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Changes in the gross composition of the colostrum from cow, sheep and goat during postpartum period

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Abstract
Nowadays, there is more increasing interest in the consumers and manufacturers about the health promoting natural foods. Colostrum, is the product of the initial secretion of mammary gland after birth of calf. It is the vital and key food for all the new-born mammals which provides high amounts of nutrient and non-nutrient biologically active substances. This study was mainly focused to determine the changes in the gross composition of cow, sheep and goat milk during lactation period. Six cows, sheep and goats were chosen and drawn the colostrum samples immediately after calving and analyzed the changes in composition of milk during post-partum period up to 10 days. The samples were analyzed for total solids, protein, fat, lactose and ash. Fat and crude protein content was found higher in first 3-5 days of post-partum for sheep and goat, whereas it was only for 3 days in cow milk. Sheep milk had highest crude protein (13.57%), cow milk showed intermediate (12.95%) and goat milk found lowest (8.8). Lactose content was increased and ash content was decreased gradually up to 5 days in all the species. Sheep colostrum was found rich source of total solids, fat, crude protein and lactose as compared to cow and goat colostrum. Hence it is recommended that the first three days of colostrum from all the species will provide maximum health benefits to new-borns.

Keywords: colostrum, cow, sheep, goat, gross composition, post-partum

Introduction
India is the world's largest livestock population amounted over 305 million in 2021 compared to the world total bovine population of 1400 million. It account for 56.3% of the world's buffalo population and 14.7% of the cattle population (Gautam *et al*., 2018) [12]. The total Livestock population is 535.78 million in the country showing an increase of 4.6% over Livestock Census 2012. The total number of cattle in the country is 192.49 million in 2019 showing an increase of 0.8% over previous Census. Milk is a highly nutritious nearly a complete food and is a good source of various nutrients and hence important for growth, repairs and provides energy (Chandrakar *et al*., 2017) [9]. Colostrum is the product of the initial milk secretion of the mammary gland following the birth of calf. It is a vital nutrient food for all the new born mammals within in first few 5-7 days after parturition (Playford and Weiser, 2021) [21]. Colostrum provides huge amounts of nutrients (protein, carbohydrate, fat, water soluble and fat soluble vitamins, major minerals) and non-nutrient components (biologically active substances) like immunoglobulins, immunomodulatory peptides, growth factors, antimicrobial factors, which provides passive immunity to the neonatal calves (Fantuz *et al*., 2016; Gupta and Mishra 2021; Godden 2019) [11, 13-14]. Ruminants have a cotyledonary placenta which is thicker and that does not allow antibodies to cross into the foetus. Due to this anatomical difference, calves must consume colostrum from the dam to receive an initial protective immunity. Feeding management throughout the neonatal and pre-weaning periods has a significant impact on calf health as well as future productive and reproductive performance of the same (Van Amburgh and Soberon 2013) [26]. The amount of colostrum administered to new born calves closely correlate with the avoidance of illness and calf losses, and an adequate and timely colostrum supply is vital for building passive immunity in calves. Today, the consumers are more interested for the well-being and health promoting foods. Colostrum and colostrum powders are produced and commercialized by several dairy industries, which provides health benefits and immune support. There is also many reports and evidences that colostrum may be used for the various treatments or medical conditions in children and adults (Panahi *et al*., 2010; Bagwe *et al*., 2015) [5, 19] and is also used as a supplementary food for athletes to improve their performance and recovery (Rathe *et al*., 2014., Kotsis *et al*., 2018., Davison *et al*., 2020) [10, 14, 17].

Depending upon the species, the levels of components and organic compounds may fluctuate between the second and the fifth day of lactation, such secretions is often called as "Transition milk". After that period the composition stabilizes and becomes normal fluid "milk" (Pecka *et al*., 2018; Bernabucci *et al*., 2013, McGrath *et al*., 2016) [7, 18, 20]. The composition of animal colostrum is influenced by a number of factors, including the animal's species, breed, and genetic features, as well as the feeding programme during pregnancy period (Puppel *et al*., 2019) [23]. During the transition period from change of colostrum to normal milk, there is a sudden change in chemical composition and properties of milk (Zou *et al*., 2012) [27]. Therefore, evaluation of composition of colostrum and post colostrums milk may also help to establish whether the milk is suitable for further processing. It is also very important to know the complete knowledge of the chemical changes occurring in the lactation period which is critical for the establishment of quality of milk, to ensure better quality of the final dairy products (Sanchez-Macias *et al*., 2014) [25]. So, the main aim of this study was to determine and compare the changes of chemical composition of colostrum milk of different species such as cow, goat and sheep during post-partum period.

