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Detection of presence of cow milk in goat milk using ethanol stability

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Abstract
Ethanol stability of fresh goat milk and cow milk samples were analyzed and used as a tool to detect the adulteration of goat milk with bovine milk. Goat milk exhibited lower stability towards ethanol when compared to cow milk and hence got immediately coagulated upon addition of 70 percent ethanol whereas cow milk does not. The stability of goat milk increased with increase in the quantity of cow milk admixture with it. When an adequate quantity of cow milk is being mixed with goat milk the rate of coagulation decreased. The nature of coagulum particles formed varies which can also be used as a basis for the detection. The remarkable variations in the content of αs1 casein and salt balance form the basis for the difference in ethanol stability of milks of two species (Zadow *et al*., 1983) [1].

Keywords: Goat milk, ethanol stability, coagulum, salt balance, αs casein

1. Introduction
Milk is a highly perishable commodity whose quality needs to be considered with utmost care. Adulteration is a common term that comes to mind when we think of quality. This fraudulent practice has been adopted by the producers with the objective of maximizing their profit returns. The lesser availability coupled with the higher price value of goat milk have led to greater chances of adulteration of the same with bovine milk which is cheaper and easily available. The superior nutritional therapeutic and medicinal values of goat milk compared to bovine milk serves as the driving force for this unscrupulous act. The former possesses better digestibility, alkalinity, buffering capacity etc.
The coagulation properties of goat milk are different from cow milk which can serve as a tool for their distinguition. The stability of goat milk towards ethanol is low when compared to bovine milk (Guo *et al.,* 1998) [2]. Wang *et al.,* 2016 [3] stated that the goat milk produced a much flocculated precipitate but the cow milk produced no flocculated precipitate. Compared with cow milk, the higher content of ionic calcium of goat milk could have been partly responsible for the greater instability of goat milk shown by the alcohol test. The primary reason for this is the low amount or absence of αs1 casein in the former. αs1 casein fraction delays curd formation by trapping calcium ions and withdrawing them from the proteolysis of k casein. Hence greater amount of free ionic calcium left untrapped by the smaller quantity of casein is present in goat milk. According to Guo 1985, low ethanol stability of goat milk may be attributed to the lower sodium to potassium (Na/ K) ratio in it. Jennes 1980 [4] reported that goat milk has a higher content of Cl and K, and lower level of Na when compared with cow milk. He found out that the calculated ratio of Na to K of goat and cow milk is 0.23 and 0.38 respectively. The researchers also reported that the goat milk showed lower ethanol stability than cow milk at ph range 6.0-7.5 (Horne and Parker, 1982) [5]

2. Materials and Methods
2.1 Sample Collection
Fresh pooled samples of goat milk of Malabari breed and cow milk were collected from the University Farms, Kerala Veterinary and Animal Sciences University, Mannuthy, Thrissur. The samples were stored at 4 ^{o}C in refrigerator before analysis. Cow milk was mixed with goat milk at different proportions of 25%, 50% and 75%.

2.2 Ethanol stability test
A total of 5 samples (pure goat milk, pure cow milk, 25% mix, 50% mix and 75%) maintained at a temperature of 35- 400 C were taken for the analysis. Five mL each of thoroughly mixed

milk sample and 70% ethanol were taken in a test tube and shaken well. These were observed for any visible coagulation. The test samples were kept in boiling water bath for about 3 minutes. The differences in coagulation as well as the separation of layer together with the nature of coagulum particles formed at the sides of test tube were observed.

3. Results

Goat milk exhibited a faster rate of coagulation than cow milk with the coagulum particles formed at the sides of test tube being cloudy large ones while no coagulation was observed in cow milk samples. As the quantity of cow milk mixed with goat milk increased the rate of coagulation as well as the size of coagulum particles decreased proportionally. No layer separation was observed in case of 75% mix and pure cow milk. The decreasing order of rate of coagulation is as follows: Pure goat milk> 25% mix> 50% mix> 75% mix> Pure cow milk. (Fig. 1 and Fig. 2).

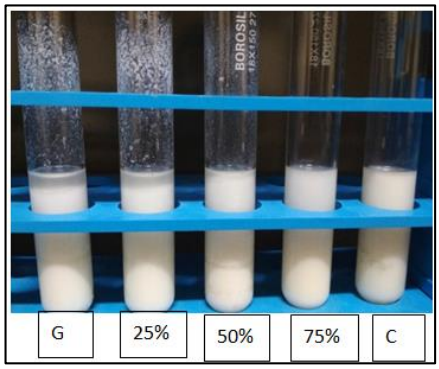

Fig 1: G- Pure goat milk, 25%- 25% cow milk, 50%- 50% cow milk, 75%- 75% cow milk, C- Pure cow milk Figure after addition of 70% ethanol

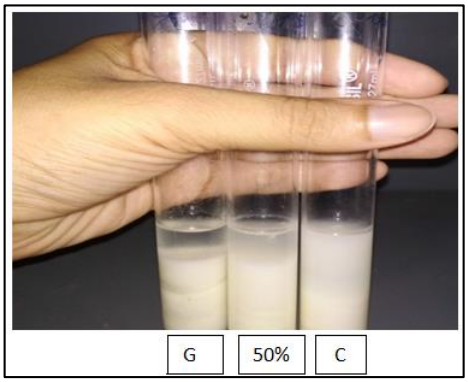

Fig 2: G- Pure goat milk, 50%- 50% cow milk, C- Pure cow milk

The relationship between the quantity of cow milk added to goat milk and its ethanol stability was statistically proven by Karl Pearsons rank correlation and it indicated that the correlation was statistically significant at 1percent level of significance.

Table 1: Correlation coefficient

		Proportion	Rank
Proportion	Pearson correlation	1	0.967**
	Sig.(2 tailed)		0.000
	N	30	30
Rank	Pearson correlation	.967**	1
	Sig.(2 tailed)	.000	
	N	30	30

**. Correlation is significant at the 0.01 level (2 tailed).

4. Discussion

Goat milk exhibited a lower stability towards treatment with 70 percent ethanol due to the absence or lower content of αs1 casein in it which has the ability to trap ionic calcium and thereby withdraw them from the proteolysis of k casein. This delayed the curd formation. The faster rate of coagulation of goat milk is attributed to this reason. Cow milk does not coagulate at all as αs1 casein is the major casein component in it. As the quantity of cow milk mixed with goat milk increased the rate of coagulation decreased proportionally with no layer separation being formed. The presence of cow milk can hence be confirmed by the absence or decreased clear separation of whey at top. If it is pure goat milk there will be immediate coagulation upon the addition of 70 percent ethanol with a clear separation at the top.

Moreover the nature of coagulum particles formed at the sides of test tube after thorough mixing also varied. While the coagulum was large cloudy type in case of pure goat milk, relatively lighter particles was observed in case of increased cow milk content in goat milk.

The detection limit of admixture was found out to be 50 percent as the clear separation was observed in case of 25 percent mix.

5. Conclusion

Many experiments have been done regarding the ethanol stability of goat milk and found out that it was lower compared to cow milk. It was also discussed that there are many factors which affects the ethanol stability such as the salt balance, pH etc. This particular characteristic of goat milk was used to check the presence of cow milk in it at different percentages. The results showed that the nature of the coagulum varied according to the percentage addition of cow milk to goat milk. This method can be considered as the initial step for checking the mixing of cow milk to goat milk with clear distinction at the level of 50 percentage.

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