T1	13.15aA	0.35bB	0.23aA	0.51bB	10.84bB	0.94aC	4.09eB	0.47cA
T2	12.68bA	0.44aB	0.23aA	0.55aB	9.02dB	0.89cC	4.10dB	0.50bA
T3	13.23aA	0.35bB	0.23aA	0.52bB	11.00aB	0.89dC	4.12cB	0.48cA
T4	12.81bA	0.42aB	0.23aA	0.55aB	9.90cB	0.79eC	4.28bB	0.56aA
20 days								
C1	9.31dA	0.31cA	0.12bA	0.39cB	7.50fC	1.05bB	3.95fC	ND
C2	9.28dA	0.31cA	0.13bA	0.40cB	7.60eC	0.83fB	4.27aC	ND
T1	13.15aA	0.35bA	0.24aA	0.52bB	10.12bC	1.12aB	3.74eC	0.49cA
T2	12.71bA	0.45aA	0.25aA	0.56aB	8.87dC	1.00cB	3.89dC	0.52bA
T3	13.24aA	0.36bA	0.24aA	0.52bB	10.91aC	0.87dB	4.08cC	0.50cA
T4	12.80bA	0.42aA	0.24aA	0.56aB	9.80cC	0.85eB	4.25bC	0.58aA
30 days								
C1	9.31dA	0.31cA	0.12bA	0.39cA	7.45fD	1.17bA	3.70fD	ND
C2	9.28dA	0.32cA	0.13bA	0.40cA	7.56eD	0.90fA	4.15aD	ND
T1	13.16aA	0.36bA	0.24aA	0.52bA	9.98bD	1.23aA	3.61eD	0.49cA
T2	12.72bA	0.45aA	0.25aA	0.56aA	8.00dD	1.16cA	3.60dD	0.53bA
T3	13.24aA	0.36bA	0.24aA	0.53bA	10.34aD	0.91dA	4.02cD	0.50cA
T4	12.90bA	0.42aA	0.24aA	0.56aA	9.57cD	0.92eA	4.10bD	0.58aA

C1 = Control 1 (unheated FMP) C2 = Control 2 (heated FMP) ND= Not detected
T1 = 50% unheated FMP + 50% mango pulp T2 = 50% unheated FMP + 50% carrot pulp
T3 = 50% heated FMP + 50% mango pulp T4 = 50% heated FMP + 50% carrot pulp

The total carbohydrate of the prepared functional beverages significantly decreased ($P \leq 0.05$) during storage at ~4°C up to 30 days. Also, there were significant differences ($P \leq 0.05$) between total carbohydrates in the different treatments during storage period. This decrease may be due to the microbial fermentation. The results were in agreement with those reported by Atallah (2015).

The prepared beverages from unheated FMP showed higher acidity and lower pH ($P \leq 0.05$) than that prepared from heated FMP throughout the storage period which can be explained the higher total viable count in the unheated treatments. However in both the heated and unheated beverages, acidity was increased and pH decreased during cold storage, which can be attributed to the activity of the occurring microorganism in all samples (Table 2). These results confirm those obtained by Hegazi *et al.* (2009).

The fiber content of fresh T1 to T4 beverages varied from 0.45 to 0.55%, and remained almost unchanged during storage (Table 2). The fiber in all beverages was less than 5%, which indicates that there was no adverse effect on the nutrient utilization. Gronowska-Senger *et al.* (1980) found that the presence of 5% fiber in the diet had a positive effect on carotene utilization whereas 10 to 20% had a negative effect.

Antioxidant activity and biologically active compounds:

The results in Table (3) indicated that the antioxidant activity, total phenols, total flavonoids and ascorbic acid contents of the mango beverage were significantly ($P \leq 0.05$) higher than that of carrot beverage. However, the biologically active compounds and antioxidant activity were significantly decreased ($P \leq 0.05$) during cold storage, due to their low stability. The results are in agreement with those given by Ma *et al.* (2013).

On the other hand, carrot beverage showed the highest ($P \leq 0.05$) carotenoids and anthocyanin contents followed by that containing mango. The anthocyanin and carotenoid contents of the prepared functional beverages decreased gradually ($P \leq 0.05$) during storage period. The obtained results are in agreement with that of Chun *et al.* (2005) and Mehriz *et al.* (2013). Fruits and vegetables have always been considered an essential part of a healthy diet, with respect to its vitamin C and β-carotene contents (Li, 2008).

