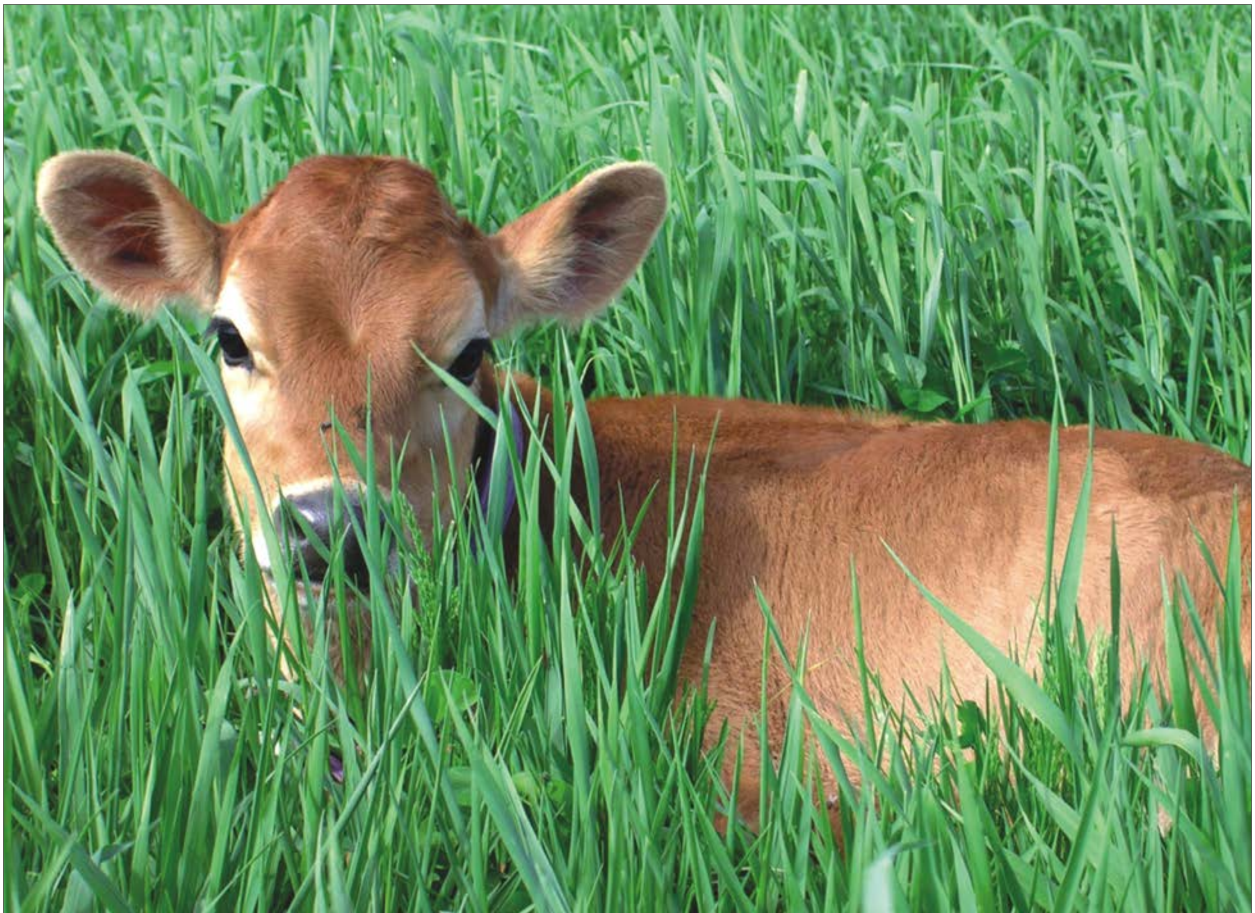

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Manufacture and Evaluation of Four Novel Wheat Fermented Milks Beverages

