Manufacture of Cultured Butter Milk Beverage from Whole and Skimmed Goat's Milk

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Abstract: The development of high quality cultured butter milk beverage (CBMB) is primarily dependent on a controlled fermentation of the milk constituents. Cultured butter milk beverage was made from either whole or skim goat's milk, using mesophilic L-starters FR 19-8126 (Lacfococcus lactis subsp.lactis, Lact. cermohs subsp.cremoris and Leuconostoc cremohs) and DL-starters A-8101 (the same of microorganisms L-starters contain plus Lact. lactis Subs, diacetilactis). Chemical, flavour and organoleptic properties of the resultant four CBMB treatments were compared, when fresh and during 15 days of storage at 7°C. The CBMB made from goat's whole milk cultured with DL-starters had diacetyl and acetaldehyde values which were reported to be necessary for a good flavour balance. Moreover, it received the highest organoleptic scores. Therefore, this CBMB was recommended to be produced commercially in Egypt.

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1. Introduction

Goat's milk is a very good source of calcium and the amino acid tryptophan. It is also a good source of protein, phosphorus, riboflavin (vitamin B2) and potassium. Perhaps the greatest benefit of goat's milk, however, is that some people who cannot tolerate cow's milk are able to drink goat's milk without any problems. It is not clear from scientific research studies exactly why some people can better tolerate goat's milk. Some initial studies suggested that specific proteins known to cause allergic reactions may have been present in cow's milk in significant quantities yet largely absent in goat's milk, Cheng, et. al.(2005); Elwood, et al. (2007); Ensminger and Esminger (1986).

Goat's milk has a more easily digestible fat and protein content than cow milk. The increased digestibility of protein is of importance to infant diets. Goat milk can successfully replace cow milk in diets of those who are allergic to cow milk. In under-developed countries, where meat consumption is low, goat milk is an important daily food source of protein, phosphate and calcium (Paul kindstedt, 2005).

The origin of fermented milks in the diets of humans date back many thousands of years and predates the existence of written records of their production and consumption. Fermented milks were produced since 10,000-15,000 years ago as man's way of life changed from being food gatherer and hunter to food producer. It is likely that this transition may have occurred at different times in different parts of the world. However, archaeological evidence shows some civilizations e.g. the Sumerians and Babylonians in Mesopotamia, the Pharoes of ancient Egypt and the Indians in Asia were well advanced in agricultural and animal husbandry y methods and kept cows and buffalos for milk production, which was either consumed as such or processed into other products (Bill,2009).

Originally, butter milk is a by-product of butter making, now became a milk product cultured with lactic acid. It is available in both whole and skim milk, the cultured butter milk beverage (CBMB) is a fluid with suitable viscosity, of typical clean refreshing acid taste with pleasant flavour and aroma (Alm, 1982a). It is usually consumed fresh, and should be kept refrigerated throughout distribution. CBMB is usually manufactured from pasteurized milk (Whole or skim), using mesophilic mixed-strain starter cultures containing acid producing Lactococcus lactis subsp.lactis and Lact. cremoris subsp.cremoris, and flavour producing either Leuconostocs (L-starter) or both the Leuconostocs and Lact. diacetilactis (DL-starter).

Relatively, little information exists about the effect of goat's milk and skimming of milk and starter type on the chemical, flavour and organoleptic properties of CBMB. So, this was the object of the present paper.

2. Materials and Methods

Fresh bulk goat's milk (whole milk) was obtained from a private sector at Dakahliah Governorate, Egypt. It had an average composition of 13.14% T.S., 4.2% fat, 3.87% lactose, 0.16% acidity, 4.43% protein, and pH 6.63. Skim milk was obtained from the whole milk using a mechanical separator, it contained 9.43 S.N.F. Mesophilic L-starters (FR-198126) and DL-starters (A-8101) were obtained from the Netherlands Institute for Dairy Research (Nizo, Ede, Netherlands). They are usually used for the production of Dutch-cultured butter milk and other cultured dairy products (Noomen et al, 1992). The L-starters contained Lacfococcus lactis subsp. lactis, Lact. cermoris subsp. cremoris and Leuconostoc cremoris, were used to inoculate to CBMB. Addition to these microorganisms the DL-starters contain Lact. lactis Subs, diacetilactis were used to inoculate the other treatment.