Mineral contents of prepared functional beverages:

Data in Table (4) revealed that the highest ($P \leq 0.05$) K, Na, Z and Cu contents were found in mango beverage due to the high percentage of these minerals in mango pulp. The Ca and P contents were slightly but significantly different ($P \leq 0.05$) between all treatments, as Ca content ranged between 29.00 to 54.00 mg $100g^{-1}$, and P contents between 20.20 to 29.03 mg $100g^{-1}$. Fermented permeate was responsible for the relatively high Ca and P of the prepared beverages due to its high contents of these elements. Results also indicated that carrot beverage recorded higher content of Mg and Fe, than those of other treatments, due to the variable contents of these elements in the used ingredients.

From the results of minerals it could be concluded that the prepared functional beverages can be considered a good source for some of these minerals. Trace elements are essential for growth and development, wound, healing, immunity and other physiological processes (Miller, 2000). These results are closely agreed with those reported by (Miller, 2000 and Atallah, 2015).

Microbiological properties:

Fig (1) indicates significant differences ($P \leq 0.05$) in the microbiological quality of beverages from unheated and heated FMP, and control sample during cold storage. The LAB counts gradually decreased up to the end of the storage period. Different LAB microorganisms were not detected in heated FMP and heated fermented beverages throughout the storage. The *Str. thermophilus* and *Lb. delbrueckii* subsp. *bulgaricus* counts of fresh products from unheated beverages decreased gradually ($P \leq 0.05$) and not detected in heated FMP, and heated fermented beverages during storage up to 30 days, due to their sensitivity to the developed acidity in the product (Atallah, 2015).

Table (3): Antioxidant activity and biologically active compounds of prepared functional beverages during storage periods at ~4°C (mg $100g^{-1}$).

Treat-ments*	Antioxidant activity	Total phenols	Total flavonoids	Ascorbic acid	Anthocyanin	Carotenoids
Fresh						
C1	11.02eA	ND	ND	ND	ND	ND
C2	11.03eA	ND	ND	ND	ND	ND
T1	34.23cA	35.23aA	3.70aA	14.10aA	ND	2.56bA
T2	15.98aA	4.32cA	1.07bA	4.05cA	0.14aA	17.87aA
T3	32.63dA	33.54bA	3.65aA	13.23bA	ND	2.54bA
T4	15.56bA	4.00dA	1.05bA	3.87dA	0.13aA	17.80aA
10 days						
C1	10.86eA	ND	ND	ND	ND	ND
C2	10.85eA	ND	ND	ND	ND	ND
T1	33.61cA	34.65aA	3.66aA	13.91aB	ND	2.54bA
T2	15.50aA	4.18cA	1.03bA	3.88cB	0.12aA	17.72aA
T3	32.74dA	33.20bA	3.62aA	13.00bB	ND	2.54bA
T4	15.05bA	3.85dA	1.02bA	3.24dB	0.11aA	17.79aA
20 days						
C1	10.81eA	ND	ND	ND	ND	ND
C2	10.81eA	ND	ND	ND	ND	ND
T1	33.35cA	34.27aA	3.54aA	13.71aC	ND	2.49bA
T2	15.40aA	4.05cA	1.02bA	3.54cC	0.11aA	17.72aA
T3	32.13dA	33.00bA	3.49aA	12.71bC	ND	2.48bA
T4	15.00bA	3.71dA	1.01bA	3.09dC	0.10aA	17.78aA
30 days						
C1	10.78eA	ND	ND	ND	ND	ND
C2	10.79eA	ND	ND	ND	ND	ND
T1	33.00cA	33.42aB	3.43aA	13.21aD	ND	2.48bA
T2	15.02aA	3.83cB	0.98bA	3.20cD	0.10aA	17.70aA
T3	32.01dA	32.52bB	3.39aA	12.52bD	ND	2.05bA
T4	14.97bA	3.33dB	0.98bA	3.00dD	0.09aA	17.77aA

*See footnote Table 2.

Table (4): Mineral contents of produced functional beverages (mg $100g^{-1}$).

