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Effect of Fermentation Process on the Improvement of Nutrition Value of Camel Milk

Abdulaziz S. Bahobail[1] **Abdelrahim A. Ali**[2] and **Abdallah A. Alyan**[3]

[1]Department of Microbiology, Faculty of Science, Taif University
[2]Department of Chemistry, Faculty of Science and Education (Khurma Branch), Taif University
[3]Department of Biotechnology, Faculty of Science and Education (Khurma Branch), Taif University

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Abstract

This study was carried out to determine the effect of fermentation process using lactic acid bacteria on nutrition value of camel milk . The sample of camel milk has been collected from local market and kept at -18^{O}C and well prepared biochemical tests were done. The average chemical characteristics were 88.8 moisture, 0.87% ash 2.4% proteins, 4.1% fats, 11.5% total solids, 0.79% acidity and 4.4 pH. Vitamin C decreased from 7.3 to 5.9mg/100g in fermented milk In this an increase concentration in amino acids, fatty acids and organic acid were observed after fermentation process.

Key words*: Camel, milk, fermentation, nutrition*

Introduction

Raw camel milk or spontaneously fermented milk play an important role in the diet of native region in Saudia Arabia . Fermentation is spontaneously initiated through continuous utilization of fermentation gourds or vessels at ambient temperatures over one to two days. It results in a microflora dominated by lactic acid bacteria (LAB) probably originating from the vessel surface (Lore, Mbugua, & Wangoh, 2005). Unfermented (raw) camel milk could be an additional source of typical dairy-LAB species (Khedid, et al). LAB contribute to sensorial as well as textural properties of fermented dairy products and microbial safety through the production of bacteriocins and organic acids (Leroy & De Vuyst, 2004). Although many LAB are generally recognized as safe and approved by the qualified presumption of safety for food production and human consumption (Leuschner et al., 2010).

Milk plays a significant role in human s nutrition for wonderful reason that they are excellent source of various nutrients. Milk diet has been suggested in the management of various diseases.(Kergoats et al, 1992). Camel s milk in particular is a good source of various vitamins and minerals and characterized for its low cholesterol and high concentration of insulin (Knoess , 1979, Agrawal, et al 2005). Camel, which is also known as ship of desert, is used for transportation and is a source of milk, meat and wool (Meiloud et al 2011). It has medicinal properties and antibacterial and antiviral activity(Al-Agamy et al, 1992, and El-ouardy et al 2011)which may be due to higher concentration of lactoferrin in camel s milk (Yagil et al 1994). An Indian study report that camel milk has hypoglycemic effect against diabetics in rats (Agrawal et al 2005).

The present study was carried out to determine the improvement in nutritional value that occur in the camel milk during fermentation by selected starter cultures.

Materials and Methods

Preparation of samples

Traditional camel milk was obtained from different locations, sterilized container and kept at -18C. then heated at 90C for 15 minues, immediately cooled to 42C and then inosculated with traditionally fermented milk. The chemical analysis of fresh camel milk and fermented was investigated. Moisture content of fermented milk samples was determined according to AOCS (1980), The Kejeldahl method was used to determined the protein content according to AOCS (1980), Casein content was determined according to the method described by AOCS (1970), Ash content was determined according to AOCS (1980), The pH measurement of fermented milk was measured using pH meter model CO 840 according to AOCS (1984) at 26C. The titremetric determination of acidity of the different samples was accomplished according to AOCS (1980). The total solids were determined according to AOCS (1980). Soluble sugar analysis was performed according to the method of Pirisino (1983). using HPLC Shimadzu LC. NH2 from Shimadzu, Kyoto-Japan. Sugar standards were purchased from Sigma (Sigma Chemical Co., St. Louis, Mo). Results were reported as percentage (w/w).

Determination of mineral content

The content of minerals of fermented camel milk will be determined according to the method described by Miller-Ihli(1996). Samples will be kept in oven at temperature of 450C for 6 hours, then cooled and will dissolved in concentrated HNO3 for analysis, then will be diluted two times. The flame atomic absorption with variant spectrophotometer(Spctr-AA-10) will be used to determined the macro-elements Ca, Mg, Na and K and micro-elements Cu,I, Zn and Mg. Flame photometer (Model Eppendort Elex 6361) will be used to determined phosphorus.

