

MILK COMPOSITION EVALUATION IN DIFFERENT BREEDS OF LOCAL DAIRY TYPE ANIMALS IN PUNJAB

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ABSTRACT: The current study was carried out during the period of July 2022 to June 2023 with a total of 2012 milk samples to evaluate the effect of species on milk composition including fat, protein, solid not fat (SNF) and total solids (TS). The milk samples were collected from indigenous livestock species of Punjab Pakistan including cow, buffalo, sheep, goat and camel kept for milk purpose. The study was carried out at Livestock Production Research Institute (LPRI) Bahadurnagar, Okara. The objective of current study was to investigate the effect of species and breed on composition of milk. Milk samples were collected from pure Sahiwal cow, cross of Sahiwal cow with Friesian, local non-descript cow, Nili Ravi buffalo, Lohi sheep, goat and camels maintained at different livestock experiment stations under Livestock and Dairy development department Punjab Pakistan. Results showed highest milk fat in Lohi sheep 7.17 percent followed by camel 5.63 percent, buffalo 6.76 percent and goat 4.73 percent. Milk fat content of purebred Sahiwal, cross bred Sahiwal and local Qadirabad cow was 4.77, 4.52 and 5.19 percent respectively. Lacto meter reading (LR) was highest in Lohi sheep 30.02 followed by camel 29.59, buffalo 30.15 and then cow breeds. Solid not fat (SNF) content was highest in Lohi sheep 8.98 percent followed by Buffalo 8.84 and camel 8.51 percent. SNF content for goat was 7.55 percent and for purebred Sahiwal, cross bred Sahiwal and local Qadirabad cow was 7.50, 7.28 and 7.79 percent respectively. Total solids (TS) were found to be highest in Lohi sheep 16.12 followed by buffalo 15.83, camel 13.97 and then cow breeds ranging from 11.74 to 12.99 percent. The milk protein content was found to be highest for goat 4.82 percent followed by sheep 4.75, camel 3.95 percent and then by cow and buffalo.

Keywords: Lacto meter reading (LR), Specific gravity (SG), Milk fat, Total solids (TS), Solid not fat (SNF), Indigenous livestock Breeds.

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INTRODUCTION

Milk production has been mainly exploited in terms of expansion in south Asia since 1970. Pakistan, among the highest milk producing countries, is ranked fifth after India, United States of America, China and Brazil (Koch 2019). Milk produced by various species of livestock in Pakistan include cattle, buffalo, sheep, goat and camels. The role of each specie in terms of its contribution in national milk yield in each country varies accordingly whereas in Pakistan buffalo is the major stakeholder contributing 59.93 percent of overall gross milk production in the country. The estimate of population of these species in millions is 55.5 cattle, 45.0 buffalo, 32.3 sheep, 84.7 goat and 1.1 camels (Economic survey of Pakistan 2023). Pakistan is ranked second largest country for hosting buffalo population. The main breeds of buffalo in Pakistan include Nili Ravi and Kundi. Nili Ravi is regarded as world's best dairy breed

(Bashir et al 2015). There are several well recognized breeds of cows and buffaloes in the region such as Red Sindhi, Gir, Tharparkar, and Sahiwal among the cows of which Sahiwal is regarded as best milk type breed locally. Among goat and sheep, Teddy and Lohi sheep are included in current study that are important contributor of livestock in local context. The gross milk production in Pakistan is 67873 thousand tons out of which specie wise contribution is 25151 thousand tons by cattle, 40678 by buffalo, 42.0 by sheep, 1040 by goat and 956 by camel (Economic survey of Pakistan 2023). The specie of dairy animal, its breed, age and weight loss program in conjunction with the stage of lactation, parity, farming system, climate and season have an impact on the color, odor, taste and composition of milk in turn allowing the production of wide variety of milk products (FAO 2003). In most developing countries, milk is produced by small holders and milk production contributes to household livelihood, food security and

nutrition. Milk provides relatively quick returns for small-scale producers and is an important source of cash income.

