



## Effect Of Breed And Method Of Preparation On Composition Of Goat Milk Mozzarella Cheese

Surendra Pal Singh<sup>1</sup>, R.B. Sharma<sup>2</sup> and Gitam Singh<sup>3</sup>

<sup>1</sup>Amardeep Degree College, Firozabad, UP, <sup>3</sup>K.V.K.Banasthali vidyapeeth Tonk, Rajasthan

<sup>2</sup>National Agricultural Higher Education Project (NAHEP), ICAR, New Delhi, 110012

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### Abstract

A third major outlet for cheese is in the production of a broad range of processed cheese products which in turn have a range of applications, especially as spreads, sandwich fillers or food ingredients. Fresh Jakhrana and Jamunapari goat milk was collected within 1.5-2 hour of milking from Livestock Units of Central Institute for Research on Goats, Makhdoom, Farah, Mathura (U.P.). The milk was strained through muslin cloth to remove the dirt. The fat percentage in goat milk mozzarella cheese made from Jakhrana and Jamunapari goat milk was found to be  $19.324 \pm 0.155$  and  $19.427 \pm 0.154$  respectively. Similarly the fat percentage in goat milk mozzarella cheese made by direct acid, starter culture and modified method was found to be  $18.983 \pm 0.102$ ,  $20.517 \pm 0.104$  and  $18.627 \pm 0.135$  respectively. The overall average percentage of fat in cheese was  $19.376 \pm 0.109$ . The protein percentage in goat milk mozzarella cheese made from Jakhrana and Jamunapari goat milk was found to be  $22.424 \pm 0.163$  and  $22.767 \pm 0.141$  respectively. Similarly the protein percentage in goat milk mozzarella cheese made by direct acid, starter culture and modified method was found to be  $23.047 \pm 0.178$ ,  $22.013 \pm 0.188$  and  $22.727 \pm 0.151$  respectively. The overall average percentage of protein in cheese was  $22.596 \pm 0.109$ . The statistical analysis revealed that a significant difference existed in the moisture content of cheese made from different breed's milk. Cheese made from milk of Jamunapari goat had significantly higher moisture content in comparison to Jakhrana goat milk. The statistical analysis revealed that a significant difference existed in pH value of cheese made from different breed's milk. Cheese made from milk of Jamunapari goat had significantly higher ( $p > 0.05$ ) pH value in comparison to Jakhrana goat milk. However no significant difference was observed between different methods of preparation.

**Key Words:** Effect of breed and method, Composition, Goat milk, Preparation of mozzarella cheese.

### Introduction

Products such as butter and cheese made from sheep, goat or buffalo milk are very white in comparison with their counterparts made from bovine milk. This yellowish colour may make products produced from cows' milk less acceptable than products produced from sheep's, goats' or buffalo milk in Mediterranean countries where the latter are traditional (Springer New York, 2017).

Equally important is the calculation of the effects that each milk component, and in particular, fat and casein, can have on cheese yield, in order to adopt a milk quality payment system that could remunerate each parameter for its actual value (Paolo et al. 2008).

Many factors may affect the composition of goat milk like that the specific gravity in the milk of Jamunapari goat breeds under field and farm rearing conditions for aforesaid multiple birth, the specific gravity was found to be  $1.0296 \pm 0.00039$  and  $1.0304 \pm 0.00037$ ,  $1.0286 \pm 0.0004$  and  $1.0294 \pm 0.00039$  and  $1.0286 \pm 0.00038$  and  $1.0292 \pm 0.00036$ , respectively. Fat percentage in the milk of Jamunapari goat breeds under field and farm rearing conditions for aforesaid multiple births the fat per cent was found to be  $4.71 \pm 0.047$  and  $4.85 \pm 0.047$ ,  $4.83 \pm 0.044$  and  $4.98 \pm 0.043$  and  $4.92 \pm 0.048$  and  $5.10 \pm 0.049$  per cent respectively. Protein percentage in the milk of Jamunapari goat breeds under field and farm