Determination of total amino acids

Amino acid composition was determined with Moore and Stein (1963) method. Fermented samples were duplicated by transferring one gram of sample into a 15 ml ampoule, adding 10 ml 6 N HCl, sealing the vial under vacuum and digesting at 110°C for 24 h. Amino acids analysis was performed on reverse phase-highpressure liquid chromatography (RP-HPLC) (Shimadzu 34 LC – 10 AD, Shimadzu corporation, Kyoto, Japan).

Determination of fatty acids composition using fatty acid methyl esters

The fatty acid methyl esters of milk of samples will be prepared by the procedure of Sheppard and Iverson (1975). They will be identified by their retention time in comparison with standards and will expressed as percent of total.

Gas chromatography

A Pye Unicam series 304 chromatography (Pye Unicam Ltd UK) with flame ionization detector will be used to analyse the fatty acid methyl esters in using 10% polyethylene glycol adipate column (PEGA, 2.5 m length, 4 mm diameter). The temperature of injector, column and detector were 190, 195 and 220°C respectively. Nitrogen served as a carrier gas at a flow rate of 60ml/min while the flow rates of hydrogen and air were 60ml/min and 480 ml/min respectively.

This condition will achieved for separation of fatty acid of triacylglycerols of camel milk and colostrum. The same results will be obtained when we will used temperature programming. Starting column temperature was 140°C and final temperature was 200°C with increase rate of 5°C per min

Determination of organic acids

The organic acids and ethanol were determined according to Marssili et al. (1980). 10 ml of fermented milk were centrifuged at 10000 rpm for 20 min. The supernatant was filtered through membrane filter 0.45 µm diameter 25 mm (Schleichen µ Schiill- Germany) and analyzed for lactic acid, formic acid, acetic acid and ethanol by HPLC Shimadzu LC. NH2 was from Shimadzu, Kuoto- Japan, using an organic acid column PL Hi-plex H (from Polymer Laboratories Amherst, M.A. 01002, U.S.A) fast acid column. Results were reported as percentage (w/w)

Determination of vitamins

Vitamins was determined according to AOAC (1984)

Results and Discussion

The results of the chemicals analysis of fresh camel milk and fermented one are presented in Table (1) The mean values of total solids were 11.08% and 11.5% for fresh and fermented camel milk samples respectively. This measure attributed to decrease in moisture (Abu- Lehia 1989). The mean values of protein content of the fresh and fermented samples were 2.83 and 2.4%, respectively These results were closed to those obtained by Mirgani (1994), Variation in protein content could be attributed to many factors, including feeding, inheritance, seasonal variation, nutrition, age and stage of lactation Meiloud, et al 2011.

The fat content of fresh camel milk 3.2 was lower than that of fermented milk which were 4.1. The mean values of lactose content 3.7% in fermented milk which is lower than fresh milk 4.6%. Several factors could be responsible for those differences, which include the difference in chemical composition of milk used, the period of incubating milk for fermentation, in addition to microbial population in the samples.

Moisture has a significant effect on the stability and quality of food, and one of the most commonly used measures in processing and testing of foods. were 89% and 88% respectively. These values agreed with Mirgani (1994). Fresh milk samples contained moisture that was a little higher than fermented milk. Relatively higher ash content was found in fermented camel milk 93.3 compare to fresh camel milk Ash content of camel milk could be greatly affected by drought conditions (Yagil and Etzion,1980), introducing wide range of variation. The pH of fresh and fermented milk were 6. 6 and 4.46 respectively. The pH was lower in fermented than the fresh milk. These changes was obviously due to fermentation, also difference in pH may be due to lactic acid bacteria strains, which may form a symbiotic action between these strains (Robinson, 1995).

The acidity was expressed as lactic acid value% , were 0.74% and 0.85% in fresh and fermented milk samples respectively. From the above results its clear that fermented samples was higher in acidity and lower in pH values. This could be to higher bacterial load which produce acids in the medium.

