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Comparative Study on Chemical Characteristics of Cow Milk and Goat Milk, Kefir

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ABSTRACT

This study was conducted to determine the chemical characteristics of kefir samples prepared using cow and goat milk separately from locally purchased kefir grains that contained lactococci, leuconostoc, Lactobacillus and yeasts bringing about biochemical changes during fermentation of milk. Goat milk sample of (Beetal indigenous breed) is used for kefir preparation when compared to cow milk it had lower lactose, higher protein, fat and total solids. The fat content of goat milk sample was like naturally homogenized form. But cow milk fat globules which were bigger needed homogenization. Kefir prepared using cow milk and goat milk had almost same titratable acidity of nearly 1 per cent lactic acid; lactose of cow milk as well as goat milk kefir showed lactose hydrolysis of 21.4 and 22.4 per cent; proteolysis accounted for 7.2, 7.5 per cent and fat hydrolysis in case of cow milk kefir and goat milk kefir was 6.5 and 4.2 per cent respectively. Both kefir variants of cow milk and goat milk kefir samples had ethanol content of 0.74 and 0.85 per cent, respectively.

Key words: *Microflora, Cow or Goat's milk, Kefir and Kefir grains*

INTRODUCTION

Fermented milk products are classified based on the starter culture used. Kefir is a self-carbonated, refreshing fermented milk drink which has a unique acidic flavour originally a Russian product prepared using cow or goat's milk. Its origin can be traced back to the Caucasus region where it has been produced by a traditional method in bags made from animal hides or in oak barrels or earthenware pots. As these containers were used continuously, the microorganisms tend to form a thin layer and later clustered on the surfaces of the containers. Approximately equal amounts of lactic acid and alcohol are produced during fermentation by the microflora. Typical flavour results from a balance between lactic acid, diacetyl, aldehyde, alcohol, and acetone.

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Fizz is provided by the carbon dioxide that is also produced during fermentation by yeast[12].

The major factors affecting rheological properties of kefir are the chemical composition of the milk used for its production, the starter culture, microbial content, the incubation temperature, the thermal processing of milk. Composition of kefir also changes in different countries. The main aroma forming compounds are diacetyl and acetaldehyde in kefir. Their level affects the aroma and depends on the production method. Yeast level, type and time of fermentation, kefir grain or starter culture type affect the alcohol content (0.1-1.0%) of kefir[11].Heperkan[4] stated that bovine milk is commonly used for commercial production of kefir. According to the author, ewe milk, goat milk, camel milk and buffalo milk also can be used. He also attempted the use of coconut, rice, almond, soy milk for the production of kefir and concluded that the type and volume of milk affect its sensory, chemical and textural properties. Milk kefir grains become non-propagable if continually cultured in non-dairy milk for long periods.Goat's milk is less allergenic, easier to digest, rarely causes lactose intolerance. In goat milk, the lipid globules are significantly smaller than in cow milk (naturally homogenized). Goat milk has been recommended as a substitute for patients allergic to cow milk. Goat's milk matches up to the human body better than cow's milk. As goat milk does not require homogenization, it may provide a good substrate for fermentation using kefir grains[2].

MATERIAL AND METHODS

Collection of milk samples

Cow milk samples were collected from Dairy farm, Department of ILFC, Veterinary College, KVAFSU, Hebbal, Bengaluru-24, while, Goat milk samples were collected from Sinchana Private Goat farm located in Baglur, Bengaluru North, Karnataka, India. The samples were transported to the laboratory under refrigerated conditions.

Maintenance of kefir grains:

Kefir grains purchased from a house hold in Bengaluru, were preserved and propagated in laboratory at 30 ^{0}C/ 24 h with 1-2 weekly transfers of heat treated (85^{0}C/30 min.) cow and goat milk under refrigeration condition (4^{0}C) for short term storage.

Kefir preparation

Fresh kefir grains maintained in cow and goat milk of 1 gm was inoculated aseptically into 300 ml glass container containing heat treated (85^{0}C/30 min.) cooled (30^{0}C) cow and goat milk separately. The containers were covered with paper towel and incubated at 30^{0}C for 24 h. Kefir needs air space, they thrive when exposed to oxygen and seem to do slightly better when the lid is breathable (a cloth, paper towel, etc). The prepared kefir was used to carryout chemical analysis.