Materials and Methods

Sample collection

Six cows, six goats and six sheep were randomly selected from Vijayanagram local farms for this study. The first colostral samples from each individual animal (50 mL) were immediately collected after confinement before suckling by offspring was begun. The samples were taken daily once by hand milking in the morning for the following 10 days of postpartum with interval of 24 h. The condition of animals health was monitored for mastitis, diarrhoea or fever during the experimental period, and found that the animals were healthy.

Proximate composition of colostrum

All the colostrum samples collected from cow, goat and sheep were analyzed for total solids, fat, protein, lactose and ash content immediately after calving and for the following 10 days of parturition. Total solids and ash content were determined by gravimetric method, protein by kjeldhal method as described in AOAC (2019).

Fat content of milk samples were determined using volumetric method. Exactly 10 mL of Gerber sulphuric acid was measured using automatic (tilt) and poured into the butyrometer. Then 10.75 ml of the well-mixed colostrums samples and 1 ml amyl alcohol was added to the above butyrometer and tighten the stopper and mixed the contents by shaking the butyrometer at 45° angle until all the curd have been dissolved. The butyrometer was kept into the centrifuge machine. The samples were centrifuged at 1000-1200 rpm for 5 min and observed the fat % by adjusting the fat column within the scale on butyrometer. Lactose content was calculated by subtracting the sum of protein, fat and ash from the total solids content.

Statistical analysis

The statistical analysis was carried out using SPSS program (Statistical Package for Social Sciences version 16). The significant differences between means were calculated by one-way Analysis of Variance (ANOVA).

Results and Discussion

Total solids of milk content was highest on day one in all three species. In case of sheep and cow milk the total solids are lower by 10% on day 3 (18.81%, 16.89%) compared to the first milking after parturition (20.86%, 18.97%). Where as in goat milk total solids are lower by 20% (16.71%) in third day milk in comparison with first milking (Figure 1). After one week of calving milk total solid content was maintained statistically in cow and goats whereas in sheep total solids content was decreased until the last day of the study. On the day of calving milk total solids content was significantly (p<0.001) higher in ewes compared to goat and cow, this might be due to the quantity of the colostrum secreted by ewes compared to goat and cow (Ahmadi *et al.*, 2016) [2].

The protein content was found higher in first day 12.95, 13.57 and 8.00 for cow, sheep and goat respectively. There was a steep fall in crude protein (CP) content in the first 3 days in cow milk. In case of other two species gradual decrease of CP content was observed for first three days. From day five of postpartum CP content in both cow and goat milk remained relatively constant. A high protein concentration in the first colostrum postpartum and a quick fall in protein concentration at each consecutive milking following initial extraction have been reported by many researchers (Hadjipanayiotou, 1995; Argiiello *et al*., 2006) [15]. Concentration of CP is significantly higher (P<0.001) in sheep milk in comparison with cow and goat milk on the first day. Cow has significantly higher (P<0.001) CP content than goat milk on first day milk. The gross composition and properties of mammary glands secretions are influenced by genetic and environmental factors. Quality and types of the feed and their additives determine the quality and characteristics of products of animal origin (Pecka *et al*., 2018) [20].

Milk lactose content followed increasing trend in all three species as postpartum days followed; Generally, on the fifth day it was observed the values of lactose content were 3.28, 4.18 and 4.32% for cow, sheep and goat colostrum respectively, similar to normal milk (Boudry *et al*., 2008) [8]. While the fat content in all three species followed decreasing trend in during the experiment period. Similar results were reported by Abd El-Fattah *et al*. (2012) [1] for cow and buffalo colostrums.

The fat and lactose in the colostrum are necessary for the new born lamb to produce heat and avoid hypothermia (Keskin *et al*., 2007) [16]. Milk fat was significantly (P<0.001) higher in sheep milk in all the experiment period than goat and cow milk. Milk lactose was significantly (P<0.001) higher in goat milk than sheep and cow milk for first two days thereafter sheep milk lactose content was higher than goat and sheep milk until the last day of the experiment. Milk Ash content was highest on day 1 in all three species decreased till one week, there after being almost constant. This might be due the higher fold of minerals in the colostrums (Barrington and Parish, 2001; Playford *et al*., 2001) [6, 22]. It was also reported that all animal species including humans have higher mineral concentrations and lower lactose content in colostrum than in milk. As the transition period advanced, the total solids, fat, protein, ash components in colostrums were decreased gradually.