Cultured butter milk beverage treatments were made from:

Tr.1. Whole milk cultured with L-starters.
Tr.2. Whole milk cultured with DL-starters.
Tr.3. Skim milk cultured with L-starters.
Tr.4. Skim milk cultured with DL-starters.

Manufacture of cultured butter milk beverage:

Manufacturing was done according to the method of Walker and Gilliland (1987).

Then cooled to 7°C, bottled and stored in a refrigerator. Samples were taken from the CBMB after fermentation and after storage for 3, 5, 7 and 15 days at 7°C. Triplicate samples were taken for analysis.

Chemical analysis:

The pH was measured using a digital pH meter with combined electrode, total solids (T.S), fat, acidity, lactose, total protein and non-protein nitrogen (NPN) percentages were determined according to AOAC (2000). The total volatile fatty acids (TVFA) were estimated according to Kosikowski (1984); diacetyl according to Less & Jago (1970), and acetaldehyde by using method of Lees and Jago (1969). The CBMB from different treatments was scored for organoleptic properties by a panel 20 staff members of Food Technology and Dairying Department, National Research Centre. The assessed properties were: flavour (40), acidity (20), colour (10) and consistency (30).

3. Results and Discussion

Chemical composition

The total solids, fat and protein contents of CBMB from whole goat's milk, and skim milk were not significantly affected either by starter type or storage period (tables1,2). This could be explained on the basis that mesophilic lactis bacteria has low lipolytic and proteolyic activity towards milk fat and protein, respectively, (Alm,1982b,d) and Law & Kolstada (1983). However, the NPN content of CBMB slightly increased after fermentation and during storage (Tables 1, 2). This could be explained on the basis that the added starter may cause a limited hydrolysis of some whey proteins (Alm, 1982d). However, the NPN content of CBMB was not significantly affected by milk skimming or starter type.

The amount of lactose of CBMB generally, decreased after fermentation (at fresh) in all treatments (Tables 1, 2) ranging from 3.87 to 3.71%. This range was in accordance with those reported for Swidish-Fresh CBM (Alm, 1982b). The lactose content proportionally decreased with increasing keeping time of CBMB. At the end of storage time (15 days), the amounts of lactose were in the range of 2.90-2.50% in all samples, indicating that the fermentation of lactose was continued but at a relatively low rate during storage. The changes in the pH values of CBMB from different treatments coincided with the decrease in lactose content with increase acidity in all treatments. They decreased significantly after fermentation. At this pH range, most bacterial growth could be inhibited, which makes the fermented product biologically safe (Walestra et al., 1993). During storage the pH value of CBMB with the use of DL-starier slightly decreased than with the use of L-starter. Also, pH of CBMB from skim milk was generally less than that from whole milk.

Table (1): Chemical composition of cultured butter milk beverage (CBMB) from whole goat's milk during storage.

	Tr.1						Tr.2					
days	0	3	5	7	10	15	0	3	5	7	10	15
TS%	13.2	13.2	13.3	13.3	13.4	13.5	13.1	13.1	13.2	13.3	13.3	13.42
Fat%	4.2	4.1	4.1	3.9	3.5	3.5	4.4	4.4	4.3	4.2	4.0	3.6
Protein %	4.43	4.43	4.50	4.52	4.58	4.71	4.16	4.18	4.26	4.41	.48	4.52
NPN%	0.03	0.03	0.03	0.04	0.05	0.05	0.03	0.03	0.04	0.04	0.04	0.045
Lactose%	3.71	3.60	3.41	3.18	2.86	2.70	3.87	3.63	3.48	3.13	3.01	2.90
pH	5.0	4.84	4.71	4.51	4.50	4.46	5.2	5.0	4.94	4.88	4.81	4.76
Acidity%	0.95	1.01	1.09	1.18	1.21	1.26	0.92	0.97	1.02	1.03	1.17	1.19

T1- Whole milk + L-starters. T2- Whole milk + DL-starters

Table (2): Chemical composition of cultured butter milk beverage (CBMB) from skim goat's milk during storage.