Milk is a white fluid secretion from the mammary glands of females mainly mammals (Merriam-Webster 2023). Like other mammals the ruminants also produce milk to nourish their newborn but the surplus is collected for human consumption. Milk is a very nutritious food commodity for human beings from infancy to adulthood. Milk is a source of major and minor nutrients including fat, protein, sugar, vitamins and minerals necessary for the maintenance and production. With regard to quantification of different milk nutrients including fat percentage of cow, buffalo, sheep, goat and camel milk is, 4.56, 5.1 to 7.0, 8.96, 4.73 and 4.43 percent respectively; LR is 30.0, 27.65, 28.05 and 28.65 respectively; specific gravity is 1.03, 1.02, 1.28 and 1.02 respectively; TS is 13.73, 14.04, 18.53, 13.55 and 11.97 respectively; SNF is 9.17, 8.79, 9.71, 8.92 and 7.56 percent respectively; milk protein is 5.23, 3.87, 6.57, 2.38 and 3.0 respectively (Cady et al 1981, Kanwal et al 2004, Yoganandi et al 2014). The milk composition varies according to the genetic as well as environmental factors. The species as well as breed differences are important factors responsible for variations in milk composition. It has been documented that the breeds known for high milk fat content produce low quantity of milk in terms of volume (Castle and Watkin 1979). Other contributing factors that affect composition of milk include stage of lactation like during early stage lactation the volumes of milk produced are usually high whereas in later stages fat increases while volume decreases. At start of lactation the colostrum is high in proteins whereas on later stages the protein content of milk sharply decreases (Eckles et al 1957). The objective of current study was to compare the composition analysis of milk obtained from various species and breeds of dairy type in Punjab, Pakistan to snap shot the quantity of different nutrients in milk.

MATERIALS AND METHODS

Animals and samples: A total of 2012 milk samples from different species and breeds including Nili Ravi

buffalo, Sahiwal cattle, local crossbred cow, Lohi sheep, Teddy goat and local pahari camels were from July 2022 to June 2023. The milk samples measuring 100 ml were collected in sterile glass bottles and stored at 4°C until the analysis was done except LR that was performed at the time of collection of samples. The rest of milk analysis was performed at the milk analysis laboratory of LPRI Bahadurnagar Okara. The analysis was performed using lacto scan Lactoscan-S Milk Analyzer (Milkotronic Bulgaria). The parameters studied were milk fat, SNF, total solids and LR. A total of 2012 samples were taken from different species and breeds of lactating animals out of which 1144 samples were from cattle breeds (Sahiwal, crossbred Sahiwal and local non-descript) 327 samples from Nili Ravi buffalo, 143 from sheep, 367 from goat and 31 from lactating dromedary camels. The animals belonging to different breeds aging 3 to 15 year with variable parity were included in the study.

Sample Collection and Laboratory Analysis: Milk samples from individual animals were collected approximately at monthly intervals during lactation. Milk samples were taken in the morning milking using sterile sampling bottle. All samples were kept refrigerated at 4°C until being transferred to the onsite milk analysis laboratory for immediate analysis. The gross chemical composition (fat, protein, lactose, TS and SNF) of raw milk were determined using automatic milk analyzer. Test results for individual animals and samples were recorded.

Statistical Analysis: Data were analyzed through analysis of variance (ANOVA) by SPSS version 20.0. The means were compared through Dunkans multiple range test. The data were adjusted for any missing values.

Objective: The objectives of the study was to monitor the chemical composition of regularly collected individual milk samples in order to establish the base line milk composition for local dairy type species and breeds in Pakistan.

RESULTS

The results are presented in table 1 below.