Table (1) Chemical composition of fresh camel milk and fermented camel milk

Item	Fresh Milk	Fermented Milk
pH	6.6	4.46
Acidity%	0.133	0.74
Fat%	3.2	4.1
Protein%	3.83	2.4
Lactose%	4.6	3.7
Total solid%	11.08	11.5
Ash%	0.88	0.82
Moisture%	88.92	88.5

Calcium levels of fresh milk ranged between 106 -109 mg/100g. This level is greater than that determined by Gran and Sheiha (1986) who determined value of 131.6 mg/mg, so fermentation process increase the level of calcium to 130 mg/100g.

The magnesium in fresh milk 9.7 mg/100g and increased to 11 mg/100g in fermented milk .It is clearly seen that the fermentation process resulted in slightly increasing of most elements expressed as mg/100g. this could be attributed to the microbial action on milk components Steinkraus, 1983. Wang and Hesseltine 1976 stated that, coagulation results in greatest variations in concentration due to uneven distribution of elements between the curd and whey, depending on the different binding forms present in milk. Some of micro- elements are important from nutritional point of view, Cu is of greatest importance due to catalytic action on fat autoxidation, Mn is important in metabolism of some lactic acid bacteria, especially for the fermentation of citric acid and in some milk Mn content is too low for production of diacetyl by Leuconostocs.

Table (2) Mineral content of fresh milk and fermented milk mg/100gm

Element	Fresh	Fermented
Calcium	109	130
Magnesium	9.7	11
Sodium	69	68.3
Potassium	164	167
Phosphorus	89	108
Iron	0.38	1.1
Copper	0.11	0.5
Manganese	0.33	0.86
Zinc	0.8	0.99

Fatty acid composition of fresh and fermented milk

Fatty acid composition of fresh and fermented milk represented in Table (3). Fatty acids may originate in lipids of animals feed, or non lipid portion of diet, In this study short-chain fatty acids (C6-C12) and long-chain ones (C14-C18) . The data showed that there is a marked increase in fatty acids concentration in fermented milk compared to fresh milk short chain fatty acids, on the other hand the long-chain fatty acids (C14- C18) were found in lower percentages compared with fresh milk samples. The low content of long-chain fatty acids due to fermentation its not easily metabolized and absorbed.

Table (3) Fatty acid composition % of fresh and fermented milk

Fatty acids	Fresh milk	Fermented milk
Caproic (C6:0)	0.08	2.56
Caprylic(C8:0)	0.14	5.95
Capric(C10:0)	0.25	0.55
Lauric (C12:0)	0.15	0.45`
Myristic (C14:0)	8.87	7.04
Palmitic (C16:0)	38.77	1.63
Stearic (C18:0)	12.85	4.3
Oleic (C18:1)	22.33	ND
Linoleic (C18:2)	3.07	65.45
Linolenic (C18:3)	2.9	0.85

The amino acid composition of fermented camel milk and fresh milk are presented in Table (4) The content of histidine 1.45 and 2.80 mg/100g in fresh and fermented camel milk respectively. There is a marked increase camel fermented milk obtained slight significant increase in glycine, alaninie, leucine, lysine and argninie, while there were slight decrease invaline, methionine and tyrosine in comparison to unfermented camel milk. The values of amino acids in this study are higher than those given by Rao et al. (1978) who studied the amino acid of Labneh (a concentrated yogurt product consumed routinely in the middle East) made from goat and cow milk. This variation in the amino acid composition may be due to differences in preparation procedure of milk (goat or cow) and the type of final product Many studies have shown that concentrations of most of he amino acids slightly increase due to fermentation .Muradyan et al. (1986) reported that fermentation of milk by thermophilic lactic streptococci or acidophilic roenriched the final products with at least 4 amino acids cysteine, valine, proline and arginine). The contents of essential amino acids such as valine, threonine methionine, isoluecine, leucine, histidine, lysine and phenylalanine tyrosine in the fermented camel milk were found to be higher than those of the FAO/WHO/UNU1985.These findings confirm the excellent nutritional quality of fermented camel milk protein.

