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Evaluation of Titrable acidity (Ta) of camel and buffalo milk during lactic acid fermentation by using *Lactococcus lactis* ssp. *cremoris* and *Lactococcus lactis* ssp. *lactis*

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Abstract
To study the Titrable Acidity (TA) of camel and buffalo milk by using *Lactococcus lactis* ssp. *cremoris* and *Lactococcus lactis* ssp. *lactis*, an experiment was designed and conducted at National Research Center on Camel, Bikaner, Rajasthan, India and Department of Livestock Products Technology, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India. There was a highly significant (P<0.01) increases in the TA value of camel and buffalo milk samples from zero to 12 hour with advancement of fermentation hours. Hence it may be concluded that the stability of camel and buffalo milk decreased day by day with enhancement of fermentation hours.

Keywords: Milk, Titrable acidity, fermentation

Introduction
Camel milk is unique in terms of low fat (1.5-3%), low protein (2.5%) and longer shelf life, higher ratio of ß-casein to k-casein, absence of Lysozyme-C and ß-lactoglobulin and presence of Whey Acidic Protein (WHP) and Peptidoglycan Recognition Protein. There are reports on its antibacterial and other therapeutic properties. Fresh and fermented camel milk is an important nutritional and functional source. The *Camelus dromedarius* is good producer of milk which differs from bovine milk in the composition and structure of protein content and thus has different functional and medicinal properties. Caseins (CNs) are the major proteins in camel milk, and α, β and κ-CN constitutes about 65, 21 and 3.47% respectively, of total caseins present in milk (Kappeler *et al.*, 2003) [5].

Buffalo milk had higher concentrations of protein, fat and ash than cow milk. The casein micelles from buffalo milk were more mineralized and less hydrated than their counterpart's cow milk. During acidification, some molecular changes, such as precipitation/aggregation of casein, solubilizations of calcium and inorganic phosphate and decrease in hydration of casein occurred. These molecular changes were qualitatively similar for both species (Ahmad *et al.*, 2008) [2].

When camel milk is left to stand, the acidity rapidly increases. The lactic acid content increases from 0.03 percent after standing 2 hours to 0.14 percent after 6 hours.

The acids present in the milk influence the flavours, colour, microbial stability and keeping quality of milk. The importance of determining acidity is to determine the freshness of milk, the more the lactic acid levels, means that milk is rotten. Acidity indicators reflect the quality of milk. The amount of acids in milk directly affects the flavor, color, stability, and the level of quality of milk.

Material and Methods
About 2 liter of fresh camel milk camels was collected from camel dairy maintained at National Research Center on Camel, Bikaner, Rajasthan, India and about 2 liter of fresh buffalo milk was collected from buffaloes maintained under the project "Establishment of live demonstration models of diversified livestock production systems for motivating adaption to enhancing agricultural income (RKVY-15)" College of Veterinary and Animal Science,

Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India at weekly interval for period of 2 months to perform the different experiments as mentioned below under the study.

Titratable acidity (TA) measurement

Titratable acidity expressed as percentage of lactic acid, was determined by 10 ml of each sample titrating with 0.1 N NaOH using phenolphthalein as an indicator to an end-point of faint pink colour.

Calculation

$$\% \text{ Lactic acid} = \frac{\text{Number of ml. of 0.1 N NaOH solutions required for neutralization} \times 0.009}{\text{Weight of sample}} \times 100$$

(Weight of sample = Volume of milk x specific gravity)
NaOH = sodium hydroxide

Result and Discussion

The data related to TA of camel milk has been presented in Table 1(a) and depicted in figure 1. The TA value of fresh camel milk was found to be 0.14 ± 0.003 for *Lactococcus lactis* ssp. *cremoris* and 0.14 ± 0.002 for *Lactococcus lactis* ssp. *lactis* before inoculation. These results were in line with those reported by Ahmed (1990) [1], Elamin and Wilcox (1992) [3] which is *0.13* and 0.15%, respectively.

Table 1(a): TA (Mean ± SE) of camel milk during fermentation

Treatment	*Lactococcus lactis* ssp. *cremoris*	*Lactococcus lactis* ssp. *lactis*	Over all
Fresh	0.14±0.003	0.14±0.002	0.14^{a}± 0.003
Hour2	0.25±0.004	0.24±0.006	0.25^{b}±0.004
Hour4	0.27±0.004	0.27±0.003	0.27^{c}±0.003
Hour6	0.35±0.004	0.32±0.005	0.33^{d}±0.006
Hour8	0.48±0.005	0.46±0.006	0.47^{e}±0.005
Hour10	0.68±0.004	0.64±0.005	0.66^{f}±0.006
Hour12	0.83±0.005	0.72±0.006	0.77^{g}±0.017
Overall	0.44^{b}±0.034	0.34^{a}±0.031	0.50±0.022

Note: Means bearing different superscripts differ significantly.