	Tr.3						Tr.4					
days	0	3	5	7	10	15	0	3	5	7	10	15
TS%	9.43	9.43	9.43	9.49	9.53	9.58	9.24	9.24	9.28	9.31	9.34	9.38
Protein %	4.18	4.18	4.22	4.26	4.30	4.32	4.43	4.43	4.45	4.49	4.51	4.58
NPN%	0.03	0.033	0.04	0.04	0.05	0.059	0.036	0.04	0.053	0.058	0.062	0.068
Lactose%	3.71	3.60	3.76	3.08	2.66	2.50	3.77	3.36	3.42	3.08	2.91	2.72
pH	4.4	4.3	4.2	3.9	3.81	3.62	4.32	4.26	4.20	3.86	3.65	3.57
Acidity%	1.24	1.28	1.31	1.34	1.40	1.44	1.13	1.13	1.19	1.22	1.28	1.33

T3- Skim milk + L-starters. T4- Skim miik + DL-starters.

The development of acidity are presented in Fig. 1. They generally supported the results of lactose and pH determinations. The acids consisted mainly of lactic acid and a little of acetic acid (Walestra et.al, 1993). In figure 1, the acidity of CBMB increased during storage, these results were generally in accordance with other reported by Alm, 1982c; Noomen et al., 1992 and Varnam & Sutherland, 1994 . During storage, the acidity gradually increased to reached to 1.44% after 15 days of storage. Kosikowski (1984), reported similar increase in acidity during storage of CBMB. The results also indicated that the use of skimmmilk, with L-starter gave more acids in CBMB than whole milk and DL-starters, respectively. Using standardized cow's milk with less than 0.4% fat developed excess acid flavour in Dutch CBM (Noomen etal., 1992).

Total volatile fatty acids (TVFA)

The TVFA values (Fig. 2) were increasing during storage. These results were in accordance with those reported by (Alm, 1982 a). At the end of storage time (15 days), the TVFA were relatively high in CBMB made with the use of DL-starters compared to the CBMB made with L-starters.

Diacetyl and Acetaldehyde

Fig: 3 and 4 shows that DL-starters produced more diacetyl and acetaidehyde after fermentation than L-starters in CBM made from the same milk. This could be explained on the basis that DL-starters have the ability to ferment citric acid more rapidly and produce more diacetyl than L-starters (Walstra et al., 1993). During 15 days of storage, the diacetyl content gradually increased indicating that the flavour-producing strains (Leuconostocs and or Lactococcus diacetilactis) in the added starters remained active during this periods. On the other hand, the acetaidehyde content proportionally decreased during storage. The loss of acetaidehyde occurs during storage might be due to the ability of Leuconostocs to convert part of the acetaidehyde forming ethanol which was reported to have no role in the flavour of CBM (Collins & Speckman, 1972 and Varnam & Sutherland, 1994). Since the diacetyl : acetaidehyde ratio is near the 4:1, which is considered to be necessary for a good flavour balance in CBM (Lindsay et. al., 1965 and Badings, 1984). This desired ratio was hard to be found in the commercial buttermilk sample analyzed by Keenan et al. 1968 and Vasavada & White, 1979.

Organoleptic properties

Table (3) shows organoleptic scores of the CBMB treatments when fresh and after storage. All CBMB treatments appeared like fluid without wheying-off and gained high scores for consistency and colour. Fluidity is reported to be ideal for CBM, it also increases its refreshing quality (Kosikowki, 1984). After fermentation, the scores of consistency and colour showed no differences due to the different starters used, while they showed slightly lower values when using skim milk than whole milk. At the end of storage time, all the samples were scored lower. Furthermore, all the samples had clean and refreshing acid taste with pleasant flavour and aroma. They generally have good scores for acid and flavour. CBMB made from whole milk cultured with L-starters showed higher score than the other samples. The total organoleptic score, however, gradually decreased with advancing storage time.

