Some Chemical and Physical Properties of Cereal Fermented Milk Product

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ABSTRACT

Two types of whole cereal fermented milk were prepared by adding different concentrations of either whole wheat flour (wwf) or whole barley flour (wbf) by (3,5 and 7%) during manufacture. The addition of cereal caused an increase in total solids, T. protein, fat ,crude fiber, carbohydrates and ash content by 21, 6.25, 1.4,0.18, 48.5 and 4.3% in the case of 3% wwf-fermented milk and increase by 37.1, 17.9, 1.7, 29.5, 79.7 and 14.49 in 5% wwf-fermented milk. The corresponding values in 3% wbf-fermented milk were 21.79, 12.4, 1.52, 30.5, 45.3 and 5.6% and 34.3, 20.9, 2.7, 53.3, 69.4 and 15.9% in 5% wbf-fermented milk.

The viscosity of the both type cereal-fermented milk was increased as the percent of cereal added and storage time increase by about 4-5 fold time in the fresh products and 9-12 fold time after 14 days of storage, therefore 3% (wbf) and 5% (wwf)-fermented products were accepted depending on the sensory evaluation.

INTRODUCTION

Whole-grains cereals intake are associated with beneficial health effects and epidemiological studies have shown that it is protective against cancer, diabetes and obesity, Jacobs et al (1998) and kushi et al (1999). Whole-grains are rich in fermentable carbohydrates such as dietary fiber, resistant starch and oligosaccharides and one proposed protective mechanism is the effect on human gut microbiota. Whole-grains cereals comprise three distinct physiological regions, the endosperm, germ and bran. The grains endosperm is composed mainly of starch, whose digestibility and subsequent fermentability will be affected by food processing, grain germ, is made up of a complex mixture of lipids and proteins and some mainly soluble carbohydrates, while wheat bran is composed of non digestible mainly insoluble, and poorly fermented carbohydrates such as cellulose as well as polyphenolic lignans all together indicated as dietary fiber. It contains many compounds such as antioxidants, lignans, vitamins and minerals that may protect against chronic disease. An important amount of phenolic compounds (500-1500mg /kg), is linked to the dietary fiber and this explain why wheat dietary fiber has a marked antioxidant activity, beside the importance of fibers in diets which makes food more thoroughly chewed, slow down eating process, slow digestion and absorption so keep blood sugar as a more even level and it is broken down in colon by fermentation process giving simple organic acid helps to nourish the lining of the colon. Esposito et al (2005).

Yoghurt is among the most common dietary products consumed around the world, and its sensory attributes have a large effect on consumer acceptability Saint-Eve et al., (2006). As popularity of yoghurt products continues to grow, manufactures are continuously investigating value-added ingredients such as prebiotics and probiotics to entice health conscious consumers FAO/WHO, (2001). The fermented dairy product has been studied extensively in the past few decades.

Yoghurt like products have been produced from various kind of cereals such as liquefied starch. Shin, (1989), Cooked maize meal mixture Zulu et al, (1997), and prefermentable rice flour (Lee et al, 1992). Coda. et al, (2012) used rice, emmer, oat and soya flour for making yoghurt like beverages using two strains of lactobacillus plantarun.

The aim of this study was to produce a fortified fermented milk with some nutritional and functional products like whole wheat and barley flour acceptabile for some consumers at for all the consumers.

MATERIALS AND METHODS

Ingredients:

Low heat dried whole milk (BBA- Lactalis industrie 35230 Bourgarre-France).

Cereals whole wheat flour (Triticum restivum) and whole barley flour (Hordeum vulgare) were purcashed from local markets. Whole grains were washed, dried and crushed.

Starter:

Yoghurt starter (Streptococcus thermophilus +Lactobacillus delbruckie ssp bulgaricus) (YC X11) (CHR Hansen).

Manufacturing of yoghurt- cereal fermented milk products using whole wheat flour or whole barely flour

The whole milk powder was reconstituted to obtain 12% T.S. Three levels of cereals powder were used (3,5and 7%) for each whole wheat flour or whole barley flour. The cereals were added before heat treatments at 85ºc/15min, then cooled at 45ºc, 2% of starter was

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Received April 03, 2013, Accepted June 11, 2013

added, the inoculated cereal milk was distributed in plastic cups (100gm each) and incubated at 42ºc till complete coagulation ,then cooled and stored at 5±1ºc.

