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# Effect of Genotypes of Beta Lacto Globulin on Milk yield and Milk composition during four Lactation Periods in Red Sindhi cows

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## Abstract

*The present study was undertaken to study the effect of Beta lactoglobulin (β-LG) genotypes on milk yield and milk composition during four lactation periods. Individual mid lactation milk samples of 75 ml of each were collected from 95 Red Sindhi cows in first, second, third and fourth lactation period maintained at Livestock research station, Hosur. Effect of genotypes of β-LG AA, AB and BB on milk fat% , protein%,Casein%,Total solids% and 305 days milk yield were analysed by completely random design by least square analysis. β-LG genotypes (AA, AB and BB) were found to be having highly significant (P≤0.01) effect on Fat% during first and second lactation and significant effect (P≤0.05) during third and fourth lactation respectively. β-LG genotypes were found to be having significant effect on protein% during first, second, third and fourth lactation periods. Genotypes of β-LG were found to be having significant effect on casein% during first lactation and highly significant effect during second, third and fourth lactation periods. β-LG genotypes were found to be having significant effect on total solids % during first lactation period only and no significant effect during second, third and fourth lactation periods. β-LG genotypes were found to be having highly significant effect on milk yield during first and third lactation period and significant effect during second and fourth lactation periods.*

**Keywords:** Red Sindhi Cows, β-lactoglobulin, lactation period, genotypes.

## Introduction

Red Sindhi breed is well known for heat tolerance and milk production. Red Sindhi is originated from Pakistani state of Sind. Red Sindhi have spread in to many parts of India and at least 33 countries in Africa, Asia, America and Oceania. Red Sindhi are normally deep rich red colour but can vary from yellowish brown to dark brown.

Milk protein comprises casein and whey protein. Whey proteins have two major fractions alpha-lactalbumin and Beta-lactoglobulin. Beta-lactoglobulin exists in different allelic forms which are controlled by co-dominant autosomal genes. The milk proteins vary in amino acid composition and thus possess different nutritional value, processing properties and capacity of manufactured milk products[1]. Beta lactoglobulin belongs to lipocalin family[2] and genotypes of beta lactoglobulin have greater stability at acidic pH[3].

Milk protein genes such as κ-Casein and beta lacto globulin are associated with milk production performance and have a major influence on the composition of milk on the processing properties of milk[4]. β-LG is a major whey protein found in bovine milk. It is a molecule of 162 amino acid and occurs in different allelic forms[5]. β-LG BB genotype found to have higher fat%, higher milk yield. Higher percentage of protein and serum proteins were associated with AA genotype of β-LG[6]. The effect of genotypes of β-LG on milk yield and milk production traits irrespective of lactation number and gene frequencies of β-LG has been reported in Red Sindhi cows[7]. The present study was undertaken to study the effect of β-LG genotypes on milk yield and milk composition during four lactation periods.

## Material and Methods

Individual mid lactation milk samples of 75 ml each were collected from 95 Red Sindhi cows in first, second, third and fourth lactation period maintained at Livestock Research Station, Hosur, Tamil Nadu, in clean sterile polypropylene containers. Animals were already typed for β-LG genotypes by Polyacrylamide gel electrophoresis (PAGE) Whey protein isolated from red sindhi milk was run on 12% PAGE to identify the genotypes of β-LG and Polymerase chain reaction – restriction fragment length polymorphism (PCR-RFLP)was used to confirm the genotypes at DNA level[8,9]. The% fat was estimated by Gerber's Butyrometer (Fucoma test), protein% by Kjeldhals method. Casein% by Indian standards method and total solids% by Gravimetric method[10] (IS: 1479 (PartII) 1961). 305 days milk yield data were collected from records.

**Correlation studies and analysis of data:** Effect of genotypes of betalactoglobulin during four lactation periods on milk fat%, milk protein%, total solids%, 305 days milk yield, total solid% and casein% in Red Sindhi cows were analyzed by completely random design by least square analysis[11] (Snedecor and Cochran, 1967). Fat%, Protein%, casein% and total solids % were less than 30%, so the values were converted to Arcine√p values and milk yield values were taken as such for analysis.

## Results and Discussion

Fat%, Protein %, Milk casein%, total solids % and 305 days milk yield during four lactation periods for different genotypes and least square analysis are given in table 1, 2, 3, 4 and 5 respectively.