Table 1: Milk composition in common livestock dairy type species in Punjab

Specie / Breed	Temperature (°F)	LR	Specific Gravity	Fat (%)	SNF (%)	Total Solids (%)	Protein (%)
Sahiwal cow	89.75±3.71 ^a	25.44±4.91 ^a	1.12±.56 ^b	4.77±.71 ^b	7.50±1.01 ^b	12.00±1.56 ^{ab}	3.58±.54 ^a
Crossbred Sahiwal	88.74±4.06 ^{bc}	25.63±.75 ^a	1.03±.00 ^{ab}	4.52±.30 ^a	7.28±.33 ^a	11.74±.88 ^a	3.59±.28 ^a
Local Qadirabad	87.89±2.98 ^b	27.06±2.37 ^b	1.0300 ^{ab}	5.19±1.01 ^c	7.79±.78 ^c	12.99±1.76 ^c	3.38±.28 ^a
Buffalo	89.12±4.89 ^c	30.15±2.12 ^c	1.03±.00 ^{ab}	6.76±.88 ^e	8.84±.46 ^e	15.83±2.18 ^e	3.50±.28 ^a
Goat	89.97±4.88 ^c	26.60±2.21 ^b	1.03±.00 ^{ab}	4.73±.89 ^b	7.55±.66 ^b	12.31±1.46 ^b	4.82±31.97 ^c
Lohi sheep	89.36±4.22 ^c	30.02±1.31 ^c	1.03±.00 ^{ab}	7.17±.83 ^f	8.98±.62 ^e	16.10±1.13 ^e	4.75±49.93 ^c
Camel	79.32±6.78 ^a	29.59±2.26 ^c	1.03±.01 ^{ab}	5.63±1.08 ^d	8.51±.74 ^d	14.11±13.96 ^d	3.95±.16 ^b

Lactometer reading and Specific gravity of milk: The results on milk LR are presented in table 1. The LR of milk from buffalo, lohi sheep and camel are 30.15 ± 2.12 , 30.02 ± 1.31 and 29.59 ± 2.26 respectively. The LR of milk from local Qadirabad 27.06 ± 2.37 significantly high than Sahiwal cow and crossbred Sahiwal whereas significantly low from buffalo, lohi sheep and camel at $P \leq 0.05$. The LR value of buffalo is significantly high than Sahiwal purebred and cross bred cows. Specific gravity of milk is high at $P \leq 0.05$ for Sahiwal cow $1.12 \pm .56$ whereas all other species are non- significantly different from one another.

Milk fat: The data on milk fat is presented in table 1. The fat content of milk from lohi sheep is $7.17 \pm .83$ percent significantly high at $P \leq 0.05$ from all species and breeds under current study. The fat content of buffalo milk is $6.76 \pm .88$ that is significantly high to all cattle breeds, camel and goat milk. The milk fat contents of pure bred Sahiwal, cross bred Sahiwal and local Qadirabad cattle are $4.77 \pm .71$, $4.52 \pm .30$ and 5.19 ± 1.01 respectively showing all are significantly different within the cattle group with the highest for local Qadirabad.

Milk Solid not Fat (SNF): The results on SNF content of milk of different dairy type species are presented in table 1. The SNF content of lohi sheep, buffalo and camel $8.98 \pm .62$, $8.84 \pm .46$ and $8.44 \pm .74$ are significantly high as compared to other species and or breeds at $P \leq 0.05$. The SNF content of different breeds of cow and teddy goat under current study are non-significantly different from each other except local Qadirabad cattle $7.79 \pm .78$ that is highest and cross bred Sahiwal $7.28 \pm .33$ is lowest among cattle breeds.

Milk Total Solids (TS): Total solid content of the milk from different livestock breeds/ species are presented in table 1. TS content in the milk of Lohi sheep, buffalo and camel are found to be significantly high 16.10 ± 1.13 , 15.83 ± 2.18 and 14.11 ± 13.96 respectively at $P \leq 0.05$. TS content of Lohi sheep is 1.68 percent higher than buffalo and 13.34 percent higher than camel. Among cows under current study, all the breed variants including purebred Sahiwal, crossbred Sahiwal and local Qadirabad differ significantly $P \leq 0.05$ from each other calibrated as 12.00 ± 1.56 , $11.74 \pm .88$ and 12.99 ± 1.76 respectively.

