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EFFECT OF GOAT BREEDS ON THE MILK MINERAL COMPOSITION UNDER FIELD AND FARM REARING CONDITIONS

GITAM SINGH* AND R. B. SHARMA
National Coordinator, National Agricultural Higher Education Project,
ICAR Headquarter, KAB – II, Pusa Campus, New Delhi - 110 012, INDIA
e-mail: gitamsingh@yahoo.com

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***Corresponding author**

ABSTRACT
It was a total of 1215 samples from 44 particular goats including field and farm rearing conditions 377 Jamuna pari milk samples and 631 Jakhrana goat milk samples under farm rearing conditions. In the field conditions, total 207 milk samples was collected 102 Jamunapari goat milk samples and 105 Jakhrana goat milk samples from different villages. Calcium content in the milk of Jakhrana as well as Jamunapari goat breed under field rearing conditions was found to be 0.140 ± 0.0020 and 0.145 ± 0.0018 per cent, respectively. In case of farm rearing conditions, the calcium content in Jakhrana and Jamuna pari goat breed's milk was found to be 0.146 ± 0.0018 and 0.151 ± 0.0019 per cent, respectively. The overall average per cent of calcium, phosphorus, potassium, magnesium, chloride and selenium in all above samples and conditions was 0.1455 ± 0.0019, 0.1233 ± 0.0010, 0.111 ± 0.00085, 0.01455 ± 0.00015, 0.1055 ± 0.00059 and 0.01667 ± 0.000058 respectively. The calcium, phosphorus, potassium, magnesium and chloride percentage in the milk of Jakhrana as well as Jamunapari goat breeds under farm rearing conditions was significantly higher than that of field rearing conditions.

INTRODUCTION

Milk is termed to be a complete food, and a component of proteins, carbohydrates, fats, vitamins and minerals (Baig *et al*., 2009). Goat milk is rich in certain minerals i.e. sodium, iron, copper; certain vitamins i.e., vitamin A, nicotinic acid and choline. The goat milk nutritive value varies with its lactation stage, breed type and nutritional regime (Rout *et al*., 2004). Milk is a complex biological fluid containing proteins, fats, carbohydrates, vitamins, minerals and enzymes. Milk composition is considered as an important attribute essential for dairy farmers to maintain raw milk worth, dairy industries to produce better quality products and consumers to sustain nutritional quality and safety (Reis *et al.,* 2013 and Patbandha, *et al*., 2015) .The nature and concentration of milk components are influenced by various production and processing factors such as breed (Singh *et al*., 1990; Kala and Prakash 1990). Under such conditions, animals that are hardy against the vagaries of droughts, disease and poor management are more attractive options than more productive breeds that are vulnerable to these conditions (Braker *et al*., 2002). This is on the background that the composition of milk is also a function of several factors including breed, stage of lactation, climatic conditions and season (Merin *et al*., 1988). Milk composition is affected by several factors including the animals' feed, since it reflects not only their diet but also the local geographical, economical and climatic conditions (Voutzourakis *et al*., 2014). The type of breed had an influence on milk fat; with intensively managed Nguni goat does yielding more milk fat than the Boer goat does in an intensive nutritional system, Gall (1981).The chemical composition of milk, in terms of fat content and its fatty acid composition, depends on dietary (composition and availability), animal (breed, lactation stage, body condition) and environmental (especially cold and heat stress) factors. Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments. Goat being a multipurpose animal produces meat, milk, skin, fibre and manure. The country is endowed with large and biologically diverse population of goats. Most of the Indian goat breeds are meat type except some large size breeds of northwestern region such as Jamunapari, Beetal, Jakhrana and Sirohi, which produce fairly good amount of milk. Rural landless, small or marginal farmers and pastoralists normally belong to low poverty lines. Due to poverty and lack of money, they suffer from malnutrition and under nutrition. Their family nutrition is generally poor. Most of them are agricultural labourers or farmers who put in hard physical work, so they require extra nutrients in their diet. In such cases, goat milk comes to their rescue as a low price with high nutritive value along with positive health aspects. The information on the composition of goat milk minerals of Indian breeds during different seasons and stages of lactation is inadequate. Further such studies on goat milk under field and farm conditions have not been assessed, which would assist in better appraisal of these products from stand – point of processing and product diversification. Therefore, the present study was planned to study the effect of goat breeds on the milk mineral composition under field and farm rearing

conditions.

