



*Original Paper*

## Impact of Management Systems on Yield and Quality Attributes of Kachhi Sheep Milk

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### Abstract

The present research was carried out on the impact of two management systems on yield, physico-chemical and sensory attributes of Kachhi sheep milk. Twelve Kachhi sheep were randomly selected and divided into two groups and were reared under the intensive and semi-intensive management systems. The animals under intensive management system (group A) kept indoors and fed with green fodder and concentrate ration, while sheep in the semi-intensive management system (group B) retained indoors during the night and moved for grazing during the daytime and fed concentrate ration at evening. Maximum yield of milk ( $P < 0.05$ ) was noticed in Kachhi sheep managed under semi-intensive management system compared to sheep reared in intensive management system. However, physical attributes (specific gravity and pH values) were higher ( $P > 0.05$ ) in milk of sheep reared under semi-intensive management system in contrast to sheep kept under intensive management system. Chemical characteristics of milk like (fat and protein) were significantly higher ( $P < 0.05$ ) in milk of sheep reared under semi-intensive management system, while non-significant ( $P > 0.05$ ) difference was observed between the value of lactose and ash contents in milk of Kachhi sheep reared under intensive and semi-intensive management system. Moreover, sensory attributes; taste, color, texture, and overall acceptability of Kachhi sheep milk reared under semi-intensive management system perceived high ( $P < 0.05$ ) score by the panel of judges, whereas non-significant variation was noted in odor/aroma of Kachhi sheep milk managed under intensive and semi-intensive management systems. It could be concluded that Kachhi sheep reared under semi-intensive system had higher milk yield, better physico-chemical quality and excellent organoleptic/sensory attributes compared to the sheep kept under intensive management system.

**Keywords:** Sensory attributes, Management systems, Kachhi sheep

*Article history*

Submitted

Jan 2022

Review

Feb 2022

Accepted

March 2022

### Introduction

It is well known that the sheep and goat have been domesticated as a source of food (meat and milk) and clothing (wool). Sheep and goat rearing by the farmers and pastoralists throughout the world is also a source of endurance and an approach to boost up their incomes. Over many centuries, milk has become a desired and valuable source of nutrients; thus, herds were formed, and dairy breeds were selected [1]. Sheep's milk contained higher concentration of fat which is quite beneficial to produce good quality butter and other fat concentrated products [2].

*Cite this:*

Tunio SA., M. Naeem, AA Behan, A. Kaka, GS Barham & GB. Khaskheli (2022). Impacts of management systems on yield and quality attributes of Kachhi sheep milk. (SS) 54: 1. 20-26

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Consumption of dairy product from sheep and goat during the last 50 years has more than doubled and this trend will continue to rise until 2030, total goat and sheep milk production is estimated at 18.7 and 10.6 million tons, respectively [3]. Moreover, nutritional quality of caprine milk is directly concerned with the lipid composition and these lipids influence the color, taste, and yield of goat milk products, like texture firmness in cheese, organoleptic attributes of yogurt [4]. Flavor and odor are known to be important milk quality traits; they are especially important for milk because the sensory attributes play vital role in acceptability of milk and dairy products [5].

Several factors affect the quality of sheep milk such as breed, animal health, environmental factors, age and parity of the animal and management systems [6]. The sheep farmers distributed according to production systems, Extensive system, Semi-extensive system, Semi-intensive and Intensive system, as seen that the application of extensive and semi-extensive system was declining, whereas the application of semi-intensive system was increasing, and the application of intensive systems remains constant [7]. The application of the intensive management system seems to result in higher feeding and structural cost per sheep, hence, the semi-intensive management system that combine grazing and a concentrate supplement could be an alternate [8]. It has been reported that the flavor of milk, antioxidant properties, and fatty acid profile were positively affected by pasture feeding [9]. Modern farmers keep their animals in facilities near their houses and feed them either homemade or commercial feeds while animals are allowed to graze in nearby field [7]. Breed difference and housing systems and milking methods applied for milking in goats directly influenced on the daily and total milk yield of the animal [10], [11]. An investigation reported statistically higher daily milk yield, overall milk production and length of lactation under semi-intensive management contrast to wide-ranging management rearing system, respectively [12]. However, milk fatty acids composition and milk nutritional value were significantly improved in the milk from farms using the semi-intensive production system [13]. Proper housing and feeding comprised of accurate calculation of bran to concentrate taken in a manner to maximize proper use of feed complements. In addition, to enhance the milk yield and dietetic quality of sheep milk farmers must fulfill nutritional requirements of dairy animals during lactation period [14]. Kachhi sheep is one of the heaviest and thin tailed breeds of sheep and resourceful asset of Sindh