Corresponding author's e-mail : [gitamsingh@yahoo.com](mailto:gitamsingh@yahoo.com)

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rearing conditions for aforesaid multiple birth, the protein per cent was found to be  $3.26 \pm 0.027$  and  $3.14 \pm 0.032$ ,  $3.23 \pm 0.024$  and  $3.10 \pm 0.035$  and  $3.17 \pm 0.031$  and  $3.03 \pm 0.038$  per cent respectively. The overall average protein percentage of all above samples of milk was  $3.205 \pm 0.031$ . The ash percentage in the milk of Jamunapari goat breed's milk under field and farm rearing conditions for aforesaid multiple births the ash per cent was found to be  $0.72 \pm 0.0078$  and  $0.68 \pm 0.010$ ,  $0.74 \pm 0.0075$  and  $0.70 \pm 0.008$  and  $0.76 \pm 0.0074$  and  $0.72 \pm 0.014$  respectively. Multiple births had conspicuous effects on milk quality of goats under study (Singh, *et al.* 2014).

Cheese yield potential of milk is largely dependent on milk composition, particularly fat and protein (Barbano and Sherbon 1984, Gilles and Lawrence 1985, Banks *et al.* 1986, Lawrence 1993 a, Lou and Ng-Kwai-Hang 1992, Lucey and Kelly 1994, Van den Berg 1994, Brito *et al.* 2002, Guo *et al.* 2004).

#### Methodology

The study was conducted at Goat Products Technology Laboratory of Central Institute for Research on Goats, Makhdoom, Farah, Mathura, Uttar Pradesh and Department of Animal Husbandry and Dairying, R.B.S. College Bichpuri, Agra (U.P.).

Fresh Jakhrana and Jamunapari goat milk was collected within 1.5-2 hour of milking from Livestock Units of Central Institute for Research on Goats, Makhdoom, Farah, Mathura (U.P.). The milk was strained through muslin cloth to remove the dirt.

Approximately 100 g portion of the cheese was cut from the center of the ball include the core of the ball as well as the periphery as to ensure a representative sample. All the glassware which were used in the milk and cheese analysis i.e. Petri dish, conical flask, test tube, pipette and glass rod etc. were properly cleaned washed and then sterilized at  $120^{\circ}\text{C}$  for 4 to 5 h in an electric sterilizer.

**Determination of fat content in Mozzarella Cheese:** Total Fat Content (TF) was extracted in Soxhlet Extraction Unit as described by AOAC (2000). Soxhlet Extractor was set with reflux condenser and distillation flask which was previously dried and weighed. Dried cheese sample (2 g) was taken in to fat free extraction thimble and placed in extraction apparatus (soxhlet). Then ether (150 ml) was poured in to extraction flask and condenser was joined and placed on electric heater in order to boil the solvent gently. Extraction was carried out for 6 h.

The solution was removed. Fat content was calculated by using the following formula:

$$\text{Fat (\%)} = \frac{W_2 - W_1}{W_3} \times 100$$

W1 = weight of empty distillation flask

W2 = weight of distillation flask + Fat

W3 = weight of sample taken

**Determination of Total protein content in Mozzarella Cheese:** Protein content was determined according to the method as described by AOAC (2000). The sample (2 g) was digested using Kjeldahl digester in the presence of catalyst (0.35 g copper sulfate and 7 g sodium sulfate/potassium sulfate) where sulfuric acid (20-30 ml) was used as an oxidizing agent and diluted with distilled water (250 ml). The diluted sample (5 ml) was distilled with 40% Na OH using Kjeldahl distillation unit where steam was distilled over 2% boric acid (5 ml) containing an indicator bromocresol green for 3 min. The ammonia trapped in boric acid was determined by titrating with 0.1N HCl. The nitrogen percentage was calculated using the following formula:

$$\text{N(\%)} = \frac{1.4(V_1 - V_2) \times \text{normality of HCl} \times 250}{\text{Weight of sample taken} \times \text{volume of diluted sample}}$$

Where,

V1 = titrated value

V2 = blank sample value

While protein percentage was determined by conversion of nitrogen percentage to protein by using conversion factor (6.38) assuming that all the nitrogen in cheese was present as protein i.e. protein percentage = N% x CF.

