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MILK PERMEATE BEVERAGE FORTIFIED WITH SWEET POTATO PASTE

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ABSTRACT

Milk permeate beverage fortified with sweet potato paste was studied to get use of the constituents of both of the milk permeate and sweet potato paste. Sweet potato paste contains 17.89% total solids, 15.93% carbohydrate and 2.95% total dietary fibers, 1.2% proteins, 0.63% ashes and 0.13% lipids, as well as several vitamins and minerals. The milk permeate was mixed at three different levels with sweet potato paste, which were 2, 3 and 4% of potato paste. The resultant beverages and the control (100% milk permeate) were assessed for chemical and organoleptic evaluation when fresh and during refrigerating storage at 6± 1 ˚C for three weeks. Analysis were carried out after preparation as well during refrigerating storage. Results indicated that fortifying milk permeate with sweet potato paste were more effective in increasing total solids, protein, ash, fiber and total carbohydrates, viscosity, vitamins (vitamin A and folate) and minerals contents(K, Mg, zinc, Fe, P and Ca). Sensory properties of beverages were very well accepted with sweet potato paste fortification. Results were successfully achieved in respect of economically viable aspect.
Keywords: milk permeate, sweet potato, beverage.

INTRODUCTION

The milk permeate (MP) is the liquid produced by using ultrafiltration (UF) process for concentration of milk. Milk permeate (MP) usually dumped into the factory's disposal system results in very high pollution loads.It consists primarily lactose in a water solution with various vitamins minerals and soluble nitrogen (Fitzpatrick and O'Keeffe 2001).

Permeate is a cheap by- product,which contains electrolytes, sodium, potassium, magnesium, zinc and calcium being utilized in sporting beverages. The human body usually lose a lot of electrolytes (sodium and potassium) through sweating during heavy exercise or work. The mineral loss can cause convulsion, shock and even death (Karppanen *et al*., 2005). Sodium and potassium help to maintain the osmotic pressure of the extra- and intra-cellular fluid, and the commercial sports beverages can replenish the lost ions quickly (ADPI. 2009). Although MP still viewed as a waste product of the UF process. It is well known that MP is the genuine thirst quenching refreshing nature with some healthy benefits. Because liquid MP is rich in vitamins minerals, it can enhance the overall nutritional content of producing beverages when MP is used as an ingredient.

Milk permeate (MP) may be used in healthy food industry and for manufacturing several types of beverages which offer good potential profit margin (Suresha& Jayaprakasha, 2003 and Beucler , 2004).

Sweet potato is the 7th most important food crop in the world (FAO, 1997). Over 95%of the global sweet potato crop is produced in developing countries, where it is the fifth most important food crop (CIP, 2006). It is a good food for people involved in heavy muscular work, since it contains high levels of vitamins and minerals.

Sweet potatoes contain potassium; phosphorus, manganese, and zinc which are good for skin. It also, contains vitamin B6, beta-carotene, in addition to vitamins A, C and vitamin E which are powerful antioxidants that work in the body to remove free radicals. These free radicals are chemicals that damage cells. These contents are excellent for prevention cancer and cardiovascular disease. Fiber and pectin contained in the sweet potato is also very good to prevent digestive disorders such as hemorrhoids, constipation, to colon cancer. A piece of sweet potato per day is sufficient as meal replacement rice complete with great benefits. (nutrikidz.net, 2011).

Despite the name "sweet", it may be considered a beneficial food for diabetics, and preliminary studies on experiment animals revealed that sweet potato helps to stabilize blood sugar levels and lower insulin resistance (Suryia-Zakir, 2008), it is low in calories and comprise no fat.

As previously noted that sweet potatoes help to improve resistance to heart attack and stroke, and its potassium content, helps in maintaining fluid and electrolyte balance in the body cells.

Sweet potatoes are rich in carbohydrates and contains little proteins too. This makes it as an ideal diet for those lean and thins who desperately want to put on weight. In addition, Potatoes are the most efficient fuel for energy production and can also be stored as glycogen in muscle and liver, functioning as a readily available energy source for prolonged strenuous exercise. For these reasons, it may be the most important nutrient for sports performance. The vitamins like vitamin-C and B-complex also help in proper absorption of this carbohydrate.