province, mostly found in the Ran of Katchh and adjoining desert areas of District Tharparkar. It is a multi-purpose animal produces milk, meat, and wool [15]. The effect of different management systems on physicochemical characteristics and milk yield of Kachhi sheep has not been extensively studied. Therefore, the present study was designed to observe the influence of management systems on yield and quality characteristics of sheep milk.

## Materials and Methods

### Experimental Design

Total twelve (12) lactating Kachhi sheep having same parity were chosen and divided in to two groups (A & B) managed under two management systems for a period of three months at Livestock Experiment Station, Department of Livestock Management, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam. Each group comprised of six (6) lactating sheep. The sheep of Group-A were managed under intensive management system provided with production ration and green fodder in sheds. While sheep of group-B were kept under semi-intensive management system, provided grazing at morning time and production ration at evening time. Clean drinking water was provided *ad libitum* to both groups of Kachhi sheep. Commercial formulated feed as per recommendations of [16] was used to fulfil the dietary requirements of milking sheep on the basis of their production requirements.

### Milking pattern and sample collection

All the lactating Kachhi sheep were milked manually twice daily. Prior to milking, the udder was cleaned, and post-dipping was performed after milking by using iodine solution. For calculating the milk yield of Kachhi sheep on daily basis volume of the milk was recorded till three months of experiment. However, composite sample (500ml) was collected from each group of lactating sheep for evaluation of physical, nutritional, and sensorial attributes of milk.

### Physico-chemical characteristics of milk

#### pH value

Milk sample was taken in beaker mixed properly and electrode of pH meter along with temperature probe was inserted in it. The reading for pH values of milk samples were appeared on the scale of pH meter and recorded as pH value of milk [17].

#### Specific gravity

Specific gravity of all milk samples was determined with the help of Lactometer. The milk sample was

poured into glass jar and lactometer and thermometer were inserted in the milk sample and reading was noted on the scale of Lactometer. The lactometer reading was used for the calculation of specific gravity of milk samples by means of following formula [17].

$$\text{Specific gravity} = \frac{\text{Corrected Lactometer reading (CLR)} + 1}{1000}$$

#### Fat content

11ml milk sample admixed with 10ml sulfuric acid with 90% purity and 1ml amyl alcohol in Gerber tube and closed with rubber cork. The Gerber tube containing the sample was centrifuged for 5 min. at 1100rpm in Gerber centrifuge machine. After centrifugation of the milk sample, a reading for fat was noted from the scale of Gerber tube [18].

#### Protein content

5g milk sample, 0.2g copper sulfate, 2g sodium sulfate and 30 ml sulfuric acid admixed in the Kjeldhal flask and digested at 550°C in the Micro-Kjeldhal digestion unit. Digested milk sample was diluted with the addition of 250ml distilled water in volumetric flask. Then 5ml diluted, and 5ml 40% NaOH solution was poured in Micro-Kjeldhal distillation unit in which condensation of sample was extracted in excess of boric acid (2%) and Bromocresol green (5ml) n indicator for 3 minutes. By titrating with 0.1N HCl solution boric acid trapped ammonia was converted into nitrogen and calculated with the help of following formula [19].

$$\text{N\%} = \frac{1.4 (V1-V2) \times \text{HCl normality}}{\text{Sample weight} \times \text{Diluted sample volume}} \times 100$$

Protein percentage = Nitrogen (N) percent × conversion factor (6.38).