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ABSTRACT

Synbiotics are products that contain both prebiotics and probiotics. To maximize effectiveness of bifidus products, prebiotics are used in probiotic foods. This study aimed to manufacture four wheat fermented milk beverages: Wheat Fermented Milk (WFM) as a control and other three milks with the addition of strawberry (SWFM), mango (MWFM) or chocolate (CWFM) inoculated with culture mix (*Lactobacillus acidophilus* ATCC 20552, *Bifidobacterium lactis* coded Bb 12 and *Streptococcus salivarius* subsp. *thermophilus*). Chemical, microbiological, sensory and physical properties were investigated. The results revealed that succinic acid was the dominant organic acid in MWFM and probionic acid was the dominant in WFM, SWFM and CWFM at the initial and after 21 days of storage. CWFM gained high Lactic acid bacteria and *Bifidobacterium* numbers at most storage times. The highest overall acceptability was for CWFM. Syneresis values were lower in the three fermented milks compared to the control, especially in CWFM. It could be concluded that addition of 5% strawberry, 5%mango and 10% chocolate to fermented milk during manufacturing process can produce acceptable probiotic milk beverages with sufficient survival rate of probiotic bacteria.

Key words: Probiotics, fermented beverages, wheat, *L. acidophilus*, *S. thermophilus*, *Bifidobacterium*, organic acids

INTRODUCTION

In recent years, cereals have been investigated regarding their potential use in developing functional foods. Cereals provide dietary fiber, proteins, energy, minerals and vitamins required for human health (Charalampopoulos *et al*., 2002). Cereals are suitable substrates for lactic acid bacteria growth, which has led to the commercialization of cereal based probiotic products (Charalampopoulos *et al*., 2003). Numbers of health benefits have been claimed for probiotic bacteria such as antimutagenic effects, anticarcinogenic properties, improvement in lactose metabolism, reduction in serum cholesterol and immune system stimulation. In addition to yoghurt, fermented functional foods with health benefits based on bioactive peptides released by probiotic organisms, including Evolus and Calpis, have been introduced in the market. The milks fermented with *Strep. thermophilus* CRL 1190 could be used in novel functional foods for preventing chronic gastritis (Rodriguez *et al*., 2009). Also the natural diversity among *S. thermophilus* strains with respect to their capacity to produce different metabolites has the potential to be exploited beyond fermentation for lactic acid production (Iyer *et al*., 2010). However, *Bifidobacterium bifidum* (BF-1) fermented milk may affect *H. pylori* infection or its activity, gastric mucosal situation and the emergence of upper gastrointestinal symptoms (Miki *et al*., 2007). Therefore, the objective of this study was to study the chemical, microbiological, sensory and physical properties of fermented milk beverages: Wheat Fermented Milk (WFM), strawberry wheat fermented milk (FSWM), Mango Wheat Fermented Milk (MWFM) and Chocolate Wheat Fermented Milk (CWFM).

MATERIALS AND METHODS

Raw materials: Cow's milk, wheat (*Triticum aeritinum*), sugar, fresh mango fruits, fresh strawberry fruits, powdered chocolate "Nesquik" manufactured in Egypt by Nestle Egypt S.A.E. with labeled ingredients (sugar, cocoa, soya lecithin, salt, vanillin and cinnamon) were obtained from the local market in Mansoura, Egypt in January.

Bacteria strains: Highly concentrated pure cultures *Lactobacillus acidophilus* ATCC 20552 and *Bifidobacterium lactis* coded Bb 12 strains were obtained by microbiology milk laboratory of Agriculture Researches Center, Giza, Egypt. *Streptococcus salivarius* subsp. *Thermophilus* was obtained by microbiology milk laboratory of National Research Center, Giza, Egypt.

Growth media: MRS- agar REF 4017292 (Biolife), Potato Dextrose Agar REF 4019352 (Biolife), M17 agar Code 401720 (Biolife) were produced by Italian S.r.l V.le Monza, 272 20128 Milano-Italy. Violet Red Bil Agar REF 211695 (Difico) was produced by Becton, Dickinson and Company sparks, France. Nutrient agar was produced by El Nasr pharmaceutical chemicals, Egypt were used as growth media.

Preparation of wheat, milk and fruits: Wheat grains were washed with tap water and soaked for 6 h and cooked in boiling water for half an hour and were put on the quiet heat until full cooked., Then they were minced well and pressed on filter (0.3 cm) to separate hard fibers. The produced extract was used as the wheat additive form to the beverages. Cow's milk was mixed, filtered and boiled in water bath for 30 min. Mango was washed with water, peeled off and destined. Strawberry was washed with water and mixed in the blender without water until it becomes homogeneous. The fruit fleshes were packed in poly ethylene bags. Prepared wheat and fruit were stored in a deep freezer (-18°C) until required.