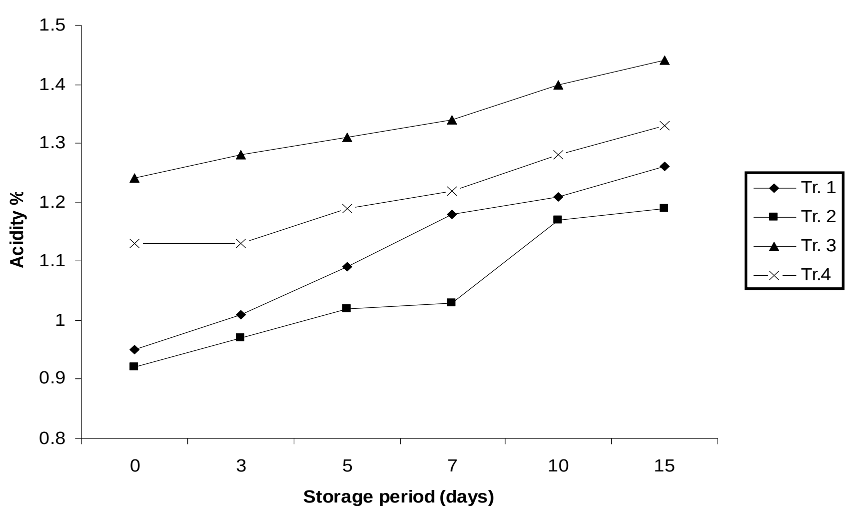
4. Conclusion

In conclusion, the manufacture of CBMB from whole goat's milk using DL-starters can be recommended as it had well balanced flavour and good organoleptic properties.

Table (3): Organoleptic properties of cultured buttermilk beverage from goat's milk during storage.

Treatment	Storage period (Days)	Organoleptic properties score				
		Flavour 40	Acid 20	Colour 10	Consistency 30	Total 100
Tr. 1 Whole milk + L-starter	0	35	16	9	29	89
	3	32	16	9	29	86
	5	32	16	9	29	86
	7	29	16	8	24	77
	10	27	14	8	24	73
	15	24	14	8	23	69
Tr. 2 Whole milk + DL-starter	0	36	16	9	27	88
	3	33	16	9	27	85
	5	33	14	9	27	83
	7	29	14	8	23	74
	10	27	14	8	23	72
	15	20	12	8	18	58
Tr. 3 Skim milk + L-starter	0	38	16	8	20	82
	3	38	16	8	20	82
	5	34	16	7	20	77
	7	29	14	7	17	67
	10	29	14	7	17	67
	15	27	12	5	15	59
Tr. 4 Skim milk +DL-starter	0	38	18	8	20	84
	3	38	18	8	20	84
	5	34	18	7	20	79
	7	29	16	7	17	69
	10	29	16	7	17	69
	15	27	14	5	15	61

Fig 1: Acidity development of butter milk from whole and skimmed goat's milk during stirage



Tr.1. Whole milk cultured with L-starters. Tr.2. Whole milk cultured with DL-starters.
T3. Skim milk cultured with L-starters. Tr.4. Skim milk cultured with DL-starters