Chemical analysis

Standard procedures mentioned by Bureau of Indian Standard: SP: 18**,** Part XI (1981) were adopted for analysis of chemical parameters such as titratable acidity (titration method), lactose (Lane-Eyon method), protein (Pyne's method), fat (Gerber's test), solids not fat (SNF) and total solids determined by adopting Richmond's formula for cow milk, goat milk samples as well as for kefir samples prepared using those milks separately. The ethanol content of kefir samples was analyzed using the procedure given by Pilone[9].

Statistical analysis:

The data obtained in the present study was analyzed using one way ANNOVA and multi linear Regression analysis using R software (R. version 3.1.3 (2015-3-09) to calculate mean and F values to prove significant or non-significant effect of parameters adopted.

RESULTS AND DISCUSSION

Chemical analysis of cow and goat milk used for kefir preparation

Cow milk and goat milk analyzed for chemical parameters revealed variation in lactose, protein and fat content. Cow milk showed more lactose by 0.35% while protein and fat content was less by 0.25% and 0.13% respectively in comparison with goat milk (Table 1). Titratable acidity of goat milk was slightly more by 0.02% lactic acid compared to cow milk. Solids not fat on an average was

less in cow milk and in turn the total solids. The statistical analysis carried out for the composition of cow and goat milk did not show any significant difference except with respect to fat globule size. The fat globules were of larger in size compared to goat milk fat globules (Plate 1). Fat globules in goat milk were naturally homogenized has lot of benefits during kefir preparation as kefir grains added do not held up in fat globule as it will be smaller in size. In order to achieve the nearly similar nature with respect to goat milk during the preparation of kefir, the cow milk was homogenized using magnetic stirrer at 50°C for 200 rpm.Park[8] compared the composition of goat milk with cow milk and opined that goat's milk is a good source of protein, contains less lactose than regular cow's milk. Goat's milk matches up to the human body better than cow's milk as goat's milk is less allergenic, easier to digest, rarely causes lactose intolerance. As goat milk does not require homogenization, as lipid globules are significantly smaller than in cow milk and may provide a good substrate for fermentation using kefir grains[2]. Jacob[6] analyzed the cow milk and found fat content of 3 to 4%, protein of 3.5% and lactose of 5%. The gross chemical composition of cow milk varies depending on the breed. As yield of goat milk is comparably lower compared to cow milk, hence cow milk also may be used in preparation of kefir after proper homogenization.

Chemical analysis of kefir prepared from cow milk and goat milk:

The prepared kefir (Plate 2) separately using cow milk and goat milk were analyzed for chemical composition (Table 2). The cow milk kefir analyzed was slightly more acidic (0.98%) than goat milk kefir (0.95%). Lactose present in both variants of kefir was 2.45, 2.15% were hydrolyzed by lactic acid bacteria of kefir grain for conversion to lactic acid and also the live organisms present in kefir help in lactose digestion thus suitable for lactose intolerant people. Both kefir types showed around 7% of protein hydrolysis with protein content of 3.22 and 3.44% while fat hydrolysis accounted for 6.5% (fat content - 4.30%) and 4.2% (fat content - 4.53%) in cow milk kefir and goat milk kefir respectively, indicating slightly more fat hydrolysis in cow milk kefir compared to goat milk kefir. Alcohol content was 0.11% more in goat milk kefir compared to cow milk kefir which may be attributed due to higher content of yeast in goat milk kefir grain. The statistical analysis revealed the insignificant difference in chemical composition of cow and goat milk kefir indicating proximity among them.Almost similar composition obtained in the present study was also reported by several authors. It was reported that typical composition of kefir consists of 3-3.4% protein, 1.5 % fat, and 2-3.5% lactose. Lactic acid amount may change between 0.6 % and 1%, alcohol level 0 to 0.1%[3] Wszolek *et al.*[13] found that the chemical composition of kefir ranged from 10.6% to 14.9% for total solids, 2.9–6.4% for crude protein, 3.8–4.7% for carbohydrate and 0.7–1.1% for ash. Beshkova *et al.*[1] carried the compositional analysis of kefir and found protein of 3-3.4%, fat of 1.5%, lactose of 2.0-3.5%, lactic acid content of 0.6-1.0% and alcohol level of 1%. The major products formed during fermentation were lactic acid, CO_2 and alcohol. Magalhaes *et al.*[7] found that Brazilian kefir contained 3.91% protein, 2.34% fat and 9.62% dry matter after 24 h of fermentation.