Milk protein: Milk protein content of different types of dairy purpose species and breeds among cows under current study are presented in table 1. Milk protein content of Teddy goat and Lohi sheep are 4.82 ± 31.97 and 4.75 ± 49.93 respectively are significantly high at $P \leq 0.05$. Milk protein content of cow breeds including purebred Sahiwal, crossbred Sahiwal and local Qadirabad are $3.58 \pm .54$, $3.62 \pm .28$ and $3.38 \pm .28$ respectively are non-significant among cows under study at $P \leq 0.05$. The milk protein content of buffalo $3.50 \pm .28$ is non-significant with cows. The milk protein content of camel $3.95 \pm .16$ is

significantly high to cows and buffalo whereas low to teddy goat and lohi sheep.

DISCUSSION

LR and specific gravity of milk: The milk LR value of dairy type cow breeds under current study are 25.44 ± 4.91 , $25.63 \pm .75$ and 27.06 ± 2.37 with corresponding specific gravity of $1.12 \pm .56$, $1.03 \pm .00$ and $1.03 \pm .00$ for pure bred Sahiwal, crossbred Sahiwal and local Qadirabad cows respectively. Specific gravity of milk is rarely less than 1.03 (at 60°C) (Kanwal et al 2004). Previous study by Prajapati et al (2017) endorse the findings of current study for specific gravity that is reported to be 1.03 for cow whereas, it is different for other species including buffalo, goat and sheep. There are studies with contradictory findings on LR as compared to current study (Kanwal et al 2004) who reported a mean LR value of 30 for cow, 27.65 for buffalo. The low LR values may represent the mineral and energy negative balance. Low lactometer reading in current study may be attributed to low fat values.

Milk fat: The milk fat and SNF of dairy type cow breeds under current study are $4.77 \pm .71$, $4.52 \pm .30$ and 5.09 ± 1.01 for pure bred Sahiwal, crossbred Sahiwal and local Qadirabad cow respectively. Whereas, the milk fat content of buffalo is $6.76 \pm .88$ high than the cows under current study. Milk fat is nutritionally associated with the acetate production in rumen that is based on feeding of good fiber content developing proper fiber matt in rumen (NRC, 2001) but there are species and breed differences responsible high fat contents (Rufener 1975; Cockrill 1976; Bureau of animal industry, 1978; Hifzulrahman et al 2019). The high buffalo fat content may be due to the fact that buffalo are better converter of poor quality roughages (Sarwar et al 1998; Kanwal et al 2004) endorsed the findings of current study. In current study Lohi sheep and camel exhibited high values of milk fat percentage endorsing the species innate ability of doing so.

Solid not fat and total solids content of milk: The milk SNF of dairy type cow breeds under current study are 7.50 ± 1.01 , $7.28 \pm .33$ and $7.72 \pm .78$ and TS percentage are 12.00 ± 1.56 , $11.74 \pm .88$ and 12.83 ± 1.76 for pure bred Sahiwal, crossbred Sahiwal and local Qadirabad cow respectively. Whereas, the SNF and TS content of buffalo is $8.84 \pm .46$ and 15.83 ± 2.18 similar with lohi sheep for SNF. TS of buffalo is significantly high than cow breeds and camel, whereas the highest is found in Lohi sheep. The finding is endorsed for all breeds by Kanwal et al (2004) whereas otherwise for buffalo. Huber and Boman (1966) claimed strong nutritional correlation of milk SNF with intake of dietary energy and good fiber sources. But there are specie interactions for innate genetic potential

for producing high and low SNF contents with requisite nutritional factors (Rufener 1975).

Milk protein content: The milk protein content of dairy type cow breeds under current study are $3.58 \pm .54$, $3.59 \pm .28$ and $3.38 \pm .28$ for pure bred Sahiwal, crossbred Sahiwal and local Qadirabad cow respectively. Buffalo

represented similar value whereas the highest protein value is for teddy goat and Lohi sheep. The milk protein content of camel is found to be similar with cow and buffalo milk. The results are endorsed by Kanwal et al (2004). The milk protein content in current study may be due to nutritional and genetic factors specific for species.