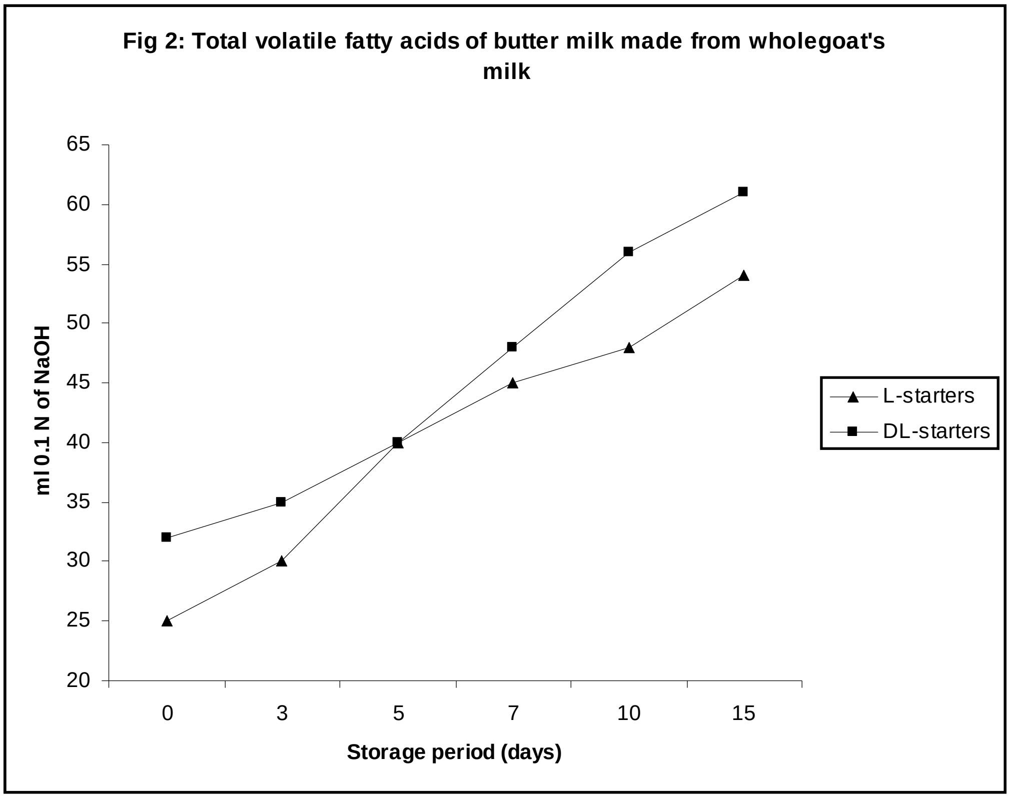


Fig 2: Total volatile fatty acids of butter milk made from wholegoat's milk
ml 0.1 N of NaOH
65
60
55
50
45
40
35
30
25
20
0
3
5
7
10
15
Storage period (days)
L-starters
DL-starters