Preparation of starter cultures: Fermented beverages were produced using mix of three types of starter cultures (2.2.1) of *Lactobacillus acidophilus* ATCC 20552, *Bifidobacterium lactis* (Bb 12) and *Streptococcus salivarius* subsp. *Thermophilus*. The microorganisms were activated in 10% (w/w) sterile reconstituted skim milk and incubated at 37°C for 48 h. The process was repeated three times prior to manufacture (Kabeir *et al*., 2005).

Preparation of fermented wheat- milk beverages: Wheat fermented milk (15% prepared wheat) was manufactured by heating of wheat and milk mix in water bath for 30 min at 90°C , followed by cooling to 40-42°C, inoculated with 10% of yoghurt culture mix (*Lactobacillus acidophilus* ATCC 20552, *Bifidobacterium lactis* (Bb 12) and *Streptococcus salivarius* subsp. *Thermophilus*) and incubated at 42°C until pH 4.9 was reached. The previous wheat fermented milk was produced as a control mix. Other three fermented milks were prepared by addition of strawberry flesh, mango flesh and chocolate powder at 5, 5 and 10 percent levels, respectively to the control formulation. These levels were chosen according to sensory evaluation of Mostafa (2011). The different formulations were evaluated for physicochemical, microbiological and sensory properties at different periodic intervals i.e., 0, 3, 7, 14 and 21 days.

Chemical analysis

Gross chemical composition was determined as follows: Moisture, crude protein and crude fat were determined according to the methods of AOAC (1995). Ash content was carried out according to the method of AOAC (1990).

Carbohydrates content was calculated by the following equation:

$$\text{Carbohydrates} = 100-(\%\ \text{moisture}+\%\ \text{protein}+\%\ \text{fat}+\%\ \text{ash})$$

The pH value was measured according to the method described by Ling (1963) using digital Orion pH meter, Model SA720 (Orion, USA) equipped with a Souder (combined glass electrode).

Determination of organic acids: Organic acids composition of fermented milks beverages was carried out in the National Research Center, Giza, Egypt. Samples were determined using the HPLC Pico Tag method according to Guzel-Seydim *et al.* (2000). Waters associates equipped with 600 E multisolvent delivery system and millennium chromatography workstation was used. Determination was carried out at wave length 210 µm, flow rate 1.5 mL min^{-1} and ambient temperature Altec column (250×4.6 mm). The mobile phase was 0.001% H_2SO_4.

Microbiological analysis: Microbiological count data are expressed as Colony Forming Units (CFU) per mL. Poured plate method was used. Eight dilutions were carried out to determine the number of bacteria during storage. One milliliter of each dilution was aseptically plated in the media plate. Enumeration of *Lactobacillus acidophilus* and *Bifidobacterium lactic* Bb 12 was performed using selective MRS agar (Himedia) according to Dave and Shah (1996) under anaerobic incubation 37°C for 3 days. Enumeration of *Streptococcus salivarius* subsp. *thermophilus* was performed as described by the International Dairy Federation (IDF Standard, 1995). Agar M17 with aerobic incubation at 42°C for 24 h. Potato dextrose agar medium (Difico) was used for molds and yeasts count according to APHA (1992). The plates were incubated at 30°C for 3.5 days. Coliform group bacteria were determined according to APHA (1992) using violet red bile agar (Difico). Plates were incubated at 37°C for 48 h. Plat count agar medium was used for enumeration the total microbiological count. Petri-plates were incubated at 37°C for 48 h. The total bacterial count was recorded as colony numbers per 1.00 mL of sample (APHA 1971).

Sensory evaluation of beverages: Sensory evaluation of beverages was carried out to determine their sensory characteristics (color, texture, taste, odor and overall acceptability) according to Moor (1970).

Syneresis determination: Syneresis was determined according to Iwalokun and Shittu (2007) by dispensing 100 g of yoghurt into a cheesecloth line funnel placed on top of a graduated cylinder. The amount of whey, 'milk serum' in 100 g was measured after manufacture and during refrigerated storage. The amount of whey drained off (expressed as milliliters per 100 g of sample) was calculated as their syneresis index.

Statistical analysis: All data were subjected to a one way statistical significant differences between treatment means were compared using F-test (Armitage, 1971). The data was evaluated at the $p<0.05$ level.