Chemical and rheological analysis

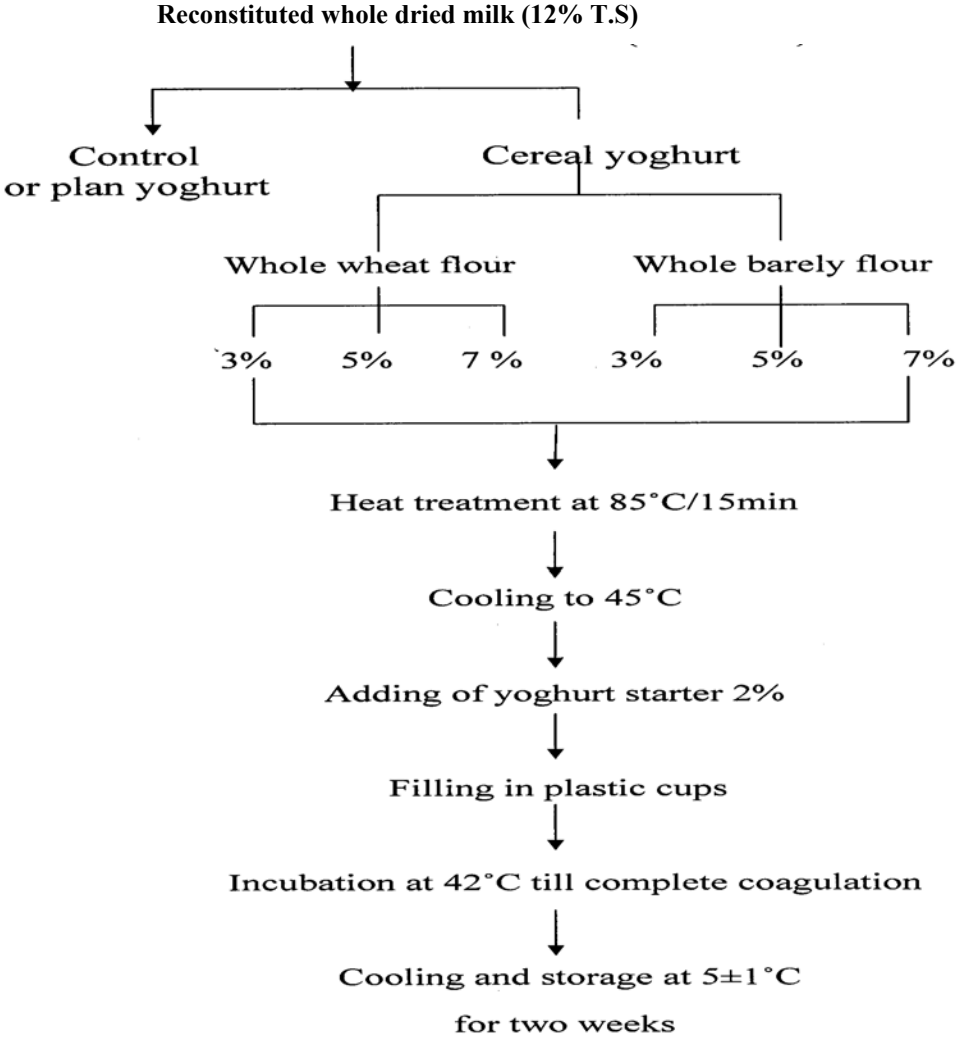
The samples were analysed in triplicates for pH, titratable acidity as lactic acid, volatile acidity, viscosity, acetaldehyde (ppm), total solids, in the fresh products and after 7, 14 days of storage, while total protein, carbohydrate, ash, crude fibers and fat content were determined only in the fresh products. Total solids %, pH value, (Accumet® model 810 pH meter, Fisher scientific), titratable acidity %, volatile acidity %, total protein%, soluble protein%, crude fibers% and Ash %were determined according to the methods described in the AOAC (2003).

Viscosity was measured in the mix at 20°C using rotary viscometer "Rheotest" type RV, Dresden, Germany. The viscosity was expressed in centipoises and calculated by using special formulas and tables supplied with the instrument.

The carbohydrate content was mathematically calculated in the fresh product according to the following equation: Carbohydrate % =100 – (Protein % + Ash % + Fat % + Fiber %)

The fat was determined in fresh product according to the AOAC (2003) by soxhlet extraction method using petroleum ether (b.p 40-60°C) for sixteen hours. The ether was evaporated on steam bath and the drying was completed at ambient temperature

The determination of the acetaldehyde was conducted according to the AOAC (2003). The color intensity was measured at 560 nm using Unicum UV 2100 Spectro photometer USA. The concentration of acetaldehyde was calculated using a stander curve of pure acetaldehyde.