Minerals	Treatments*					
	C1	C2	T1	T2	T3	T4
Ca	51.00a	54.00a	29.00c	31.00b	29.41c	31.80b
P	28.97a	29.03a	20.93c	22.00b	20.20c	23.60b
Na	18.59a	18.85a	24.89b	22.00a	25.10b	22.87a
K	12.41e	13.87d	20.51c	16.20b	20.91c	16.80a
Mg	2.51f	2.74e	5.42d	7.07b	5.84c	7.73a
Fe	0.41c	0.43c	0.57b	0.79a	0.59b	0.81a
Cu	0.05c	0.06c	0.08b	0.09b	0.09b	0.10a
Zn	0.04d	0.04d	0.07b	0.06c	0.08a	0.06c

*See footnote Table 2.

Addition of carrot and mango increased the counts of *Bif. longum* as compared to the FMP used in the preparation of the beverage. This may be explained on the basis of different nutrients added in the beverage by the fruit pulp. The counts of *Bif. longum* decreased ($P \leq 0.05$) during storage in all treatments, which is higher than that recommended for probiotic foods to exhibit their potential *i.e.* 10^6 – 10^7 cfu/g at the time of consumption (FAO/WHO 2002).

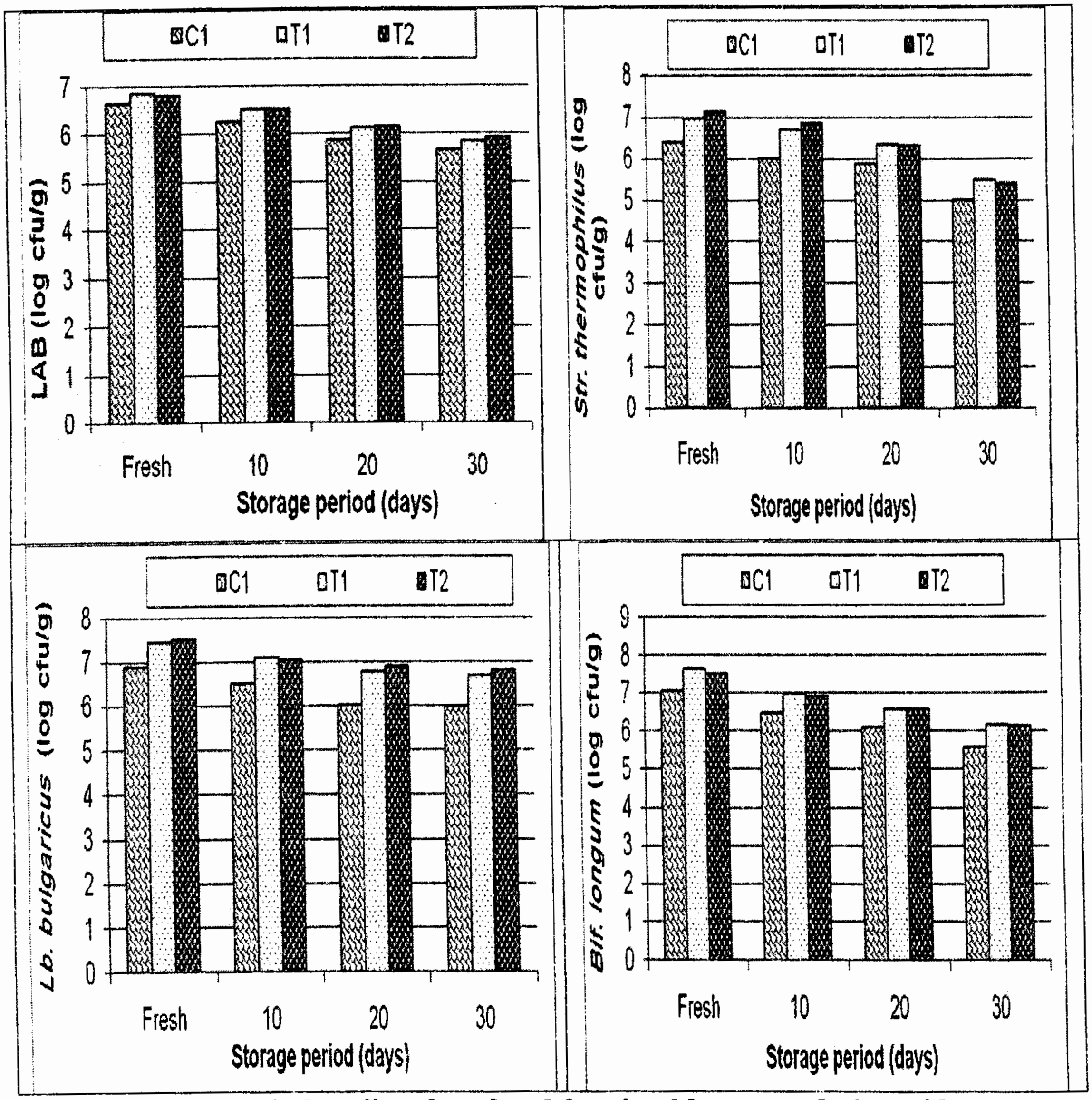

Fig (1): Microbiological quality of produced functional beverages during cold storage at ~4°C.

C1 = Control 1 (unheated FMP) **T1** = 50% unheated FMP + 50% mango pulp

T2 = 50% unheated FMP + 50% carrot pulp

Analysis of beverage samples from different treatments revealed that coliforms and yeasts & moulds were not detected when fresh or during storage. This can be attributed to the hygienic condition granted during process and storage. Similar results were obtained by Atallah (2015).

Sensory evaluation:

Data in Fig (2) illustrates that the fresh mango and carrot beverages were ranked to total scores of 88 - 92 out of 100, where mango beverage gained 91 - 92 points; followed by carrot beverage. This can be attributed to the improved flavour by the added fruit pulp. Significant differences ($P \leq 0.05$) were found in scores for different sensory attributes between all treatments during the storage period. It is of interest that beverages based on heated or unheated FMP gained close score points for the different attributes. This can be explained on the basis of the slight changes in the composition of the products during storage.