RESULTS AND DISCUSSION

Gross chemical composition (g/100 g w/w) of fruit and chocolate wheat milk beverages before fermentation: Data on the chemical composition of strawberry, mango and chocolate wheat milk beverages before fermentation are presented in Table 1. The results show significant increase ($p<0.01$) in moisture content in SWFM and MWFM comparing to control, however a significant decrease was found in CWFM. Also a significant increase ($p<0.01$) was found in ash content (0.861±0.103%), protein content (4.746±0.063), fat content (2.884±0.248%) and carbohydrates content (14.713±0.379) of CWFM when compared with control. These results are in agreement with Hiza and Bente, (2007). Also Achinewhu *et al.* (1995) indicated that crude protein content for fruits ranged from 3.2-43.1% and total carbohydrates content ranged from 11.3-76.1%.

pH values of fruit and chocolate wheat fermented milks after manufacture and during storage: The pH values of different fermented milks during storage period (21 days) at 4°C are illustrated in Fig. 1. The end point used in fermentation for all fermented milks was pH 4.9. Result showed that It decreased continuously throughout the storage period to be on day (d) three 4.6, 4.7, 4.7 and 4.8 for the control, strawberry, mango and chocolate wheat fermented milks, respectively. The lowest pH value at the end of storage period was for strawberry (pH 4.00) however the highest value was for chocolate fermented milk.

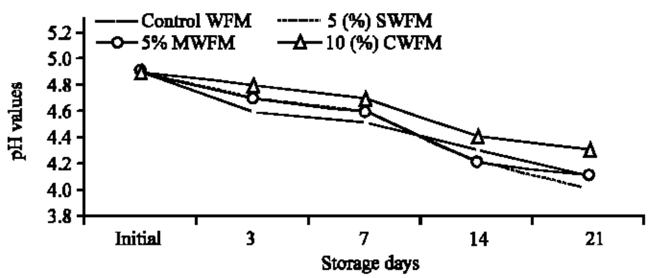

Fig. 1: pH values of fruit and chocolate wheat fermented milks after manufacture and during storage, WFM: Wheat fermented milk, SWFM: Strawberry wheat fermented milk, MWFM: mango wheat fermented milk, CWFM: Chocolate wheat fermented milk

Table 1: Gross chemical composition of fruit and chocolate wheat milk beverages before fermentation

	Composition (%)				
Beverages	Moisture	Total protein	Ash	Fat	Carbohydrates
15% wheat fermented milk	83.410±0.008	3.482±0.430	0.830±0.016	2.719±0.086	9.559±0.515
5% strawberry wheat fermented milk	85.925±0.037**	3.354±0.304*	0.624±0.012**	2.547±0.129*	7.55±0.230**
5% mango wheat fermented milk	85.285±0.030**	3.307±2.241	0.597±0.012**	3.172±0.630	7.639±1.798
10% chocolate wheat fermented milk	76.796±0.032**	4.746±0.063	0.861±0.103**	2.884±0.248**	14.713±0.379

*,**Values (Mean±SE) in each column are significant and highly significant at $p<0.05$ and $p<0.01$, respectively

Table 2: Organic acids content of fruit and chocolate wheat fermented milk beverages at initial and on day 21 of storage

Beverages	Days of storage	Organic acids (mg/100 g w/w)			
		Lactic	Citric	Succinic	Probionic
15% wheat fermented milk	Initial	0.44	0.57	3.49	6.95
	21	0.59	0.64	3.95	6.37
5% strawberry wheat fermented milk	Initial	1.15	0.80	7.23	9.30
	21	1.00	1.21	6.09	9.48
5% mango wheat fermented milk	Initial	0.75	1.13	15.47	8.27
	21	0.60	0.82	13.47	6.16
10% chocolate wheat fermented milk	Initial	0.76	0.90	3.29	6.41
	21	0.95	0.91	4.36	6.38

Akalin *et al.* (2004) reported that probiotic microorganisms reduced the pH of yogurt from 4.51-4.40, after 28 days of refrigerated storage at 4°C which in line with our study. Due to the probable high fermentable carbohydrate content of wheat compared to other raw materials, the final pH varied between 3.43 and 3.86 in wheat boza (Hui, 2012).