The uses of milk permeate fortified with sweet potato for beverage preparation would be valuable options for getting use of milk permeate. Because the demand for these drinks and beverages is largely based on their nutritive value, the flavor, aroma and color are considered (McLellan, 1990)

The objective of this study is to produce beverage from milk permeate fortified with sweet potato paste to get the benefits effect of their constituents .

MATERIALS AND METHODS

Milk permeate was obtained from the Dairy Technology Unit, Animal production Research Institute. Sweet potato and granulated sugar were obtained from the local market .

For the preparation of milk permeate fortified with sweet potato beverage, sweet potato roots were rinsed with tap water and boiled in water (around65◦C for 15-20 min) till cooked (Ratti, 2001) , peeled, blended and mashed to paste. Milk permeate was divided into four batches,then the granulated sugar was added at the vat of 8% w/v. The first batch used as

control, the second batch with 2 %(w/v) sweet potato paste (2) and the third batch with 3 %(w/v) sweet potato paste (3) and the fourth batch with 4 % (w/v) sweet potato paste (4) then pasteurized at 75 oC for 15 min and bottled hot and sealed. The bottled drinks were cooled under running cold water and stored at 7◦C for three weeks. Chemical and organoleptic analysis were carried out by fifteen trained panelists from the research staff of the Dairy Sections Department of Animal Production Research Institute, (APRI) Agricultural Research Center(ARC), beverage samples were evaluated fresh and during 1, 2 and 3 weeks storage. Treatments were replicated for 3 times.

Total solids, protein, fat, and ash were determined according to methods described in AOAC (2007), The pH values of the prepared beverages were recorded using digital pH meter (Jenway 3505 pH meter)
Viscosity of beverages samples of each treatment was measured using a Brookfield DV- E viscometer in 100 ml cream at 20˚C shear rate 6.0 ,spindle 05, then samples were stirred for 30s before measuring. All viscosity values were recorded as
centipoises (cP) units.

Samples of the prepared beverages were subjected to organoleptically evaluation by a panel of 15 staff members of Dairy Dept, Section, Animal Production Research Institute, ARC. Organoleptically evaluated was conducted on the score of (50)for flavor, (30) for Colure and (20) for appearance

The major minerals (Ca , K , Mg and zinc) and minor minerals (Fe) were determined according to the methods described in A O A C (1995) using an atomic absorption spectrophotometer (Perkin Elmer Model 460). Folate content was estimated according to Holt *et. al*. (1988) by HPLC method .Vitamin A was determined according to A O A C (1995) using HPLC method.

RESULTS AND DISCUSSION

Table (1): chemical composition of fresh milk permeate beverage fortified with sweet potato paste and their control.

Treatments	Total solids	Fat	Protein	Ash	Fiber	Total carbohydrates
Control 100%MP[1]	12.56	0.0	0.25	0.43	0.0	11.88
MP+2%SP[2]	12.95	0.02	0.30	0.45	0.8	12.18
MP+3%SP[2]	13.23	0.03	0.37	0.48	1.3	12.35
MP+4%SP[2]	13.47	0.04	0.42	0.50	1.6	12.51

MP[1] (milk permeate) SP[2] (sweet potatoes): which contain:17.89%total solid, 1.2%proteina,0.13%fat,0.63%ash,15.93% Total carbohydrates and 2.95%fiber

Results in Table (1) present the chemical composition of the fresh samples of beverages. TS, fat, protein, ash, fiber and total carbohydrate increased as percentage of sweet potato increased.

Total carbohydrates of the prepared beverages fortified with sweet potato paste ranged from 11.88 to 12.51mg/ 100 g. The relatively high sugar content is due to the addition of refined sugar to the formulation.

Table (2): The pH values of milk permeate beverage fortified with sweet potato paste and their control during refrigerating storage 6±1˚C.