Flow chart diagram for the preparation of cereal-yoghurt products

Microbiological Analysis: -

Fresh and two weeks of stored samples were analysed, by decimal serial dilution in peptone water for counting lactic acid bacteria, coliform group and yeast and moulds on MRS,VRBA and Sabourad agar media ,respectively according to the standard method of dairy products,1984.

Sensory evaluation:

All cereal fermented milk samples were sensory evaluated (flavour, body and texture, and general appearance) by ten staff members of Department of Dairy Science and Technology . Sensory evaluation was carried out using score card estimated by Clark et al (2009) with suggested score guide for designated defect intensitie.

RESULTS AND DISCUSSION

The chemical composition of raw materials used is presented in table (1) the protein % in milk powder, whole wheat (wwf), and whole barley flours (wbf) were 24.4, 9.70 and 11.70 respectively, while the corresponding values of fat content were 28.8, 058 and 1.88%. On the other hand fibers content values were 0.00, 6.00 and 10.35%, while the carbohydrates content were 37.8, 72.85 and 67.16%. The ash content in milk powder was 5.8% while in whole wheat flour and whole barley flour were 0.87 and 1.9%, respectively.

Chemical composition of cereal-fermented milk products:

The result shown in table 2 illustrate the chemical composition of cereal-yoghurt products made by adding (3, 5, 7%) of either whole wheat flour (wwf) or whole barley flour (wbf) in comparison with plan yoghurt. The total solids, total protein, fat, crude fibers, carbohydrates and ash % in plan yoghurt were 12.341, 3.356, 3.504, 0.00, 4.79 and 0.69% respectively. The corresponding values in wwf-yoghurt (3%) were 14.952, 3.566, 3.554, 0.183, 7.119 and 0.720%, while in the wbf-yoghurt (3%) the values were 15.03, 3.774, 3.561, 0.308, 6.964 and 0.736 respectively. Increasing the percent of cereal added to 5 and 7% increased these chemical contents as the cereal % increased. Increasing the cereal percent in the products inreach markedly the nutritional components value of the products especially protein and fibers. The total protein was increased in cereal fermented milk product with increasing the % of wheat or barley flour added because of the protein content of cereal which are 9.7% in wheat flour and 11,7% in barley flour.

The percent of fibers in control yoghurt was nil while in cereal yoghurt, the crude fibers were increased gradually depending on the percent of each whole wheat or whole barley flour added. It was ranged from 0.183 to 0.393 in whole wheat yoghurt and from 0.308 to 0.703 in whole barley yoghurt .It was noticed that percent of crude fiber was higher in barley yoghurt than in whole wheat yoghurt because of its higher percent of crude fibers in whole barley flour which reached 10.35%.

Vijayalakshmi et al (2010) showed that the addition of cereal protein will enhance the nutritive value and open new avenues in value addition, also the increase in solids not fat content will contribute to an increase in protein per cent which in turn contribute to the refinement in the taste of yoghurt with improved consistency, viscosity and reduced whey separation. Increasing the cereal percent in the products markedly inreach the nutritional components and value of the products especially with increasing fibers.

Changes of some chemical and rheological properties of cereals fermented milk products during storage

Data in the table (3), showed a gradual decrease in pH from 5.18 in fresh yoghurt to 3.97 after 14 days of storage period, while addition of 3, 5 and 7% whole wheat flour (wwf) for preparing fermented milk, decrease the pH from 5.35 to 4.38, 5.23 to 4.55 and 5.3 to 4.41 respectively, after 14 days of storage. Acidity showed an increase in fresh yoghurt from 0.68 to 1.0% after storage period. Addition of 3, 5 and 7% wwf caused an increase in yoghurt acidity from 0.75 to 0.95, 0.79 to 0.99 and 0.79 to 1.043% respectively after14 days of storage.