Table 1: Chemical composition of cow and goat milk

Type of milk	Acidity % L.A	% Lactose	% Protein	% Fat	% Solid Non Fat	% Total Solids
Cow milk	0.15±0.01	3.12±1.01	3.47±0.23	4.60±0.17	8.01±0.30	12.69±0.22
Goat milk	0.17±0.01	2.77±0.33	3.72±0.46	4.73±0.92	8.87±0.46	13.64±1.26
CD ($p \leq 0.05$)	0.04 (NS)	1.14 (NS)	1.87 (NS)	1.79 (NS)	1.68 (NS)	3.11 (NS)

Note:

- Values are average of three trials
- Mean ± SD (Standard Deviation)
- CD – Critical Difference
- NS – Not Significant

Table 2: Chemical quality of kefir prepared using cow and goat milk

Type of kefir	Acidity % L.A	% Lactose	% Protein	% Fat	% Ethanol
Cow milk kefir	0.98±0.39	2.45±0.21	3.22±0.34	4.30±0.36	0.74±0.09
Goat milk kefir	0.95±0.21	2.15±0.37	3.44±0.49	4.53±1.02	0.85±0.11
CD ($p \leq 0.05$)	0.82 (NS)	0.73 (NS)	1.29 (NS)	2.12 (NS)	0.58 (NS)

Note:

- Values are average of three trials
- Mean ± SD (Standard Deviation)
- Incubation condition for kefir preparation 30°C/24h
- CD – Critical Difference
- NS – Not Significant

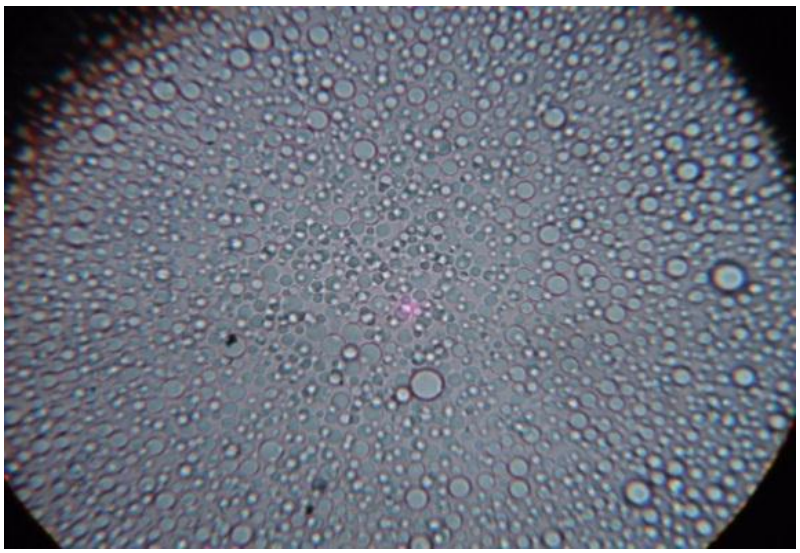

Plate 1: Microscopic observation of fat globules of goat milk (100X)

Plate 2: Prepared Kefir

CONCLUSION

Kefir is a distinctive fermented dairy product due to the unique, multi-species natural kefir grains used as the starter culture for its manufacture. The chemical composition of kefir is complex due to the inherent lactic acid bacteria and yeast. In this study, the milk and kefir samples were analysed for their chemical

composition. On the whole cow milk had more lactose while goat milk had more protein and fat. Fat globules in goat milk appeared as naturally homogenized. Both the kefir variants possessed almost the similar chemical composition. Lactose hydrolysis was more due to activity of lactic cultures compared to protein and fat as lactic cultures are weakly proteolytic and lipolytic in nature. Alcohol content was slightly more due to activity of yeast in grain microflora.

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