MATERIALS AND METHODS

The study was conducted at the Central Institute for Research on Goat, Makhdoom, Mathura; under the division nutrition feed resources and products technology for the study of farm rearing conditions. Milk samples were collected from two goat breed Jamunapari and Jakhrana under the farm and field rearing condition. Field samples were collected from different villages near about Agra and Mathura. The Jamunapari and Jakhrana breeds milk samples were available in villages of Mathura, India (27º10´N, 78-º002´E and 169 m above MSL). Geologically the Institute land falls under Jamuna alluvial is semi arid. Temperature ranges between 6ºC in winter to as high 45º C in summer. Annual average rainfall is a period of 50 - 60 days. Monsoon arrives in mid July and remains active till mid September Agnihotri and Rajkumar (2007). The methodology used was an adaption from Bourbouze (1995) and Alvarez Funes and Paz Motola (1997).

Experimental goats and management

It was a total of 1215 samples from 44 particular goats including field and farm rearing conditions 377 Jamunapari milk samples and 631 Jakhrana goat milk samples under farm rearing conditions. In the field conditions, total 207 milk samples was collected 102 Jamunapari goat milk samples and 105 Jakhrana goat milk samples under field conditions. 20 particular goats were selected per breed in farm and 1 particular goat was selected from each breed in both villages under field conditions.

Sample collection and analysis

Goat milk samples were collected from research farm and field properly in January 2009 - December 2011at various time and stages of lactation. The composition was determined by Lactoscan before the analysis of each sample was thoud at 30º C to melt the fat and cold to 20ºC.

Preparation of sample

The bulk sample was sufficiently homogenized to ensure that the aliquot/sub-sample which was taken for analysis was representative of the whole. The size of the sample was proportional to the bulk. Thoroughly mixing of sub-samples from a large bulk was preferred in representative sampling before the analysis of each sample was thoued at 30º C to melt the fat and cold to 20º C. The processing of milk sample for mineral analysis was done by dry ashing.

Dry ashing

About 5 ml milk was taken in silica crucible, weighed and dried in oven. Then, the sample was placed in the muffle furnace and the temperature was brought to 550º C and held for 4 h. After cooling, the ash obtained was dissolved 50% diluted HCl and then made up to suitable volume (100 ml). The resulting solution was used for mineral determination.

Selenium and magnesium were determined by Atomic Absorption Spectrometry (AAS), while calcium and potassium used to determine by flame photometer method. Phosphorus and chloride were determined by chemical methods (Trancoso, *et al.* 2009).

Atomic absorption spectrometry

In atomic absorption spectrometry, the sample solution was first vaporized and atomized in a flame, transforming it to unexcited ground state atoms, which absorb light at specific wave lengths. A light beam from a lamp whose cathode was made of the element in question was passed through the flame. Radiation was absorbed, transforming the ground state atoms to an excited state. The amount of radiation absorbed depended on the concentration of element in the sample. Absorption at a selected wavelength was measured by the change in light intensity striking the detector and was directly related to the amount of the element in the sample (Kazi, M.A. 2015).

Determination of calcium and potassium by flame technique

The technique was based on the fact that ground state metals absorb light at specific wavelengths. Metal ions in a solution were converted to atomic state by means of flame.

Principle

The technique of flame atomic absorption spectroscopy (FAAS) was required a liquid sample to be aspirated, aerosolized, and mixed with combustible gases, such as acetylene and air or acetylene and nitrous oxide. The mixture was ignited in a flame whose temperature ranges from 2100 to 2800ºC. During combustion, atoms of the elements of interest in the sample were reduced to free, unexcited ground state atoms, which absorb light at characteristic wavelengths. The characteristic wavelengths were elements specific and accurate to 0.01-0.1 nm.

Determination of phosphorus content in the milk

25 ml. of the ash extract was pipetted out into a 150 ml. beaker. About 10-12 g. of solid ammonium nitrate was added and heated to 25-30ºC. About 20 ml. of the ammonium molybdate reagent was added. It was stirred vigorously for 15 minutes and then occasionally for 30 minutes. It was set aside for one hour or preferably overnight, for precipitates to settle down. The precipitate was filtered and washed with cold 1% Ammonium nitrate solution till nearly free of acid. The precipitate along with filter paper was transferred into the same beaker in which the precipitation was done. About 1 ml. of phenolphthalein indicator and 20 ml. of N/10 NaOH were added and stirred well with a glass rod. The filter paper was reduced to a pulp by crushing with the glass rod. If no pink colour developed, another 10 ml. of N/10 NaOH was added. It was kept aside for 30 minutes. It intense pink colour of phenolphthalein was decolorized, a further 5 ml. of N/10 NaOH was added. The total volume of N/10 NaOH added was noted. The excess of NaOH used was titrated against standard HCl or HNO_3. The volume of N/10 NaOH used up in the reaction was calculated. The phosphorus content milk was calculated as follows:

1 ml. of N/10 NaOH = 0.3088 mg. P_2O_5 or 0.1348 mg. P.