Table 1(b): Analysis of variance for TA of camel milk during fermentation

Source of variation	D.F.	Mean Square	Level of sig.
Treated bacteria	1	0.034	**
Hour	6	0.601	**
Reminder	76	0.001	

** = Significant at 1% (P<0.01)

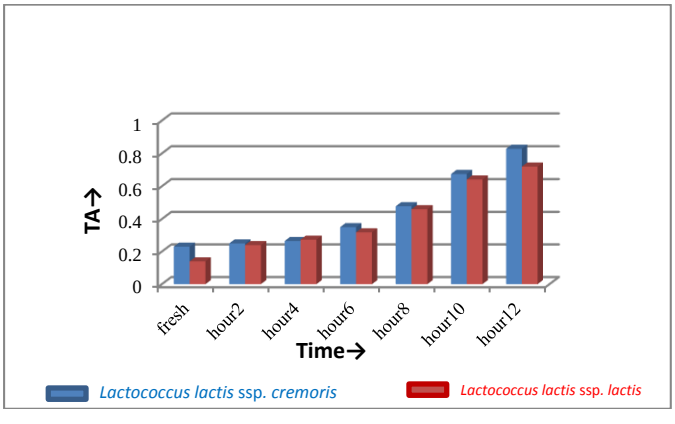

Fig 1: TA of camel milk during fermentation

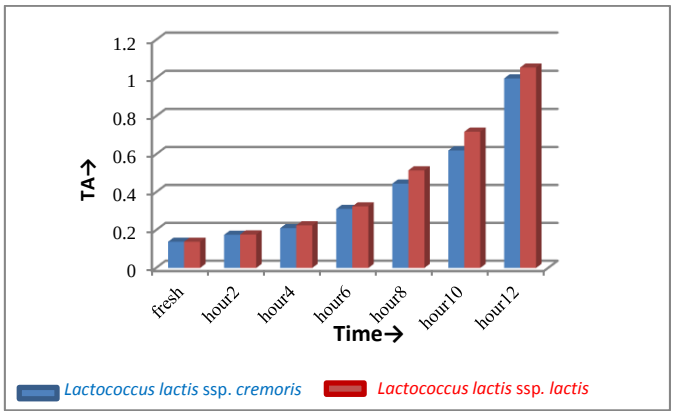

Fig 2: TA of buffalo milk during fermentation

Table 2(a): TA (Mean ± SE) of buffalo milk during fermentation

Treatment	*Lactococcus lactis ssp. cremoris*	*Lactococcus lactis* ssp. *lactis*	Overall
Fresh	0.138±0.003	0.14±0.005	0.139^{a}±0.004
Hour2	0.175±0.003	0.18±0.003	0.177^{b}±0.003
Hour4	0.217±0.003	0.23±0.004	0.223^{c}±0.004
Hour6	0.318±0.003	0.33±0.004	0.324^{d}±0.004
Hour8	0.48±0.011	0.52±0.005	0.50^{e}±0.008
Hour10	0.66±0.015	0.72±0.005	0.69^{f}±0.010
Hour12	1.00±0.018	1.06±0.008	1.029^{g}±0.013
Overall	0.43^{a}±0.008	0.49^{b}±0.005	0.440±0.006

Note: Means bearing different superscripts differ significantly.

Table 2(b): Analysis of variance for TA of buffalo milk during fermentation

Source of variation	D.F.	Mean Square	Level of sig.
Treated bacteria	1	0.042	**
Hour	6	1.180	**
Reminder	76	0.008	

** = Significant at 1% (P<0.01)

The value of TA was increased significantly as the fermentation hour were increased, and at 12 hour of fermentation it was observed to be 0.83 ± 0.005 and 0.72 ± 0.006 for *Lactococcus lactis* ssp. *cremoris* and *Lactococcus lactis* ssp. *lactis* respectively whereas the overall TA was 0.44 ± 0.034 and 0.34 ± 0.031 was observed for *Lactococcus lactis* ssp. *cremoris* and *Lactococcus lactis* ssp. *Lactis*. The statistical analysis of data shown in table 1(b), revealed that there was a highly significant (P<0.01) increases in the TA value of camel milk samples with advancement of fermentation hours.

According to Hofi *et al.*, (1966) [4] in fresh buffalo milk, lactic acid accounted for 25% of total acidity. Acidity was correlated with fat and solid-not-fat percentage in buffalo milk. The values of the titratable acidity in fresh buffalo milk were in accordance with Mahmood *et al.*, (2010) [6].

The data related to TA of buffalo milk has been presented in Table 2(a) and depicted in figure 2. The TA value of fresh buffalo milk was found to be 0.138 ± 0.003 for *Lactococcus lactis* ssp. *cremoris* and 0.14 ± 0.004 for *Lactococcus lactis* ssp. *lactis* before inoculation and was increased significantly to mean value of 1.00 ± 0.018 for *Lactococcus lactis* ssp. *cremoris* and 1.06 ± 0.008 for *Lactococcus lactis* ssp. *lactis* respectively after 12 hour of fermentation. The overall TA value of buffalo milk was found to be 0.43^{a}±0.008 for *Lactococcus lactis* ssp. *cremoris and* 0.49^{b} ± 0.005 for *Lactococcus lactis* ssp. *lactis*. The statistical analysis of data shown in table 2(b) revealed that there was a highly

significant ($P<0.01$) increases in the TA value of buffalo milk samples with advancement of fermentation hours.

During 12 hour of fermentation process, the TA value of both type of milk samples increased continuously, due to conversion of lactose into lactic acid. Results were showing similar trend with Mahmood *et al.*, (2010) [6].

Conclusion

From the present investigation it may be concluded that the stability of camel and buffalo milk decreased day by day with enhancement of fermentation hours.

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