**Determination of Moisture content in Mozzarella Cheese:** Moisture content was determined according to the method of Association of Official Analytical Chemists (AOAC, 2000). The fresh minced cheese sample (5 g) was transferred in pre-weighed flat bottom aluminum dish, which was transferred to hot air oven at  $101 \pm 1^{\circ}\text{C}$  for 3-4 h. Dried sample was then placed in desiccators having silica gel as desiccant. After 1 h, the dish was weighed. Moisture content was calculated by applying the following formula:

$$\text{Moisture (\%)} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Where,

W1 = weight of empty dish

W2 = weight of dish + sample

W3 = weight of dish + dried sample

**Determination of pH of Mozzarella Cheese:**

10 gm of Mozzarella cheese was made into paste in mortar using 10ml of glass distilled

water. The pH value was recorded with digital pH meter (Systronics).

**Results and Discussion**

The data obtained on effect of breed and method of preparation on fat content of goat milk mozzarella cheese in the present study are presented in Table -1.

**Table-1: Effect of breed and method of preparation on fat content of goat milk mozzarella cheese**

MEAN & S.E. FOR BREED NO. 1	19.324	0.155 (45)
MEAN & S.E. FOR BREED NO. 2	19.427	0.154 (45)
MEAN & S.E. FOR METHOD NO. 1	18.983	0.102 (30)
MEAN & S.E. FOR METHOD NO. 2	20.517	0.104 (30)
MEAN & S.E. FOR METHOD NO. 3	18.627	0.135 (30)
MEAN & S.E. OVER ALL	19.376	0.109 (90)
MEAN & S.E. FOR BREED NO.1 x METHOD NO. 1	19.127	0.142 (15)
MEAN & S.E. FOR BREEDNO.1 x METHOD NO. 2	20.513	0.148 (15)
MEAN & S.E. FOR BREEDNO.1 x METHOD NO. 3	18.333	0.106 (15)
MEAN & S.E. FOR BREED NO.2 x METHOD NO.1	18.840	0.142 (15)
MEAN & S.E. FOR BREED NO.2 x METHOD NO.2	20.520	0.151 (15)
MEAN & S.E. FOR BREEDNO.2 x METHOD NO.3	18.920	0.227 (15)

**Note:** Figure in parenthesis indicated number of observations.

It is observed from Table -1 that the fat percentage in goat milk mozzarella cheese made from Jakhrana and Jamunapari goat milk was found to be  $19.324 \pm 0.155$  and  $19.427 \pm 0.154$  respectively. Similarly the fat percentage in goat milk mozzarella cheesemade by direct acid, starter culture and modified method was found to be  $18.983 \pm 0.102$ ,  $20.517 \pm 0.104$  and  $18.627 \pm 0.135$  respectively. The overall average percentage offat in cheese was  $19.376 \pm 0.109$ . The interaction between different breeds and

methods of manufacture are also presented in above table.

The statistical analysis (Table-2) revealed that a significant difference existed in the fat content of cheese made by different methods. However no significant difference was observed between cheese made from milk of Jakhrana and Jamunapari goat breeds. The level of fat content was significantly higher in cheese made by starter culture method than that of other two methods used in the study.