Organic acids contents (mg/100 g) of fruit and chocolate wheat fermented milks at initial and after 21 days of storage: Organic acids contents of wheat fermented milk and its alternatives (strawberry, mango and chocolate wheat fermented milk) at initial and on day 21 of storage are shown in Table 2. The type organic acid produced at high concentration for control after manufacture was probionic acid (6.95 mg/100 g), followed by succinic acid (3.49 mg/100 g), then citric acid (0.57 mg/100 g). Lactic acid content increased in wheat fermented milk at both initial and end of storage time when compared to control. During storage, lactic acid increased in control and CWFM however decreased in both of SWFM and MWFM. Probionic acid content increased in both of SWFM and MWFM when compared to control at initial. On day 21, it increased in SWFM, however it decreased in control, MWFM and CWFM. Succinic acid content increased in both of SWFM and MWFM when compared to control, however it decreased in CWFM. On day 21 it increased in both of control and CWFM, however it decreased in both of MWFM and SWFM comparing to their initial contents. Citric acid content increased in all fermented milks at initial when compared to the control. Storage increased citric acid content in both of SWFM and CWFM, however it decreased in control and MWFM.

The results revealed that succinic acid was the dominant acid in MWFM, however probionic acid was dominant in WFM, SWFM and CWFM at initial and after 21 days of storage. Lactic acid production increased up to the end of fermentation (48 h). Fuller (1992) and Gonzales *et al.* (1990) stated that during fermentation process, lactic acid is produced, reducing pH. Lactic and acetic acids have been reported to be flavor enhancers (Gobbetti and Corsetti, 1997).

***Lactobacillus acidophilus* and *Bifidobacterium lactis* count (log_{10}/CFU mL^{-1}) in fruit and chocolate wheat fermented milks:** Results obtained in Table 3 showed count of lactic acid bacteria (log_{10}/CFU mL^{-1}) grown on MRS medium (*Lactobacillus acidophilus* and *Bifidobacterium lactis*) for four fermented milks. Data show no significant difference in count of lactic acid bacteria on d 21 between control and fruit fermented milks; however there were difference in CWFM (4.793±0.059) comparing to control and other fruit based milk beverages.

Table 3: *Lactobacillus acidophilus* and *Bifidobacterium lactis* count of fruit and chocolate wheat fermented milk beverages

	Counts (log_{10}/CFU mL^{-1})				
	Storage days				
Samples	Initial	3	7	14	21
15% wheat fermented milk	4.900±0.031	5.576±0.006	5.579±0.013	4.100±0.100	4.000±0.000
5% strawberry wheat fermented milk	5.446±0.008**	5.102±0.011**	4.359±0.058**	4.418±0.058	4.100±0.100
5% mango wheat fermented milk	5.166±0.009**	4.100±0.100**	4.359±0.058**	4.651±0.090**	4.100±0.100
10% chocolate wheat fermented milk	4.842±0.036	5.651±0.027	5.270±0.083*	5.244±0.036**	4.793±0.059**
F-value	124.073	185.360	112.536	40.653	22.680
Significance	0.000	0.000	0.000	0.000	0.000

*,**Values (Mean±SE) in each column are significant and highly significant at p<0.05 and p<0.01, respectively

Table 4: *Streptococcus thermophilus* count of fruit and chocolate wheat fermented milks

	Counts (log_{10}/CFU mL^{-1})				
	Storage days				
Samples	Initial	3	7	14	21
15% wheat fermented milk	2.883±0.019	2.952±0.028	3.307±0.018	3.359±0.029	3.402±0.024
5% strawberry wheat fermented milk	2.774±0.042	3.051±0.033	3.143±0.075	3.278±0.013	3.402±0.024
5% mango wheat fermented milk	2.793±0.059	3.102±0.011*	3.226±0.04	3.403±0.051	3.466±0.019
10% chocolate wheat fermented milk	2.725±0.026	2.937±0.017	3.064±0.033*	3.22±0.023	3.328±0.017
F-value	2.749	10.858	4.973	6.299	6.659
Significance	0.112	0.003	0.031	0.017	0.014

*,**Values (Mean±SE) in each column are significant and highly significant at p<0.05 and p<0.01, respectively

Result showed that chocolate increased the count of lactic acid bacteria in most of storage times when compared to control, however fruit increased the count at some storage times. Melaku and Faulks (1988) indicated that numbers of LAB increased during the first stages of the natural fermentation with a slight reduction in number during the later stages of fermentation. Bacteriocins produced by probiotic lactic acid bacteria may also contribute to an increased stability of the food product during its storage and shelf-life (Muller and Radler, 1993). Fruits and vegetables have been suggested as ideal media for probiotic growth because they inherently contain essential nutrients; they are good-looking and have good taste (Luckow and Delahunty, 2004; Sheehan *et al.*, 2007). However, the survival of probiotics in fruit-based matrix is more complex in dairy products, because usually the bacteria need protection from the acidic conditions in these media (Shah, 2007).