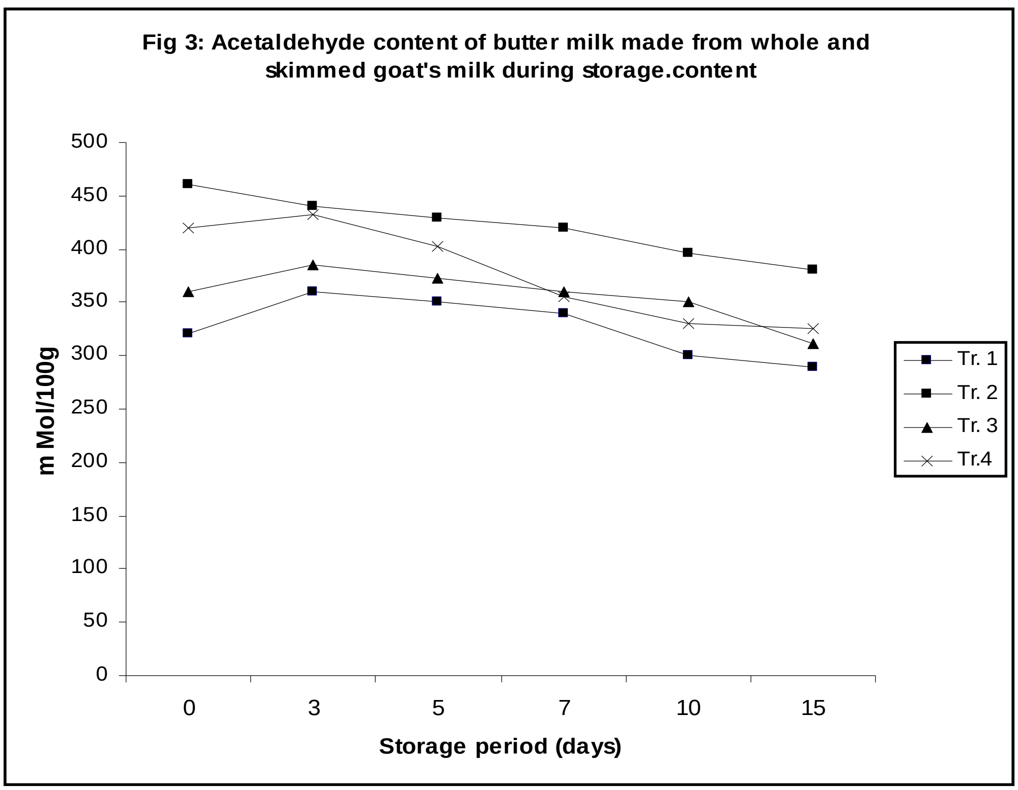


Fig 3: Acetaldehyde content of butter milk made from whole and skimmed goat's milk during storage.content
m Mol/100g
500
450
400
350
300
250
200
150
100
50
0
0
3
5
7
10
15
Storage period (days)
Tr. 1
Tr. 2
Tr. 3
Tr.4

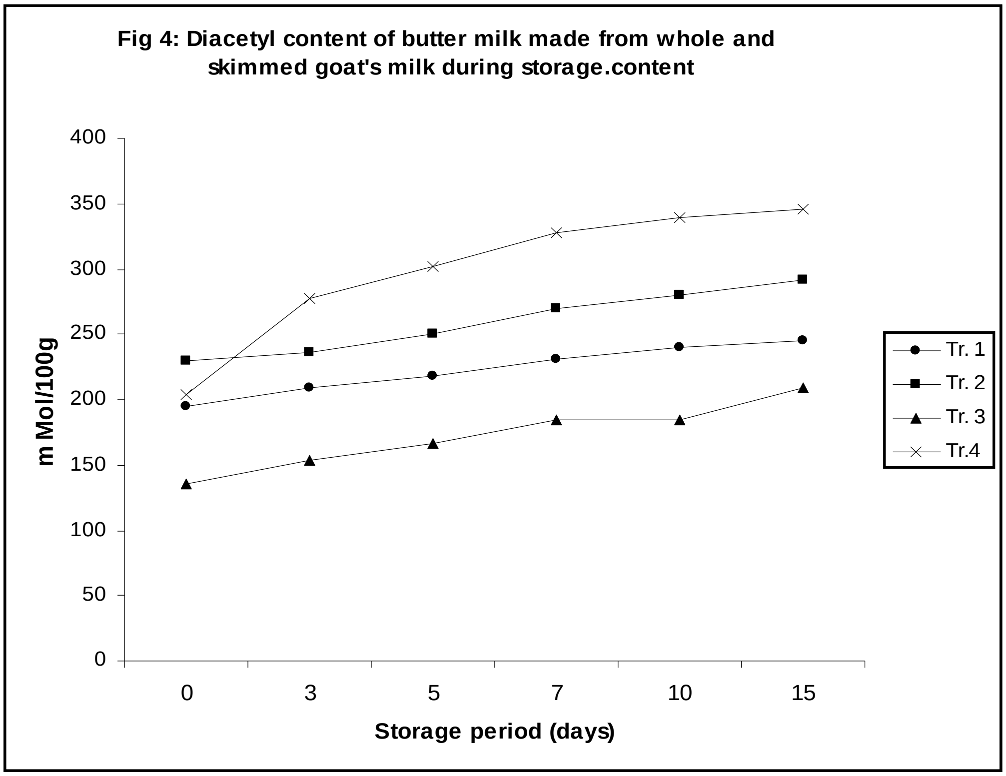


Fig 4: Diacetyl content of butter milk made from whole and skimmed goat's milk during storage.content

Tr.1. Whole milk cultured with L-starters. Tr.2. Whole milk cultured with DL-starters.
Tr.3. Skim milk cultured with L-starters. Tr.4. Skim milk cultured with DL- starters

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