Determination of chloride content in the milk

10 ml. of well mixed sample was transferred to a porcelain dish. About 1 ml of 5% K_2CrO_4 indicator was added and mixed. It was then titrated against the standard $AgNO_3$ solution till a light permanent brick red precipitate was obtained (Aliyu, *et al.,* 2015).

RESULTS AND DISCUSSION

It is clear from Table 1 that calcium content in the milk of Jakhrana as well as Jamunapari goat breed under field rearing conditions was found to be 0.140 ± 0.0020 and 0.145 ± 0.0018 per cent, respectively. In case of farm rearing conditions, the calcium content in Jakhrana and Jamunapari goat breed's milk was found to be 0.146 ± 0.0018 and 0.151 ± 0.0019 per cent, respectively. The overall average calcium per cent in above all samples and conditions was 0.1455 ± 0.0019.

Our statistical analysis on these data revealed that calcium content of Jakhrana or Jamunapari goat breed milk under field conditions was significantly ($p < 0.05$) lower than that of farm rearing conditions. It is due to better feeding of farm samples. The analysis of variance table revealed that significant variation was observed in calcium content of Jakhrana and Jamunapari goat breeds milk either field or farm rearing conditions at 5% level of significance. It is also observed from the above table that calcium percentage in Jamunapari goat breeds milk was higher than that of Jakhrana goat breeds milk in field and farm rearing conditions. Our results obtained from the present investigation on calcium content in the milk of Jakhrana and Jamunapari goat breeds are fair agreement with the Annual report of C.I.R.G. (2010-11) and Aliyu, *et al*. 2015.

The average percentage of phosphorus in field rearing conditions of Jakhrana and Jamunapari goat breed's milk in the present study was found to be 0.124 ± 0.0012 and 0.120 ± 0.0010, respectively with an average of 0.122 ± 0.0011 per cent. Similarly phosphorus content in farm rearing conditions for aforesaid goat breed's milk was found to be 0.126 ± 0.0009 and 0.123 ± 0.0011 per cent. The overall average phosphorus content in both breed's milk under field and farm rearing conditions of all 1215 samples was found to be 0.1233 ± 0.0010 per cent. It is clear from above table that phosphorus content in the milk of Jakhrana goat breeds under field rearing conditions was lower than that of farm rearing conditions but this difference was insignificant but in case of Jamunapari goat breed, phosphorus content was significantly lower in field rearing conditions than farm rearing conditions. The analysis of variance table revealed that phosphorus content in Jakhrana goat breed's milk was significantly (at 5%) higher than that of Jamunapari goat breed's milk under field and farm rearing conditions. The results obtained in the present investigation of above goat breed's milk are equal with the observations reported by Pal *et al*. (2011).

According to Table 1, the average potassium content in the milk of Jakhrana and Jamunapari goat breeds under field rearing conditions was found to be 0.111 ± 0.0008 and 0.110 ± 0.0008 per cent, respectively with an average of 0.1105 ± 0.0008 per cent. The potassium content in the milk of aforesaid breeds under farm rearing conditions was found to be 0.112 ± 0.0008 and 0.111 ± 0.0010 per cent, respectively with an average value of 0.115 ± 0.0009 per cent. The overall average potassium per cent of all 1215 samples was found to be 0.111 ± 0.00085.

It was observed from above table that potassium content was higher in farm rearing conditions than field rearing conditions of Jakhrana as well as Jamunapari goat breed's milk but this difference was insignificant. The statistical analysis of these data revealed that the breed variation either field or farm rearing conditions was insignificant at 5% level of significance but potassium percentage as found more in Jakhrana goat breeds than that of Jamunapari goat breeds for both rearing conditions. Our results find in the present study on potassium content in the milk of Jakhrana and Jamunapari goat breed are lower than the observation of Pal *et al*. (2011).