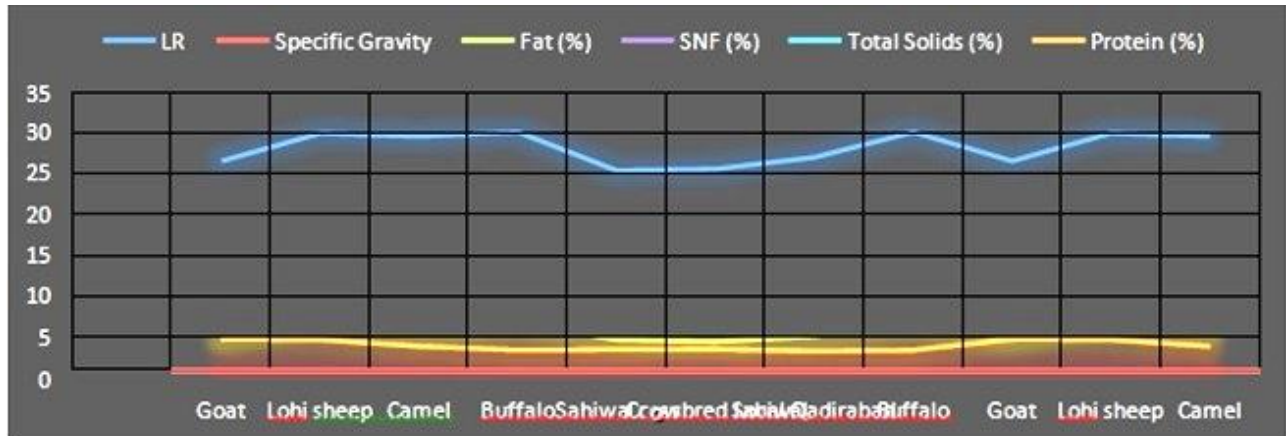


Figure 1. Comparison of dairy type livestock breeds and species milk constituents