Table 1. Chemical composition of raw materials

Natural componant %	Raw material %		
	Milk powder	Wheat flour	Barley flour
protein	24.4	9.70	11.70
fat	28.8	0.58	1.88
carbohydrate	37.8	72.85	67.17
Ash	5.8	0.87	1.90
moisture	3.3	10.0	7.00
fiber	0.00	6.00	10.35

Table 2. Chemical composition of cereal-fermented milk products

Treatment	Chemical composition %						
	Cereal %	Total solids	Total protein	Fat	Crude fibers	Carob-hydrates	Ash
Control	0.0	12.341	3.356	3.504	0.00	4.791	0.690
Whole wheat flour-yoghurt (wwf)	3	14.952	3.566	3.554	0.183	7.119	0.720
	5	16.925	3.959	3.560	0.295	8.612	0.794
	7	19.281	4.252	3.570	0.393	10.649	0.810
Whole barely flour-yoghurt (wbf)	3	15.030	3.774	3.561	0.308	6.964	0.731
	5	16.586	4.059	3.602	0.536	8.120	0.804
	7	19.364	4.288	3.666	0.703	10.501	0.909

The rate of increasing and decreasing of both acidity and pH was lower than that found in plan yoghurt; it may be due to the increase in total solid and viscosity. The same trend was found during the storage of barley fermented yoghurt, but the rate of pH decreasnd acidity increasing was higher in barley fermented yoghurt. These results were in agreement with Mehanna and Hefnawy (1990) and Mehanna (1991).

Soluble protein/ Total protein table3, showed an increased during storage in both yoghurt and cereal yoghurt because of protein degradation by starter culture in both products. The % of increasing was higher in barley flour yoghurt than in wheat flour yoghurt. Al-Othman (1997) found the same trend during his study on some commercial baby food consumed in Saudia Arabia.

The viscosity of plan yoghurt and cereal fermented yoghurt were also presented in table (3) showed that the addition of whole wheat or whole barley flours had great effect on viscosity. The viscosity of fresh yoghurt was 322cP, while it was 1251, 2419 and 2651cP in yoghurt with 3, 5 and 7% whole wheat flour respectively. The corresponding values when barley flour used were 1201, 1833 and 2178cP. After 14 days of storage, the viscosity was greatly increased in all treatments according to the increase in acidity and total solids. Newman et al (1990) measured the viscosity of hull, hull-less barley flour and wheat flour and they found that hull barley flour reached the peak of the viscosity at a lower temperature, where those for hull, hull-less barley flour and wheat flour values were 1580, 700, and 610 B.U. respectively.

From the data in table (3) it can be noticed that the volatile acidity did not affected by the addition of both wwf and wbf in different concentration and it was ranged from 0.002% to 0.055% in fresh product and from 0.011 to 0.075 at the end of storage, period.

The data presented in table(3) showed that the acetaldehyde in yoghurt fortified with wwf were ranged from 45 to 94 ppm and it was slightly higher than that in yoghurt fortified with wbf which ranged from 45ppm to 77 ppm in fresh and after storage for 14 days.

Microbiological content of plan yoghurt and cereal fermented milk product.

Table (4) illustrate the change in the log cfu/g of cereal fermented milk on MRS media during the storage of product for 14 days at 5± 1c. the log cfu/g of the control,whole wheat flour (3,5and 7%)were 6.498, 6.556, 6.619 and 6.438 respectively in fresh product changed to 6.071, 6.176, 6.258 and 6.398 respectively after 14 days. The corresponding values of wbf yoghurt 3and 5% were 6.498, 6.602, 6.627 and 6.358 in the fresh product and changed to 6.079, 6.350, 6.362 and 6.201 at the end of storage period. In conclusion the counts of starter culture did not changed markedly during storage. On the other hand the count on violet bile agar VRBA and Sabourad media were nil in either control or the two types of cereal fermented milk during storage period.

Sensory evaluation

Sensory evaluation of yoghurt and cereals fermented yoghurt prepared using whole-wheat flour or whole barley flour with different concentrations were presented in table (5). It was clear that in fresh products (1day) the addition of wheat or barley flour in 3 and 5% didn't affect the total score of them, while the addition of 7% of both had lowering the total score because of the effect on body and texture as affected by increasing the viscosity beside the decline of color to un-natural, but the taste was still good .After storage the acidity increased in control yoghurt gradually and affect the flavor and decreased its total score, while in fermented cereal product the effect of acidity on the flavor was not clear and the scores of 3 and 5% were higher than control but 7% cereal fermented yoghurt had the lowest score because of the high viscosity and dark color in whole wheat flour.

From the above results it can be concluded that in case of production of cereal fermented milk products using whole wheat flour or whole barley flour at concentration of 5 and 3% respectively give an accepted product with a high nutritional values.