**Table-2: Analysis Of Variance**

SOURCE OF VARIATION	D.F.	S.S.	M.S.S.	F-VALUE	REMARK
1 BETWEEN BREED	1	0.235	0.235	0.595	NOT SIG.
2 BETWEEN METHOD	2	60.504	30.252	76.550	H.SIG.1%
3 ERROR	86	33.987	0.395	----	
TOTAL	89	94.726			
NO.OF OBS. SE CD AT 5% CD AT 1%					
BETWEEN TWO BREED NO. 1	2	45	0.133	0.271	0.364
BETWEEN TWO METHOD NO.1	2	30	0.162	0.331	0.446
BETWEEN TWO METHOD NO.1	3	30	0.162	0.331	0.446
BETWEEN TWO METHOD NO.2	3	30	0.162	0.331	0.446

Published work reports a fat level of 18 percent of mozzarella cheese (Webb *et al.* 1983), which is comparable with the fat content of cheese prepared in the present study by the three methods of manufacturing. There was a significant difference in the fat content between the three different methods of manufacturing. It may be attributed to the unequal distribution of fat in the curd produced by modified method.

However Venkateshwarlu *et al.* 1998 reported a non-significant difference in the fat content between the above three methods of manufacturing in case of mozzarella cheese made from cow milk. Pal and Agnihotri (2000) reported that fresh direct acid Mozzarella cheese prepared from goat milk had 14.56±1.00 % ether extract.

The data obtained on effect of breed and method of preparation on protein content of goat milk mozzarella cheese is presented in Table - 3.

**Table-3: Effect of breed and method of preparation on protein content of goat milk mozzarella cheese**

MEAN & S.E. FOR BREED NO. 1	22.424	0.163	(45)
MEAN & S.E. FOR BREED NO. 2	22.767	0.141	(45)
MEAN & S.E. FOR METHOD NO. 1	23.047	0.178	(30)
MEAN & S.E. FOR METHOD NO. 2	22.013	0.188	(30)
MEAN & S.E. FOR METHOD NO. 3	22.727	0.151	(30)
MEAN & S.E. OVER ALL	22.596	0.109	(90)
MEAN & S.E. FOR BREEDNO.1 x METHOD NO. 1	23.227	0.136	(15)
MEAN & S.E. FOR BREEDNO.1 x METHOD NO. 2	21.207	0.206	(15)
MEAN & S.E. FOR BREEDNO.1 x METHOD NO. 3	22.840	0.162	(15)
MEAN & S.E. FOR BREED NO.2 x METHOD NO. 1	22.867	0.328	(15)
MEAN & S.E. FOR BREEDNO.2 x METHOD NO. 2	22.820	0.105	(15)
MEAN & S.E. FOR BREEDNO.2 x METHOD NO. 3	22.613	0.257	(15)

**Note:** Figure in parenthesis indicated number of observations.

It is observed from Table - 3 that the protein percentage in goat milk mozzarella cheese made from Jakhrana and Jamunapari goat milk was found to be 22.424±0.163 and 22.767±0.141 respectively. Similarly the protein percentage in goat milk mozzarella cheese made by direct acid, starter culture and modified

method was found to be 23.047±0.178, 22.013±0.188 and 22.727±0.151 respectively. The overall average percentage of protein in cheese was 22.596± 0.109. The interaction between different breeds and methods of manufacture are also presented in above table.

**Table-4: ANALYSIS OF VARIANCE**

SOURCE OF VARIATION	D.F.	S.S.	M.S.S.	F-VALUE	REMARK
1 BETWEEN BREED	1	2.635	2.635	3.006	NOT S.
2 BETWEEN METHOD	2	16.790	8.395	9.576	H.SIG.1%
3 ERROR	86	75.393	0.877	----	
TOTAL	89	94.818			
NO.OF OBS. SE CD AT 5% CD AT 1%					
BETWEEN TWO BREED NO.1 2		45 45	0.197	0.403	0.543
BETWEEN TWO METHOD NO.1 2		30 30	0.242	0.494	0.665
BETWEEN TWO METHOD NO.1 3		30 30	0.242	0.494	0.665
BETWEEN TWO METHOD NO.2 3		30 30	0.242	0.494	0.665

The statistical analysis (Table-4) revealed that a significant difference existed in the protein content of cheese made by different methods. However no significant difference was observed between cheese made from milk of Jakhrana and Jamunapari goat breeds. The level of protein content was significantly higher in cheese made by direct acid method followed by modified method and starter culture method. Venkateshwarlu et al. 1998 reported that the mean protein content was higher in cheese

made by modified method using cow milk when compared with the other two methods. Pal and Agnihotri (2000) reported that fresh direct acid Mozzarella cheese prepared from goat milk had higher protein content. It may be attributed to the partial precipitation of casein giving a soft coagulum. The complete coagulation of casein would give rise to a curd mass with hard texture and loss of characteristic stretchability and stringiness.