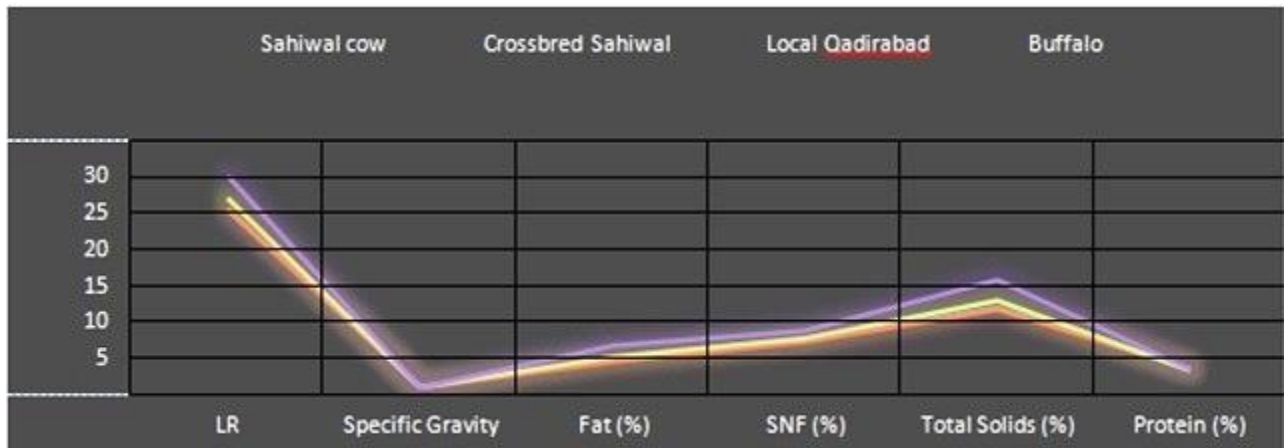


Figure 2. Comparison of cow breeds and buffalo milk constituents

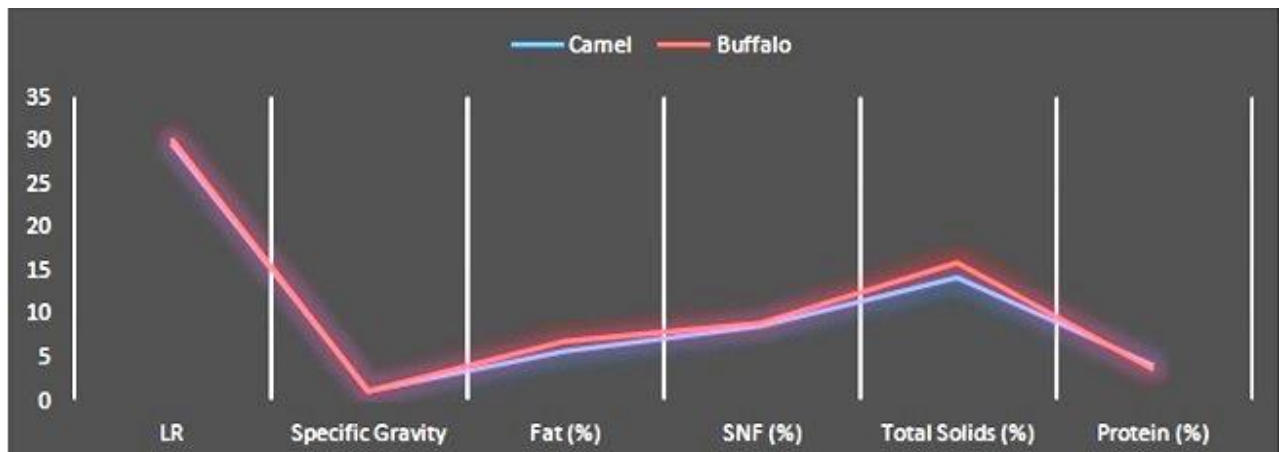


Figure 3. Comparison of camel and buffalo milk constituents

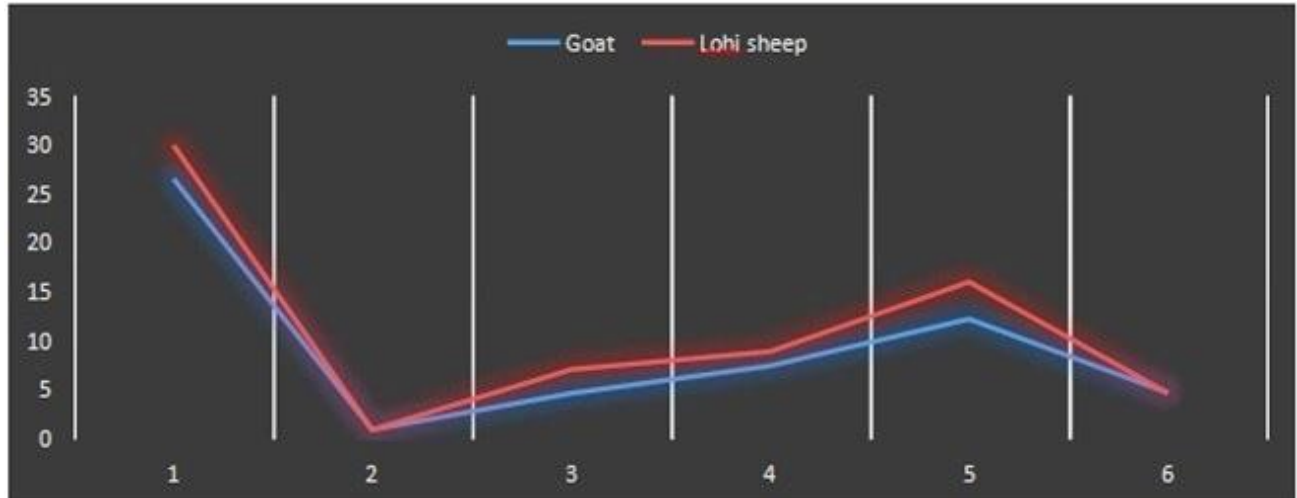


Figure 4. Comparison of goat and lohi sheep milk constituents

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