Table 3. Change in some chemical and rheological analyses of cereal- fermented milk products during storage at 5-7◦c

Treatment	Cereal %	pH			Total acidity %			T.V.A%			Acetaldhyde%		
		Storage period (days)											
		1	7	14	1	7	14	1	7	14	1	7	14
control	0.0	5.18	4.44	3.97	0.68	0.80	1.0	0.055	0.025	0.002	45	56	65
Whole wheat flour-yoghurt wwf	3.0	5.35	5.09	4.38	0.75	0.90	0.95	0.055	0.028	0.005	66	69	86
	5.0	5.23	5.04	4.55	0.79	0.94	0.99	0.055	0.044	0.024	68	75	94
	7.0	5.35	4.55	4.41	0.79	0.95	1.043	0.073	0.045	0.042	69	61	88
Whole barely flour-yoghurt wbf	3.0	4.81	4.31	4.06	0.79	0.85	0.88	0.075	0.027	0.012	50	65	74

Table 4. changes in microbial counts log(cfu/g) in wheat and barley flour fermented milk during storage at 5±1c

Storage period	Cfu/g of ferment products on MRS						
	Control	WWF yoghurt			WBF yoghurt		
		3%	5%	7%	3%	5%	7%
Fresh 14 days	6.498	6.556	6.619	6.438	5.602	6.627	6.358
	6.079	6.176	6.258	6.398	6.350	6.362	6.201

Table 5. Sensory evaluation of wheat flour fermented milk product during storage

Sample	Storage Period at 5±1°C (days)	Flavor (10)	Body and texture (5)	Appearance and color (5)	Total (20)
Control	1	9	4	4	17
A	7	7	3	4	14
	14	7	3	3	13
Whole Wheat	1	9	3	4	16
Flour 3%	7	9	3	4	16
	14	9	4	4	17
Whole wheat	1	9	4	4	17
Flour 5%	7	9	4	4	17
	14	8	4	4	16
Whole Wheat	1	8	3	2	13
Flour 7%	7	8	3	2	13
	14	7	2	2	11

Table 6. Sensory evaluation of barley flour fermented milk product during storage

Sample	Storage Period at 5±1°C (Days)	Flavor (10)	Body and texture (5)	Appearance and color (5)	Total (20)
Control	1	9	4	4	17
A	7	7	3	4	14
	14	7	3	3	13
Whole barley	1	9	4	4	17
Flour 3%	7	9	4	4	17
	14	9	4	4	17
Whole barley	1	9	4	4	17
Flour5%	7	9	3	3	15
	14	7	3	3	13
Whole barley	1	7	3	2	12
Flour 7%	7	6	3	2	11
	14	6	3	2	11

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الملخص العربي

بعض الخواص اطبيعية والكيماوية للألبان المتخمرة المدعمة بالحبوب

ملك عباس، عفت جودة، ماريان فرج

تتميز الحبوب الكاملة بالعديد من الفوائد الصحية والتي تجعـل إضافتها الى الألبان المتخمرة تؤدي الى زيادة القيمة الغذائية والصحية للمنتج المتخمر. تم إستخدام نوعين من الحبوب الكاملة هما القمـح والشعير بثلاث نسب إضافة مختلفة ٣، ٥، ٧٪ وقد تمـت إضـافة مطحون كل من الشعير والقمح الى اللبن اللفف كامل الدسم بعد إسترجاعه بنسبة ١٢٪ ثم التسخين على درجة حـرارة ٨٥°م/١٥ دقيقة ثم التبريد والتلقيح بالبادئ والتحضين على درجـة حـرارة ٤٢°م حتى تمام االتخثر ثم التبريد والتخزين على درجـة حـرارة ٥±١°م لمدة إسبوعين. وأوضحت النتـائج أن إضـافة مطحـون الحبوب الكاملة أدى الى زيادة الجوامد الصلبة والبروتين والألياف والكربوهيدرات والرماد وإرتبطت نسبة الزيادة بزيادة نسبة الإضافة من الحبوب ونسبة هذه المكونات بكل منها.

كان تأثير إضافة الحبوب الكاملة أكثر وضوحاً على اللزوجـة حيث زادت حوالي٤- ٥ مرات عن الكنترول بالمنتجات الطازجة ومن ٩-١٢ مرة بعد التخزين لمدة إسبوعين. وأوضحت التقيـيم الحسي للعينات أن إنتاج لبن متخمر يحتوي علـى ٣٪ مطحـون الشعير الكامل أو ٥٪ مطحون القمح الكامل لاقى درجـة قبـول واضحة.