It is observed from the above Table 1 that the magnesium content in the milk of Jakhrana and Jamunapari goat breeds under field rearing conditions was found to be 0.0140 ± 0.00012 and 0.0144 ± 0.00016 per cent, respectively with an average value of 0.0142 ± 0.00014 per

Table 1: Composition of goat milk minerals

Factor	Overall	Jamunapari	Jakhrana	Table value			
		Field	Farm	Field	Farm	5%	1%
N	1215	102	377	105	631		
Calcium	0.1455±0.0019(1215)	0.145±0.0018(102)	0.151±0.0019(377)	0.140±0.0020(105)	0.146±0.0018(631)	1.960	2.576
Phosphorus	0.1233±0.0010(1215)	0.120±0.0010(102)	0.123±0.0011(377)	0.124±0.0012(105)	0.126±0.0009(631)		
Potassium	0.111±0.00085(1215)	0.110±0.0008(102)	0.111±0.0010(377)	0.111±0.0008(105)	0.112±0.0008(631)		
Magnesium	0.01455±0.00015 (1215)	0.0144±0.00016(102)	0.0152±0.00017 (377)	0.0140±0.00012 (105)	0.0146±0.00014 (631)		
Chloride	0.1055±0.00059(1215)	0.102±0.00064(102)	0.106±0.00056(377)	0.106±0.0006(105)	0.108±0.00054(631)		
Selenium	0.01667±0.000058 (1215)	0.01660±0.000054 (102)	0.01648±0.00006 (377)	0.01695±0.000056 (105)	0.01665±0.00006 (631)		

Table 2: Analysis of variance

Contents for the source of variance	Variance ratio	F- Value table		
	Field	Farm	5%	1%
Calcium	3.862^{+}	3.904^{+}	3.841	6.635
Phosphorus	4.041^{+}	4.121^{+}	3.841	6.635
Potassium	3.126^{NS}	3.497^{NS}	3.841	6.635
Magnesium	4.692^{+}	4.866^{+}	3.841	6.635
Chloride	5.96^{+}	4.121^{+}	3.841	6.635
Selenium	6.936^{++}	6.163^{++}	3.841	6.635

cent. The magnesium content of above both breeds under farm rearing conditions was also found to be 0.0146 ± 0.00014 and 0.0152 ± 0.00017 per cent, respectively with an average of 0.0149 ± 0.00016 per cent. The overall average magnesium per cent of above all 1215 samples under field and farm rearing conditions was 0.01455 ± 0.00015. The statistical analysis showed that the magnesium content was significantly higher in farm rearing conditions than in field rearing conditions in the milk of Jakhrana as well as Jamunapari goat breeds. The analysis of variance of table on these data revealed that significant (at 5%) difference was observed in Jakhrana and Jamunapari goat breeds either field or farm rearing conditions. It is also clear from the present study that magnesium content was higher in Jamunapari goat breed milk than Jakhrana goat breed. Our observations obtained on magnesium content in the milk of above goat breed in the present investigations under field and farm rearing conditions are fully agreement with the findings of Pal et al. (2011) and (Aliyu, *et al*. 2015) who have reported 0.0118 ± 8.75 percent magnesium content in the goat milk.It is clear from Table 1 that chloride content in milk of Jakhrana and Jamunapari goat breeds under field rearing conditions was found to be 0.106 ± 0.0006 and 0.102 ± 0.00064 per cent, respectively with an average of 0.104 ± 0.00062 per cent. Similarly in case of farm rearing conditions, the chloride content in Jakhrana and Jamunapari goat breed's milk was found by 0.108 ± 0.00054 and 0.106 ± 0.00056 per cent, respectively with an average of 0.107 ± 0.00055. The overall average chloride content in above goat breeds of field and farm rearing conditions was 0.1055 ± 0.00059 per cent.

The statistical analysis was revealed that chloride content was significantly higher in farm rearing samples than that of field rearing samples of both breeds. The analysis of variance table on these data also revealed that chloride content in Jakhrana goat breed's milk was significantly (at 5%) greater than that of Jamunapari goat breed under field and farm rearing conditions.

Our data obtained on chloride content in the present study in the milk of Jakhrana and Jamunapari goat breed under field and farm rearing conditions are fully corroborated with the observations of Pal *et al*. (2011). The results lay down in Table 1 indicated that the selenium percentage of Jakhrana and Jamunapari goat breed's milk under field rearing conditions was 0.01695 ± 0.000056 and 0.01660 ± 0.000054, respectively. Whereas in case of farm rearing conditions the same was 0.01665 ± 0.00006 and 0.01648 ± 0.00006, respectively. The overall average selenium percentage of Jakhrana and Jamunapari goat breeds milk under field and farm rearing conditions was 0.01667 ± 0.000058.The present study also showed that selenium per cent in the milk of Jakhrana as well as Jamunapari goat breed under field rearing conditions was significantly ($p < 0.01$) greater than that under farm rearing conditions. The ANOVA Table 2 revealed that significantly greater variation was observed in selenium content in the milk of Jakhrana and Jamunapari goat breeds under field and or farm rearing conditions.

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