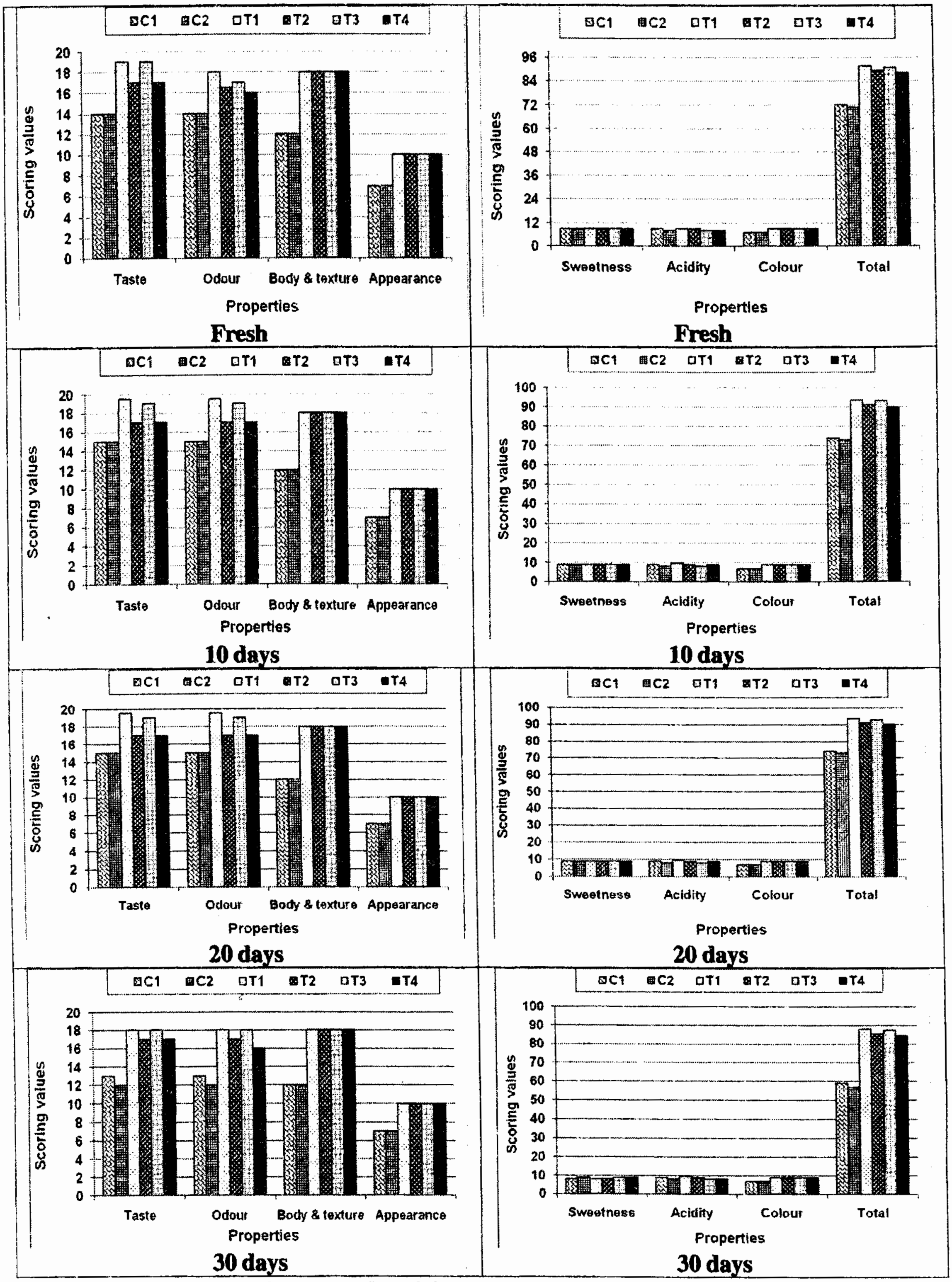

Fig (2): Sensory evaluation of produced functional beverages during cold storage at ~4°C.

C1 = Control 1 (unheated FMP) C2 = Control 2 (heated FMP)

T1 = 50% unheated FMP + 50% mango pulp T2 = 50% unheated FMP + 50% carrot pulp

T3 = 50% heated FMP + 50% mango pulp T4 = 50% heated FMP + 50% carrot pulp

During cold storage, the sensory evaluation scores increased for all treatments after 10 days. No, changes were observed among the treatments for all sensory characteristics up to 20 days of storage. After 30 days of cold storage, the same trend was observed for all the tested products with slight decreases in the obtained scores. Similar trends were obtained by Atallah (2015).

Viscosity:

Data in Fig (3) revealed that FMP had higher viscosity than the unfermented permeate. This can be explained by the production of