The data obtained on effect of breed and method of preparation on moisture content of goat milk mozzarella cheese is presented in Table - 5.

**Table-5: Effect of breed and method of preparation on moisture content of goat milk mozzarella cheese**

MEAN & S.E. FOR BREED NO. 1	47.840	0.310 (45)
MEAN & S.E. FOR BREED NO. 2	49.333	0.173 (45)
MEAN & S.E. FOR METHOD NO. 1	48.037	0.304 (30)
MEAN & S.E. FOR METHOD NO. 2	48.717	0.331 (30)
MEAN & S.E. FOR METHOD NO. 3	49.007	0.354 (30)
MEAN & S.E. OVER ALL	48.587	0.193 (90)
MEAN & S.E. FOR BREEDNO.1 x METHOD NO. 1	47.500	0.535 (15)
MEAN & S.E. FOR BREEDNO.1 x METHOD NO. 2	47.827	0.460 (15)
MEAN & S.E. FOR BREEDNO.1 x METHOD NO. 3	48.193	0.624 (15)
MEAN & S.E. FOR BREED NO.2 x METHOD NO. 1	48.573	0.237 (15)
MEAN & S.E. FOR BREED NO.2 x METHOD NO. 2	49.607	0.359 (15)
MEAN & S.E. FOR BREED NO.2 x METHOD NO. 3	49.820	0.188 (15)

**Note:** Figure in parenthesis indicated number of observations.

It is observed from Table - 5 that the moisture percentage in goat milk mozzarella cheese made from Jakhrana and Jamunapari goat milk was found to be 47.840±0.310 and 49.333±0.173 respectively. Similarly the moisture percentage in goat milk mozzarella cheese made by direct acid, starter culture and modified method was

found to be 48.037±0.304, 48.717±0.331 and 49.007±0.354 respectively. The overall average percentage of moisture in cheese was 48.587±0.193. The interaction between different breeds and methods of manufacture are also presented in above table.

**Table-6: ANALYSIS OF VARIANCE**

SOURCE OF VARIATION	D.F.	S.S.	M.S.S.	F-VALUE	REMARK	
1 BETWEEN BREED	1	50.176	50.176	18.392	H.SIG.1%	
2 BETWEEN METHOD	2	14.874	7.437	2.726	NOT SIG.	
3 ERROR	86	234.614	2.728	----		
TOTAL	89	299.664				
NO.OF OBS.	SE	CD AT 5%	CD AT 1%			
BETWEEN TWO BREED NO. 1	245	45	0.348	0.681	0.958	
BETWEEN TWO METHOD NO.1	2	30	30	0.426	0.851	1.173
BETWEEN TWO METHOD NO.1	3	30	30	0.426	0.851	1.173
BETWEEN TWO METHOD NO.2	3	30	30	0.426	0.851	1.173

The statistical analysis (Table-6) revealed that a significant difference existed in the moisture content of cheese made from different breed's milk. Cheese made from milk of Jamunapari goat had significantly higher moisture content in comparison to Jakhrana goat milk. However no significant difference was observed between different methods of preparation.

Venkateshwarlu *et al.* 1998 reported that the average moisture content of cheese samples prepared by three different methods did not show significant variation and is comparable with the published results. The findings of Pal and Agnihotri (2000) are in agreement with our findings as they have reported that fresh direct acid Mozzarella cheese prepared from goat milk had  $49.29 \pm 0.74\%$  moisture.

The data obtained on effect of breed and method of preparation on pH of goat milk mozzarella cheese is presented in Table - 7.