**Table-1**
**Least square analysis of effect of β-LG genotypes on Fat % in milk of Red Sindhi cows during four lactations**

| **Genotypes of β-LG** | **Fat% ( Mean±SE)** | | | |
|---|---|---|---|---|
| | **First lactation** | **Second lactation** | **Third lactation** | **Fourth lactation** |
| AA | **11.39±0.086** (3.90±0.058) | **11.31±0.075** (3.85±0.050) | **11.24±0.149** (3.80±0.100) | **11.16±0.075** (3.75±0.050) |
| AB | **11.68±0.065** (4.10±0.045) | **11.53±0.069** (4.00±0.046) | **11.59±0.084** (3.98±0.057) | **11.49±0.110** (3.97±0.075) |
| BB | **11.83±0.034** (4.20±0.023) | **11.73±0.043** (4.14±0.029) | **11.60±0.069** (4.02±0.038) | **11.65±0.047** (4.08±0.032) |
| Statistical value | | | | |
| F | 14.405** | 6.840** | 6.70* | 4.304* |
| SE | 0.05 | 0.07 | 0.09 | 0.09 |
| CD | 0.19 | 0.27 | 0.263 | 0.22 |

NS: Non-significant (P>0.05); *P≤0.05; **P≤ 0.01, Bold Numbers indicate transformed Arcine √p values, Numbers in parenthesis indicate original values.

**Table-2**
**Least square analysis of effect of β-LG genotypes on Protein % in milk of Red Sindhi cows during four lactations**

| Genotypes of β-LG | Protein%( Mean±SE) | | | |
|---|---|---|---|---|
| | First lactation | Second lactation | Third lactation | Fourth lactation |
| AA | **10.41±0.057** (3.28±0.008) | **10.46±0.160** (3.302±0.075) | **10.54±0.075** (3.27±0.010) | **10.30±0.165** (3.20±0.080) |
| AB | **10.17±0.102** (3.09±0.078) | **10.08±0.109** (3.05±0.065) | **10.06±0.93** (3.05±0.080) | **10.03±0.160** (3.00±0.060) |
| BB | **10.10±0.067** (3.08±0.044) | **10.04±0.097** (3.03±0.035) | **10.04±0.060** (3.03±0.030) | **9.90±0.142** (2.99±0.056) |
| Statistical value | | | | |
| F | 4.92* | 4.36* | 7.25* | 4.92* |
| SE | 0.06 | 0.15 | 0.08 | 0.08 |
| CD | 0.18 | 0.26 | 0.28 | 0.24 |

NS: Non-significant (P>0.05) *P≤0.05; **P≤ 0.01, Bold Numbers indicate transformed Arcine √p values, Numbers in parenthesis indicate original values.

**Table-3**
**Least square analysis of effect of β-LG genotypes on Casein % in milk of Red Sindhi cows during four lactations**

| **Genotypes of β-LG** | **Casein%( Mean±SE)** | | | |
|---|---|---|---|---|
| | **First lactation** | **Second lactation** | **Third lactation** | **Fourth lactation** |
| AA | **9.13±0.056** (2.50±0.028) | **9.14±0.048** (2.51±0.021) | **9.10±0.050** (2.49±0.022) | **9.06±0.055** (2.46±0.063) |
| AB | **9.16±0.147** (2.52±0.084) | **9.15±0.111** (2.52±0.052) | **9.13±0.336** (2.50±0.080) | **9.08±0.094** (2.47±0.050) |
| BB | **9.33±0.059** (2.63±0.037) | **9.34±0.090** (2.64±0.060) | **9.32±0.090** (2.61±0.040) | **9.30±0.090** (2.58±0.020) |
| Statistical value | | | | |
| F | 4.923* | 8.711** | 10.886** | 13.334** |
| SE | 0.06 | 0.06 | 0.04 | 0.06 |
| CD | 0.16 | 0.17 | 0.11 | 0.17 |

NS: Non-significant (P>0.05); *P≤0.05 *P≤ 0.01, Bold Numbers indicate transformed Arcine √p values, Numbers in parenthesis indicate original values.