exopolysaccharide (EPS) by the used EPS producing microorganisms in the fermentation of permeate. The EPS produced by *Str. thermophilus* strain was reported to improve texture of yoghurt and functional beverages (Folkenberg *et al.*, 2005).

Also, the addition of fruits led to further increase in the viscosity of the prepared beverage as compared to FMP, These findings could be related to which may be attributed to the high total solids in mango and carrot beverages. The highest viscosity values recorded for mango beverages may be due to the presence of high dietary fibers in mango which has the ability to bind water and to increase consistency of the products (Caili *et al.*, 2007). Similar trend was recorded by Atallah (2015).

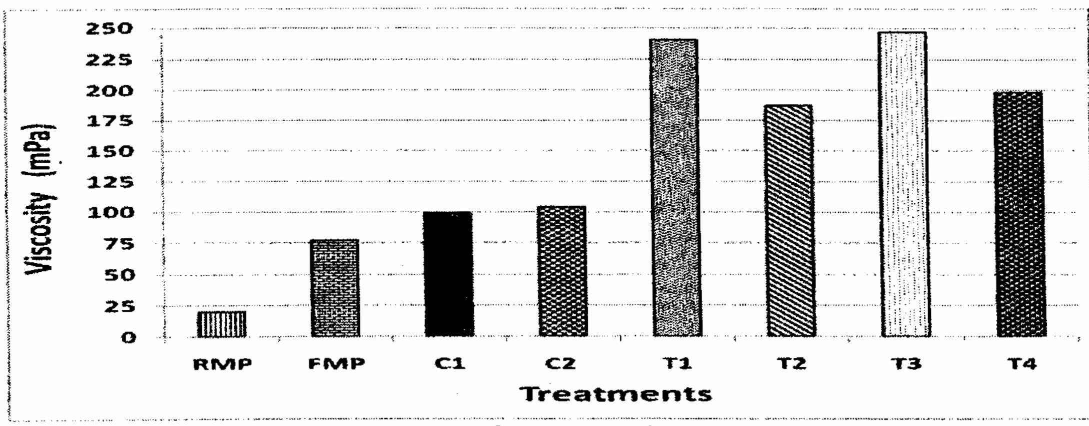

Fig (3): Viscosity of raw milk permeate, fermented milk permeate and prepared functional beverages.