#### Ash content

5g milk sample was taken in crucible and weighed on weighing balance and heated at the temperature 550°C for 4±1hrs in the muffle furnace. After heating ashed milk sample was shifted in desiccator for cooling in the presence of silica gel which was used as desiccant. Crucible was weighed after 1h and ash content was calculated with the help of following formula [17].

$$\text{Ash \%} = \frac{\text{Ignited sample weight}}{\text{Sample taken weight}} \times 100$$

#### Lactose content

By deducting the sum of total fat, protein and ash contents from total solids, lactose content of all milk samples was calculated by applying [18] formula.

$$\text{Lactose \%} = \text{TS \%} - (\text{Fat\%} + \text{Protein\%} + \text{Ash \%})$$

#### Sensory attributes

For the sensory evaluation of milk pre-tested proforma was restructured as per recommendation of [20] For the evaluation of milk well trained six (6) judges were selected by using descriptive hedonic scale was applied to rate the scores for sensory attributes; appearance/colour (10 score), odor/aroma (5 score), taste/flavor (10 score) and body/texture (5 score) of all composite milk samples received from each group of milking Kacchi sheep, where nine-point hedonic scale; one for “disliked extremely” and nine for “liked extremely” was used for rating the overall acceptability score of all milk samples [21].

#### Statistical analysis of data

For comparative analysis of milk yield, composition and sensory attributes obtained data were gathered and subjected to descriptive analysis by Statistics software using analysis of variance (ANOVA) and LSD test was applied to observe the statistical variation between the means.

## Results & Discussion

### Milk yield

In the current study the milk yield of Kacchi sheep was found significantly ( $P < 0.05$ ) higher managed in semi-intensive system in contrast to yield of Kacchi sheep managed under intensive system in **Table 1**. Selection of feeding and management systems are the basic and most important factors which influence the yield and quality of the milk [22].

Table 1. Daily milk yield (Liters/day) of Kacchi sheep reared under different management systems

Productive variable	Group-A*	Group-B**	SE±	P value
Milk yield	0.97±0.013 <sup>b</sup>	1.28±0.021 <sup>a</sup>	0.0115	<b>0.032</b>
*Intensive management system				
**Semi-intensive management system				

In accordance with current results [23] reported maximum daily milk yield and lactation length in lactating ewes under semi-intensive management

system. It is of interest to note that restraining of the productive animal in pens and low exercise produced stress which elevates the level of somatic cells in the mammary system that may cause reduction in milk secretion and its quality [24], because of that reason the milk yield of Kachhi sheep reared under intensive management system was low compared to animals reared under semi-intensive management system. Moreover, conformation of udder and feeding management is considered to be a best marker for productive performance of lactating animals [25].

#### Physical quality attributes of milk

The hydrogen ion concentration (pH) and specific gravity of Kachhi sheep milk were statistically not varied but recorded slightly higher in the sheep reared under semi-intensive management system in contrast to intensive management system in **Table 2**. The pH

Table 2. Physical characteristics of Kachhi sheep milk reared under different management systems				
Physical characteristics	Group-A*	Group-B**	SE±	P value
pH value	6.65±0.127	6.70±0.131	0.0316	<b>0.062</b>
Specific gravity	1.031±0.033	1.034±0.081	0.0012	<b>0.074</b>
*Intensive management system				
**Semi-intensive management system				

and specific gravity of the milk are the attributes have been varied with the type of nutrition fed to the animals and dry matter content of milk [26], which is increased with the supply of nutrients in shape of dietetic concentrates, forage feed stuffs and

Table 3. Influence of different management systems on chemical attributes of Kachhi sheep milk.				
Chemical attributes	Group-A*	Group-B**	SE±	P value
Fat	7.50±0.045 <sup>b</sup>	8.72±0.047 <sup>a</sup>	0.4931	<b>0.032</b>
Protein	4.02±0.071 <sup>b</sup>	4.61±0.068 <sup>a</sup>	0.1080	<b>0.041</b>
Ash	0.72±0.024	0.83±0.028	0.0781	<b>0.061</b>
Lactose	4.78±0.032	4.82±0.037	0.0877	<b>0.072</b>
*Intensive management system				
**Semi-intensive management system				

environment provided to the lactating animals [27]. Though, the pH value directly correlated with the concentration of fat that might be the reason behind

the slight variation in hydrogen ion concentration of milk of animals reared in two management systems [28], [29]. Moreover, in the present investigation the variation in the quality characteristics of Kachhi sheep milk might be due to the grazing of the animals in the open ranches [30].