Treatments	Storage periods (weeks)			
	Fresh	1.Week	2. weeks	3. weeks
Control 100%MP[1]	6.79	6.59	6.45	6.40
MP+2%SP[2]	6.75	6.43	6.37	6.35
MP+3%SP[2]	6.72	6.32	6.32	6.30
MP+4%SP[2]	6.70	6.32	6.23	6.23

MP[1] (milk permeate) SP[2] (sweet potatoes)

Data in Table (2) shows the results of laboratory analysis of the prepared beverage samples. The pH of the beverage slightly decreased as the percentage of sweet potato increased, ranging from6.79 – 6.70 for sample MP and sample with4% sweet potato paste.

The obtained data revealed that there was a reverse relationship between pH values of beverages and storage period These results are in agreement with Nagla A.Hegazi *et al* (2009) and Hattem H. E. *et al* (2011). This slight decrease in pH values of the beverages during storage period might be due to the good hygienic conditions during the manufacture process.

Table (3): Viscosity (cp) of milk permeate beverage fortified with sweet potato paste and their control during refrigerating storage 6±1˚C.

Treatments	Storage periods (weeks)			
	fresh	1.Week	2. weeks	3. weeks
		----------	cp ----------	
Control 100%MP[1]	0	0	0	0
MP+2%SP[2]	20	22	24	28
MP+3%SP[2]	32	32	34	36
MP+4%SP[2]	58	60	60	62

MP[1] (whey permeate) SP[2] (sweet potatoes)

Results in Table (3) show that viscosity of the prepared beverages increased as the percentage of sweet potato increased in the prepared leverage. These results are in agreement with Pyler (1988), who reported that the viscosity of starch pastes was increased after cooling and the potato starch granules start to swell at a markedly lower temperature. Also Ibrahim *et al*. (1992) found that the addition of sweet potato to the frozen yoghurt mix increased its viscosity. Moreover, Metwally(1994) noticed a positive relationship between viscosity of beverages and storage period .

Table (4): Total solids (%) of milk permeate beverage fortified with sweet potato paste and their control during refrigerating storage 6±1˚C.

Treatments	Storage periods (weeks)			
	Fresh	1.week	2weeks	3 weeks
Control 100%MP[1]	12.56	12.60	12.72	12.81
MP+2%SP[2]	12.95	13.03	13.09	13.15
MP+3%SP[2]	13.23	13.27	13.32	13.42
MP+4%SP[2]	13.47	13.5	13.57	13.64

MP[1] (milk permeate) SP[2] (sweet potatoes)

Data shown in Table (4) revealed that the total solid of MP beverage in control was 12.56 %, while treatments fortified with 2,3 and 4 % sweet potato were of a higher T.S content . This is due to the increase in the ratio of sweet potato. It could also be seen that chemical composition of fresh sweet potato beverage (TS, fat, protein , ash, fiber and total carbohydrate) increased as percentage of sweet potato increased

Table (5): Vitamins and minerals contents of fresh milk permeate beverage fortified with sweet potato paste and their control

vitamins and minerals contents of beverages	Treatments			
	Control	MP+2%SP[2]	MP+3%SP[2]	MP+4%SP[2]
Vitamin A (mcg)	0.0	399	531	676
Folat (mcg)	3.1	4.4	4.6	5.9
K (mg)	155.0	170.0	200.1	220.8
Mg (mg)	6.9	16.1	20.2	25.3
(mcg) Zinc	0.03	0.3	0.6	0.8
Fe (mcg)	0.02	0.7	1.1	1.7
P (mg)	4.2	51.2	69.8	85.2
Ca (mg)	30.6	45.3	50.2	54.7

MP[1] (milk permeate) SP[2] (sweet potatoes)

Results in Table (5) present vitamins and minerals content of milk permeate fortified with fresh sweet potato beverages. Results clarified that sweet potato provides a considerable amount of vitamin A content, which ranged from 399 to 676 (mcg) most varieties having higher vitamin A equivalent. It was noticed that the highest content of vitamin A was in all treatments fortified with sweet potato, which increased by increasing the fortification level of sweet potato in the resultant beverage.