RMP= Raw milk permeate **FMP**= Fermented milk permeate

CONCLUSION

Carrot and mango pulps flavoured were used successfully in the development of probiotic fermented beverages of high nutritional value mixing sweetened FMP (5% sugar) with mango and carrot pulp at ratio of 1:1, the added probiotic bacteria (*Bif. longum*) survived the refrigerated conditions for at least 30 days with number of greater than 10^6 cfu g^{-1} in unheated beverage. The pulps-enriched samples were characterised by the highest content of antioxidant activity, total phenols, total flavonoids, ascorbic acid, anthocyanins and carotenoids. The sensory scores of the functional beverages were high and accepted. Addition of exopolysaccharide-producing strain improved the textural and viscosity of the produced beverages.

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إعداد وخواص المشروبات الوظيفية على أساس راشح اللبن الداعمة للحيوية مع الجزر ولب المانجو

تم إعداد وتقدير خواص المشروبات الوظيفية على أساس لب الفاكهة وراشح اللبن الداعمة للحيوية. حيث تم تخمير راشح اللبن مستخدما ٢٪ خليط من ثلاث مزارع بادئات بنسب خلط (١:١:١) والتى تتكون من سلالة *Lactobacillus delbrueckii* subsp *bulgaricus* وسلالة *Streptococcus thermophilus* المنتجة للسكريات العديدة و سلالة البكتريا الداعمة للحيوية الـ *Bifidobacterium longum*. تم إضافة السكروز (٥٪) الي راشح اللبن ثم تم تقسيمه الي قسمين: القسم الاول تم حفظة بدون معاملة حرارية والقسم الثاني تم معاملته حراريا (٨٥°م /١٥ق). وتم تقسيم كل جزء إلى قسمين متساويين وتم الخلط بشكل منفصل مع أحجام متساوية من لب المانجو والجزر، وتم تعبئة المشروبات المحضرة فى زجاجيات معقمة وتخزينها لمدة ٣٠ يوما على درجة حرارة ~٤°م. وأجرى تقييم المشروبات المعدة لفيتامين C، الكاروتين، الفينولات الكلية، مركبات الفلافونويد الكلية ومركبات الأنثوسيانين والنشاط الكلي للمركبات المضادة للأكسدة. وقد تم تحليل المشروبات أيضا من حيث القياسات الفيزيوكيميائية والخواص الريولوجية والميكروبيولوجية والصفات

الحسية أثناء التخزين. وقد كشفت النتائج ان راشح اللبن يعتبر مصدر جيد للمعادن مثل الكالسيوم والفوسفور والصوديوم والبوتاسيوم والمغنيسيوم. وقد وجد زيادة طفيفة في محتوي الجوامد الكلية، الرماد، الدهون، البروتين، الألياف والحموضة، في حين انخفض محتوي الكربوهيدرات الكلية، النشاط المضاد للأكسدة، ومجموع الفينولات، ومجموع فلافونيدات وفيتامين C، والأنثوسيانين والكاروتينات وقيمة الرقم الهيدروجيني أثناء التخزين البارد للمشروبات المعدة. وأدى استخدام المانجو أو الجزر الي زيادة كبيرة في محتوي الكالسيوم والفوسفور والصوديوم والبوتاسيوم والمغنيسيوم والحديد والنحاس والزنك في المشروبات المنتجة. وقد ظلت أعداد البكتريا الداعمة للحيوية المستخدمة فى المشروبات المتخمرة الغير معاملة حراريا أعلى من العدد المسموح به ($6 \log cfu\ g^{-1}$) لتحقيق التأثير المفيد والصحى حتى نهاية فترة التخزين. وقد أوضح التقييم الحسى للمشروبات الوظيفية المتطورة ارتفاع درجات القبول الحسى.