Table (4) Amino acid concentration in fresh camel milk and fermented camel milk (mg/100g)

Amino acids	Fresh camel milk	Fermented Camel milk
	Essential amino acids %	
Histidine	1.54	2.8
Threonine	2.65	4.65
Valine	4.6	5.5
Methionine	1.2	2.54
Leucine	2.72	4.34
Isoleucine	4.45	6.55
Tyrosine	1.37	3.43
Phenylalanine	3.29	3.35
Lysine	5.12	7.25
	Non-Essential amino acids %	
Arginine	1.1	2.87
Alanine	2.05	3.12
Serine	2.62	3.15
Glycine	2.45	2.9
Proline	4.9	5.67
Cystine	2.33	3.85
Aspartic acids	5.25	7.18
Glutamic acids	15.5	17.64

Vitamins content

Vitamin C, A, E and B2 contents of the fresh and fermented camel milk are shown in Figure 1. Vitamin C contents were 7.3and 5.9 mg/100g respectively. This finding is consistent with those reported by Oberman (1985) (Magdi et al 2010) who found that lactic acid bacteria fermentation resulted in a marked decrease in vitamin B6, B12 and vitamin C level, while only small changes in vitamin A, B1, B2 and niacin took place. Baranova et al. (1998) also reported that fermentation of goat milk by selected lactic acid bacteria significantly decrease vitamin C, but resulted in slight decrease in B1 and B2 and did not influence tocopherol contents .An increase in folic acid content and a slight decrease in vitamin B12 was found in fermented milk compared to raw milk (Alm, 1984)

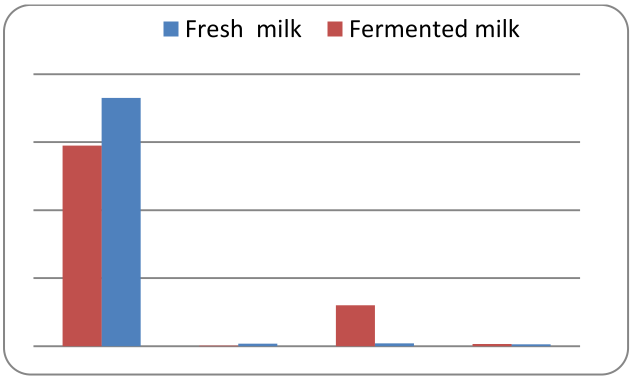

Figure (1) Vitamin content of fresh and fermented camel milk (mg/100g)

Organic acids concentration

The lactic acid, citric acid and acetic acid concentrations in the fermented camel milk products are shown in Figure2. Three organic acids (lactic acid, citric acid and acetic acid) were detected, The lactic acid content was higher compare to other acids. The same result noted by Magdi et al 2010, who used five different species of Lactic acid bacteria for fermentation. Formation of volatile acids during fermentation of Swedish fermented milk products showed that acetic acid and ethanol were low in yogurt than in bifidus milk (Alm, 1981). Kato et al. (1992) studied organic acids during fermentation of skim milk with lactic acid bacteria, and detected seven organic acids. In a similar study, Damir et al. (1992) found more than six organic acids during kishk fermentation, with lactic acid been the highest while formic acid the lowest.

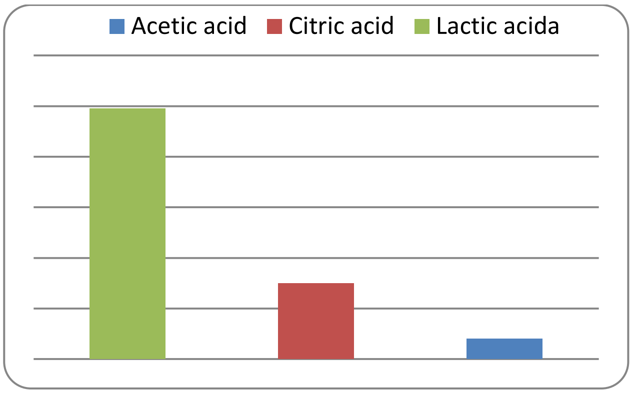

Figure (2) Organic acids concentration% of fermented camel milk

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