***Streptococcus thermophilus* count (log_{10}/CFU mL^{-1}) of fruit and chocolate wheat fermented milks:** *Streptococcus thermophilus* count of four fermented wheat milk beverages were represented in Table 4. No significant differences in *S. thermophilus* count were found between the control and strawberry beverage all over the storage period. Mango caused a significant increase in *S. thermophilus* count in MWFM on day 3 (p<0.05), however there were no significant difference at initial and on day 7, 14 and 21. It is clear that chocolate caused a significant decrease in *S. thermophilus* count comparing to control on day 7 (p<0.05), however there were no significant

Table 5: Total microbial evaluation of fruit and chocolate wheat fermented milks

	Counts (log_{10}/CFU mL^{-1})				
	Storage days				
Samples	Initial	3	7	14	21
15% wheat fermented milk	5.053±0.012	5.715±0.009	5.770±0.004*	5.823±0.005	6.046±0.004
5% strawberry wheat fermented milk	5.556±0.006**	5.555±0.018**	5.643±0.011**	5.605±0.009**	5.969±0.006**
5% mango wheat fermented milk	5.321±0.011**	5.254±0.013**	5.440±0.023**	5.508±0.0240**	6.099±0.009**
10% chocolate wheat fermented milk	5.040±0.022	5.780±0.006*	5.701±0.012	5.789±0.006	5.857±0.006**
F-value	277.022	335.111	96.57	121.534	222.966
Significance	0.000	0.000	0.000	0.000	0.000

*,**Values (Mean±SE) in each column are significant and highly significant at p<0.05 and p<0.01, respectively

difference at initial or on day 3, 14 and 21. This result agrees to less extent with Pescuma *et al.* (2010) who recorded that the decrease in *S. thermophilus* CRL 804 and *L. delbrueckii* subp. *bulgaricus* CRL 656 was more pronounced (1.0 and 2.5 log CFU mL^{-1}) in beverage formulation after 28 h of incubation.

Coliform, yeast and molds of fruit and chocolate wheat fermented milks: No growth of yeast and molds or coliform was detected in all wheat fermented milks over the storage period at 4°C. This indicates that proper care was taken to avoid contamination throughout the process and the product has good quality. There was no post processing contamination. This is due to low pH according to Salji and Saadi (1986) who found out that the lowest count of coliform bacteria was enumerated in the lowest pH yoghurt. Steinkraus (2002) and Erbas *et al.* (2006) noticed that fermented foods are safe due to low pH and high organic acids, such as lactic acid. The production of acids and other antimicrobial components during fermentation may promote or improve the microbiological safety and stability of the product (Holzapfel, 1997).

Total microbial count (log_{10}/CFU mL^{-1}) of fruit and chocolate wheat fermented milks: Results obtained in Table 5 shows total microbial count of four wheat fermented milks. Data shows that there were high significant increase (p<0.01) in the total count at initial in both of strawberry and mango fermented milks comparing to control, however no significant differences were observed between CWFM and control. High significant decrease (p<0.01) of total microbial count in SWFM and MWFM comparing to control were observed on day 3, 7 and 14.

The highest value was for control followed by MWFM then SWFM and the lowest value was for CWFM. Slight decrease in bacterial growth rate was observed on day 3 for SWFM and MWFM; this may be due to the change in temperature from the incubation (37°C) to the storage (4°C) which may cause temporary interruption in microorganism activity. The higher decrease in SWFM and CWFM when compared to control on day 21 may be due to deficiency of specific preferable nutrients (sugars) for lactic acid bacteria strains. These results are in harmony with Almeida *et al.* (2007) who stated that total count of microbial population on different culture media throughout fermentation of cassava to produce cauim varied from 5.8 to 10.2 log CFU mL^{-1}.

Organoleptic properties of fruit and chocolate wheat fermented milks: Average of organoleptic scores recorded in wheat fermented milk (control) and its alternatives (SWFM, MWFM and CWFM) are presented in Table 6.