**Table-7: Effect of breed and method of preparation on pH of goat milk mozzarella cheese**

MEAN & S.E. FOR BREED NO. 1	5.713	0.028	(45)
MEAN & S.E. FOR BREED NO. 2	5.789	0.017	(45)
MEAN & S.E. FOR METHOD NO. 1	5.723	0.031	(30)
MEAN & S.E. FOR METHOD NO. 2	5.800	0.022	(30)
MEAN & S.E. FOR METHOD NO. 3	5.730	0.031	(30)
MEAN & S.E. OVER ALL	5.751	0.017	(90)
MEAN & S.E. FOR BREEDNO.1 x METHOD NO. 1	5.713	0.057	(15)
MEAN & S.E. FOR BREEDNO.1 x METHOD NO. 2	5.767	0.030	(15)
MEAN & S.E. FOR BREEDNO.1 x METHOD NO. 3	5.660	0.054	(15)
MEAN & S.E. FOR BREEDNO.2 x METHOD NO.1	5.733	0.027	(15)
MEAN & S.E. FOR BREEDNO.2 x METHOD NO.2	5.833	0.032	(15)
MEAN & S.E. FOR BREEDNO.2 x METHOD NO.3	5.800	0.022	(15)

**Note:** Figure in parenthesis indicated number of observations.

It is observed from Table - 7 that the pH of mozzarella cheese made from Jakhrana and Jamunapari goat milk was found to be  $5.713 \pm 0.028$  and  $5.789 \pm 0.017$  respectively. Similarly the pH of mozzarella cheese made by direct acid, starter culture and modified method

was found to be  $5.723 \pm 0.031$ ,  $5.800 \pm 0.022$  and  $5.730 \pm 0.031$  respectively. The overall average value of pH of goat milk mozzarella cheese was  $5.751 \pm 0.017$ . The interaction between different breeds and methods of manufacture are also presented in above table.

**Table-8: ANALYSIS OF VARIANCE**

SOURCE OF VARIATION	D.F.	S.S.	M.S.	S.F-VALUE	REMARK
1 BETWEEN BREED	1	0.128	0.128	5.500	SIG. 5%
2 BETWEEN METHOD	2	0.108	0.054	2.317	NOT SIG.
3 ERROR	86	2.008	0.023	----	
TOTAL	89	2.245			
NO.OF OBS.	SE	CD AT 5%	CD AT 1%		
BETWEEN TWO BREED NO. 1 2	45	45	0.032	0.064	0.089
BETWEEN TWO METHOD NO.1 2	30	30	0.039	0.078	0.109
BETWEEN TWO METHOD NO.1 3	30	30	0.039	0.078	0.109
BETWEEN TWO METHOD NO.2 3	30	30	0.039	0.078	0.109

The statistical analysis revealed that a significant difference existed in pH value of cheese made from different breed's milk. Cheese made from milk of Jamunapari goat had significantly higher ( $p>0.05$ ) pH value in comparison to Jakhrana goat milk. However no significant difference was observed between different methods of preparation.

Venkateshwarlu et al. 1998 reported that the methods of manufacturing of mozzarella cheese had no influence on the pH value of the cheese and the pH values observed in the three experimental samples were comparable with the findings reported by Tunick et al. (1991). Pal and Agnihotri (2000) reported slightly higher ( $5.57\pm 0.15$ ) pH value for goat milk mozzarella cheese using direct acidification method. Sharma et al. 2009 reported that packaging treatment significantly ( $p< 0.01$ ) affected the pH of goat milk mozzarella cheese. Aerobically packed cheese showed lower mean value ( $5.58 \pm 0.05$ ) than vacuum packaged ( $5.72 \pm 0.036$ ). Storage period also significantly ( $p<0.01$ ) affected the pH. The overall mean value for pH was recorded to be  $5.65 \pm 0.035$ . Our results for overall pH were  $5.751\pm 0.017$ .

### Conclusion

It is concluded that a good quality Mozzarella cheese can be made from Jakhrana and Jamunapari goat milk by modified method as per the procedure developed in the present study.

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