Along the same line, Collins (1981) reported that juice prepared from high Beta- carotene sweet potato cultivars contained approximately 1 mg beta-carotene 100 g-1, and could furnish more than 40% of the adult of vitamin A. Its content in commercial drinks ranged from 0.8 mg/100 g in

canned mango juices to only 0.012 mg/100 g in aseptically packaged orange juice (Collins, 1981).

Vitamin A deficiency is one of the major public health problems in developing countries. Even though vitamin A content in the beverage samples are very low. As sweet potato contains high beta-carotene would serve a good source for sweet potato beverage in combating vitamin A deficiency.

In this respect, the observed natural color of the sweet potato beverage, light yellow to orange is similar to that of fruit drinks/juices, and this may be a promotional advantage to the enhanced artificial color in most commercial drinks. Thus, sweet potato beverage will be more welcomed by consumers, who are now more conscious about the nutritional content of what they consume.

Regarding folate vitamin, it increased by increasing the ratio of sweet potato paste by 2 to 3% to be one and half time the value of milk permeate beverages(control) . However, folate in sweet potatoes helps to reduce homocysteine levels, a chemical capable of destroying the circulatory system and causing heart attacks. Heart disease is the #1 cause of death in humans and claims nearly one million American lives annually. The high folate content is important and necessary for healthy fetal cell and tissue development. Eat sweet potatoes help maintain the body's normal Foliate levels, the when body folic acid content is too low, it increases the risk of cancer as mentioned in nutrikidz.net (2011).

Concerning potassium mineral content, it was noticed that whey permeate beverages fortified with Sweet potato paste contains higher level of potassium mineral compared with their control. This is because the sweet potato contains more potassium, which is very important in the maintenance of proper acid-alkaline balance in the blood and tissues**.** In addition, potassium is essential for muscle contraction, and it helps the kidney to detoxify the blood. It prevents over-acidity, which is the precursor of so many diseases.

In this respect, potassium in sweet potatoes helps in the maintainance of fluid and electrolyte balance in the body cells, as well as normal heart function, nerve function and blood pressure. It assists in the regulation of the acid-base balance. It assists in protein synthesis from amino acids and in carbohydrate metabolism. It is necessary for the building of muscle and for normal body growth.It is essential for the normal electrical activity of the heart. Panel on Dietary Reference Intakes for Electrolytes and Water, Standing Committee on the Scientific Evaluation of Dietary Reference Intakes The National Academies (2004)

Regarding magnesium content, the whey permeate beverages fortified with sweet potato paste contains higher amount of magnesium. This is because its well proved that sweet potato is also rich in magnesium. This mineral is crucial in many bodily functions, such as cellular replication, energy production, and protein formation. Also magnesium participates in more than 300 enzyme reactions in the body, and operates as a catalyst in many functions including the production of the very crucial ATP as mentioned by Elson, (2006)

Also, zinc is among sweet potato components, which increases in beverages fortified with sweet potato paste. This mineral is extremely important during fetal development, where a deficiency during this period can cause premature birth, growth retardation, and low birth weight. It is needed in the formation of DNA and RNA, and in the synthesis of proteins. It is very helpful in treating Alzheimer's disease, Wilson's disease, macular degeneration, and acne. Moreover, Zinc prevents night blindness, hair loss, epilepsy, and osteoporosis, Maret, (2006)

In relation to phosphorus, Calcium and iron contents in the fortification of whey permeate beverage with sweet potato paste**,** phosphorus is very important for the brain and the nervous system. Calcium and phosphorus work together to build strong bones and teeth. Boron prevents postmenopausal osteoporosis, enhances brain functions, and promotes alertness. Regarding to the results in Table (5) iron increased in all beverages treatments fortified with sweet potato paste compared with their control these results because sweet potato is rich with iron mineral as reported by Martins, (1984) and Zeratsky, (2010).