**Table-4**
**Least square analysis of effect of β-LG genotypes on Total Solids % in milk of Red Sindhi cows during four lactations**

| Genotypes of β-LG | Total Solids %( Mean±SE) | | | |
|---|---|---|---|---|
| | First lactation | Second lactation | Third lactation | Fourth lactation |
| AA | **20.64±0.023** (12.48±0.235) | **21.01±0.045** (12.82±0.075) | **21.00±0.045** (12.89±0.070) | **20.87±0.175** (12.72±0.200) |
| AB | **21.24±0.180** (13.12±0.058) | **21.08±0.147** (12.93±0.172) | **21.02±0.149** (12.91±0.171) | **20.93±0.198** (12.96±0.010) |
| BB | **21.37±0.082** (13.28±0.032) | **21.29±0.058** (13.20±0.067) | **21.20±0.094** (13.12±0.110) | **21.13±0.110** (12.95±0.112) |
| Statistical value | | | | |
| F | 6.130* | $2.016^{NS}$ | $0.678^{NS}$ | $0.637^{NS}$ |
| SE | 0.13 | 0.12 | 0.13 | 0.16 |
| CD | 0.36 | - | - | - |

NS: Non-significant (P>0.05); *P≤0.05; **P≤ 0.01, Bold Numbers indicate transformed Arcine √p values, Numbers in parenthesis indicate original values.

**Table-5**
**Least square analysis of effect of β-LG genotypes on 305 days milk yield in Red Sindhi cows during four lactations**

| Genotypes of β-LG | 305 days milk yield in Kg (Mean±SE) | | | |
|---|---|---|---|---|
| | First lactation | Second lactation | Third lactation | Fourth lactation |
| AA | 2106±32.140 | 2107±43.000 | 2109±24.000 | 2054±14.000 |
| AB | 1860±64.044 | 1860±48.020 | 1872±40.290 | 1861±38.950 |
| BB | 1865±23.050 | 1865±24.270 | 1870±21.510 | 1833±26.470 |
| Statistical value | | | | |
| F | 8.316** | 3.849* | 6.701** | 4.335* |
| SE | 39.09 | 48.15 | 32.25 | 34.88 |
| CD | 192.60 | 133.46 | 117.63 | 96.66 |

NS: Non-significant (P>0.05); * P≤0.05; **P≤ 0.01

β -LG genotypes were found to be having significant (p<0.01) effect on fat% during first, second lactation and significant effect during 3rd and 4th lactation periods. β -LG genotypes have significant effect on casein% during first and highly significant effect during second, third and 4th lactation period. β -LG genotypes have significant effect on total solids% during first lactation only and they have significant effect on 305 days milk yield during first and third lactation and they have significant effect during second and fourth lactation.

B-LG BB milk was associated with higher percentage of fat and casein and with lower percentage of total protein and whey protein. It has also been reported that use of β -LG BB genotype would be more appropriate for cheese yield as they have higher contents of fat and casein which primarily determine cheese yield[6].A significant relationship of β -LG genotypes with milk yield and milk composition irrespective of lactation number has been reported in red sindhi cows[7]. Significant relationship between β -LG genotypes on fat% has been reported in Holstein Friesian cows[12]. Concentration of fat% was significantly higher in milk of BB than AA genotype[13, 14].

Replacement of β -LG B allele by A allele resulted in increase of 0.05%, 0.07% and 0.08% protein for 3 lactation period in Quebec Holstein cows[15]. The results of the present study are not in agreement with Hamza et.al[16] who has reported that parity number had no effect on milk components. (Fat, protein, Total solids and SNF content). Fat and protein contents tended to increase with increasing parity. Similar findings were reported by Tyriseva [17] who demonstrated that parity number did not influence both fat and protein contents. However there is a significant effect during four lactation period in the present study.

The increase in lactation milk and fat yield with age is well known. Although the differences did not reach significance in all components. The concentration of total solids, fat, protein, casein, whey protein and β-LG increase to a maximum in either the second or third lactation and then declined[18]. In determining the milk protein genes most favorable for the breeding of dairy cattle to produce milk suitable for product manufacture, it is important to stress that factors other than milk yield and composition must be taken in to account. Such factors include feed efficiency[19], fertility[20] and resistance to mastitis infection.

The results of the present study are in complete agreement with many reports. Jairam and Nair[21] reported that β-LG BB genotype animals produced more milk than AB genotype in Tharparker and their crosses. Similar results may be due to genetic similarity between Red Sindhi and Tharparker.

As the lactation number increases the protein% also increases for genotype AA and decreases as the lactation number increases for other genotypes. There is a decline in fat% as the lactation number increases. As the lactation number increases, the casein% also decreases. As the lactation number increases the 305 days milk yield also increases but decreases during fourth lactation. There is no much variation between first and second lactation period for all the genotypes.

## Conclusion

From the present study it is clearly observed that β-LG BB genotype was found to be superior to AA genotype in 305 days milk yield, fat%, casein% in all the four lactation period. To improve the 305 days milk yield, fat%, casein% animals with genotype BB can be used for breeding. To improve the protein% genotype AA can be selected for breeding.

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