Table 6: Organoleptic properties of fruit and chocolate wheat fermented milks

	Parameters				
Beverages	Color	Texture	Taste	Odor	Overall acceptability
15% wheat fermented milk	8.00±0.00	8.200±0.133	8.700±0.152	8.700±0.260	8.400±0.136
5% strawberry wheat fermented milk	8.800±0.326	7.800±0.200	8.400±0.221	8.300±0.152	8.325±0.224
5% mango wheat fermented milk	8.300±0.335	8.400±0.266	8.800±0.388	8.600±0.305	8.525±0.323
10% chocolate wheat fermented milk	8.200±0.249	8.300±0.260	9.00±0.258	9.200±0.326	8.675±0.273*
F-value	1.648	1.407	0.862	1.924	3.853
Significance	0.195	0.257	0.470	0.143	0.017

*,**Values (Mean±SE) in each column are significant and highly significant at $p<0.05$ and $p<0.01$, respectively

Table 7: Syneresis values after 30 m for fruit and chocolate wheat fermented milks after manufacturing and during storage

	Syneresis (mL/100 mL)				
	Storage days				
Samples	Iuitial	3	7	14	21
15% wheat fermented milk	14.666±0.333	18±0.577	19.666±0.333	21.000±0.577	51.333±0.666
5% Strawberry wheat fermented milk	14.000±0.577	15.000±0.577**	16.333±0.333*	21.333±0.881	32.000±0.577*
5% Mango wheat fermented milk	11.000±0.577*	17.333±0.333	17.666±0.881	23.000±0.577	32.333±0.333**
10% Chocolate wheat fermented milk	18.333±0.881*	10.333±0.333**	12.000±0.577**	12.333±0.333**	14.333±0.333**
F-value	23.333	54.167	31.639	59.310	913.333
Significance	0.000	0.000	0.000	0.000	0.000

*,**Values (Mean±SE) in each column are significant and highly significant at $p<0.05$ and $p<0.01$, respectively

Data shows that there were no significant differences between the control and other fermented milks in color, texture, taste and odor. Results revealed that SWFM gained the highest color score followed by MWFM, CWFM and then control. MWFM recorded the highest value of texture score, followed by CWFM, then control. Data also shows that CWFM obtained the highest taste score (9.00±0.258), followed by MWFM (8.800±0.388) then control (8.700±0.152). The highest Odor value was for CWFM followed by control, MWFM, then SWFM. It could be also noticed that there were significant differences ($p<0.05$) between control and CWFM in overall acceptability for CWFM, however there were no significant differences between control and both SWFM and MWFM. CWFM gained the highest overall acceptability followed by MWMF then the control. These results are in line with Gadaga *et al.* (1999) who stated that fermentation is an inexpensive technology, which preserves the food, improves its nutritional value and enhances its sensory properties. The fruit juices have been suggested as an ideal medium for the functional health ingredients because they inherently contain beneficial nutrients, they have taste profiles that are pleasing to all the age groups and because they are perceived as being healthy and refreshing (Tuorila and Cardello, 2002). Also, Luckow and Delahunty (2004) evaluated the consumer's acceptance for the appearance, aroma, texture and flavor of the probiotic fruit juices. The fermented foods are of great significance because they provide and preserve vast quantities of nutritious food in a wide diversity of flavors, aromas and textures which enrich the human diet (Steinkraus, 2002).

Syneresis values of fruit and chocolate wheat fermented milks after manufacture and during storage: Table 7 shows syneresis values of four wheat fermented milks. The obtained results revealed that syneresis values affected by adding fruits and chocolate to fermented milks. Results revealed that both fruits and chocolate milks were better than control regarding the ability to absorb moisture. CWFM was the best product due to the high level of addition (10%) and its low moisture content with insignificant difference with other milks at various stages.

Syneresis rate decreased in CWFM from initial to day 3 as a result of the cold storage, after that the values increased, however it increased in all other beverages from initial to day 21, this may be due to constituents metabolism interactions in products.

CONCLUSION

With the growing interest of consumers in health-related foods, the market for probiotic health microorganisms would have a bright and promising future. Manufacture of fermented milk beverages by addition of chocolate, strawberry and mango are suggested to give more acceptability, suitable levels of microbiological aspects and a significant decrease in syneresis values particularly in Chocolate fermented milk. It can be concluded that using different natural additives such as fruits and chocolate gives wide range of choices to the consumer's desires in the market of probiotic fermented beverages with functional properties.

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