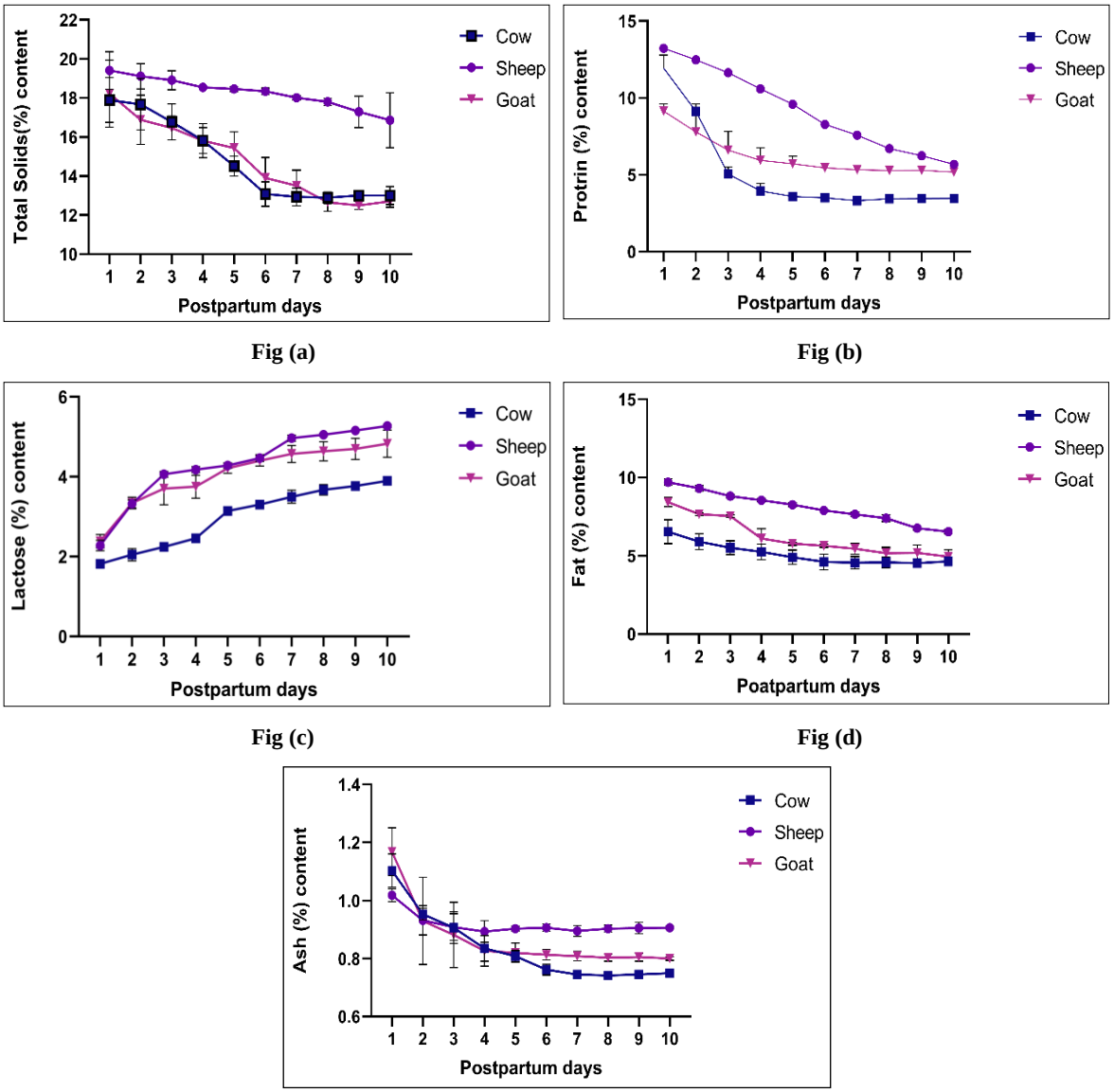

Fig 1: Early postpartum period diurnal variation of Total solids (a), Protein (b), Fat (c), Lactose (d) and Ash (e) in postpartum milk of cow, sheep and goat.

Conclusion

It is concluded that during the first three days the colostrum was the most beneficial to the calf in all three species. It is further concluded that colostrum of the sheep has got more total solids, lactose, crude protein and fat content than cow and goat.

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