These results of vitamins and minerals content of control (whey permeate) agree well with Hanaa H. Elsayed (2007)

Sensory properties of beverages were very well accepted with sweet potato paste fortification and didn't affected by refrigerated storage periods (Table 6). Beverages fortified with sweet potato paste have increased in its sensory scores especially in flavor, color and appearance as compared with their control (whey permeate 100%) and the other treatments (of fortification levels with sweet potato paste) in fresh and during refrigerated storage periods. No detectable changes were observed in flavor, color and appearance and a of the fortified samples .during refrigerated storage.

Table (6): Sensory properties of milk permeate beverage fortified with sweet potato paste and their control during refrigerating storage 6±1˚C.

Storage period (week)	Properties	Treatments			
		Control	MP+2%SP[2]	MP+3%SP[2]	MP+4%SP[2]
Fresh	Flavour (50)	25	40	44	48
	Coloure (30)	10	18	25	28
	Appearance(20)	10	15	18	18
	Total (100)	**45**	**73**	**87**	**94**
1	Flavour (50)	25	40	44	48
	Coloure (30)	10	28	25	28
	Appearance(20)	10	15	18	18
	Total (100)	**45**	**73**	**87**	**94**
2	Flavour (50)	25	40	44	48
	Coloure (30)	10	18	25	28
	Appearance(20)	10	15	18	18
	Total (100)	**45**	**73**	**87**	**94**
3	Flavour (50)	20	38	42	45
	Coloure (30)	10	18	25	28
	Appearance(20)	10	15	18	18
	Total (100)	**40**	**71**	**85**	**91**

MP[1] (milk permeate) SP[2] (sweet potatoes)

Conclusion:

It is of great importance to use wasted milk permeate in preparing beverages of high nutritive value and acceptable properties, made with cheep economically materials. As sweet potato paste has enormous essential components of minerals (K,Mg,zinc,Fe,p and calcium) and vitamins(A and folate),in addition to high fiber contents. This study confirmed the advantage of preparing milk permeate beverage fortified with sweet potato paste as a Fortifying agent.

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مشروب راشح اللبن المدعم بعجينة البطاطا الحلوة

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***قسم تكنولوجيا الألبان بمعهد بحوث الإنتاج الحيوانى**
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للاستفادة من راشح اللبن الناتج من عملية الترشيح الفوقى الذي يقدر بملايين الاطنان سنويا علاوه على ما يمثله من مشكله بيئيه . لذا تم دراسة انتاج مشروب جديد من راشح اللبن المدعم بعجينة البطاطا الحلوة .وفى هذه الدراسة تم استخدام البطاطا الحلوة T.S 17.89% ,15.93% كربوهيدرات , 2.95% اليـاف ' 1.2% بـروتين ' 0.63% رمـاد ' 0.13% ليبيد وعديد من الفيتامينات و الاملاح . وقد تم اضافة و خلط عجينة البطاطا الحلوة بنسبة ٢, ٣, ٤ % الى راشح اللبن .

وبالتحليل الكيماوى و التقيم الحسى للمشروبات طازج و اثناء التخزين على درجة حرارة الثلاجة ٧ م لمدة ٣ اسابيع ، فقد دلت النتائج على ان تدعيم راشح اللبن بعجينة البطاطا الحلوة أدى إلى زيادة المواد الصلبة الكلية (T.S) و البروتين و الالياف و الرماد و الكربوهيدرات و اللزوجة والفيتامينات (فيتامين A والفولات) ومحتوى الاملاح (بوتاسيوم –ماغنيسيوم – كالسيوم – حديد – زنك) فى الطازج بزيادة نسبة عجينة البطاطا الحلوة . وقد وجد التقيم الحسى للمشروبات قبولا جيدا باضافة عجينة البطاطا الحلوة .

لذلك توصى الدراسة على امكانية استخدام راشح اللبن المدعم بعجينة البطاطا الحلوة فى انتاج مشروب اقتصادى ذات فوائد غذائية وصحية .

قام بتحكيم البحث

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