#### Chemical quality of Kachhi milk

Chemical characteristics like fat and protein of Kachhi sheep milk managed under semi-intensive management system were significantly higher (P<0.05) in contrast to intensive management system, while non-significant (P>0.05) difference was observed between the values of lactose, and ash content in the milk of sheep reared under intensive and semi-intensive management systems **Table 3**. The management systems, feeding of the dairy animals

influenced the production and nutritional attributes of the milk [31], In support with the current results [32], [33] reported that diet with high energy fed to the lactating ewes improved the productive performance, composition, higher concentration of energy in diet of high yielding does be liable to boost up milk yield and its compositional contents, nitrogen, fat and mineral contents. Carbohydrates and oil compounds in diet may well directly influence the yield, fat, and lactose contents of milk [34]. Improper water supply and intake reduced milk yield and increased lactose and protein contents in high-yielding lactating breeds of sheep [35]. The variations in the current results related with the proximate characteristics of milk under intensive and semi-intensive management systems are supported by the

panel of scientists and they documented that the variation in the analytical characteristics of milk depending on the management systems adopted by the farmer. Further they concluded that the milk obtained under semi-intensive systems had higher fat, fatty acids like MUFA, PUFA,  $\alpha$ - and omega-3 fatty acids and protein contents in dairy animals [36]. Milk fat and protein, lactose and mineral

contents were not markedly influenced by the management system [37]. Higher concentration of carbohydrates in milk could be allied with the additional supplementation of fatty acids usually play their part in synthesis of fat or acetyl CoA derivative from fatty acids utilized in synthesis of lactose in mammary glands of the lactating animals [38]. Evidence has been cited by the scientists in context to that the slight change in the composition of milk of dairy animals reared in confined and stall-feeding system is because of physiological environment of body, restriction in movement and age, breed, parity, nutrition, lactation and housing systems [24].

#### Sensory quality attributes of milk

In the current study the influence of semi-intensive system was noticed remarkably high on the sensorial

Sensory attributes (Score)	Group-A (Intensive management system)	Group-B (Semi-intensive management system)	SE±	P value
Appearance/Color	6.85±0.033 <sup>b</sup>	7.10±0.056 <sup>a</sup>	0.1462	<b>0.048</b>
Odor/aroma	3.30±0.052	3.80±0.051	0.2741	<b>0.054</b>
Taste/flavor	6.30±0.051 <sup>b</sup>	7.75±0.042 <sup>a</sup>	0.0885	<b>0.038</b>
Body/texture	3.20±0.036 <sup>b</sup>	4.30±0.051 <sup>a</sup>	0.0365	<b>0.034</b>
Overall acceptability	6.55±0.056 <sup>b</sup>	7.70±0.070 <sup>a</sup>	0.0843	<b>0.043</b>

quality attributes of Kachhi sheep milk, especially taste, color, texture, and overall acceptability compared to intensive management system, whereas slight variation ( $P>0.05$ ) was noted in odor/aroma of Kachhi sheep milk managed under intensive and semi-intensive management systems **Table 4**. Sensory quality and acceptance of milk is related with its nutritional quality that is associated with the type of grazing; management patterns applied on the dairy animals which are certainly persuaded with the nutrient's quality of the in milk [39]. However, the colour and general appearance of milk is associated with the carotenoids present in diet [38]. The better results of current study are strongly supported by [40], [41] argued that the nutritional characteristics of sheep milk remarkably improved reared under semi-intensive management system compared to animals fed in confined area. The major contributors those improved the flavor, taste; texture and acceptance are fat and protein in milk which made it attractive to the consumer. Better results for the organoleptic attributes of milk of Kachhi sheep allowed for grazing under

semi-intensive management system are associated with the grazing on natural pastures having natural medicinal plants and herbs [42]. In addition, grazing at different pastures not only increased the level of fatty acids and amino acid in milk of dairy animals is improved at the same time it enhanced sensory quality for patrons [43].

#### Conclusions

Based on the findings of current study it is concluded that Kachhi sheep managed under semi-intensive system had higher milk yield, better physico-chemical quality and better sensorial quality attributes compared to sheep managed under intensive management system.

#### Acknowledgement

Authors appreciate the support provided by the Department of Animal Products Technology and Department of Livestock Management, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam to complete this research.

#### Conflict of interest

The authors declare that no conflict of interest exists.

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