# Composition of Milk And Its Influence On Weaning Weight Of Calves From Criollo, Guzerat And F1 Cows

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## Introduction

In cow-calf systems maternal ability of beef cows is an important factor for survival and preweaning growth of calves. A critical component of maternal ability is the nutritional environment provided by the dam through milk production (Neville (1962); Clutter and Nielsen (1987)). Differences in milk yield and composition have shown to be important for preweaning growth of calves (Mallinckrodt et al. (1993); Brown and Brown (2002)). Research with beef cattle has been done to estimate correlations between composition of milk and preweaning growth of calves. Results have shown correlations of low relevance between percentage of milk components and weaning weight of calves (Rutledge et al. (1971); Chenette and Frahm (1981); Mondragon et al. (1983)). In contrast, higher and significant correlations have been found between milk components in kg and weaning weight of calves (Marston and Simms (1992); Brown and Brown (2002); Cerdótes et al. (2004)). The objectives of this study were to compare percentages and kg of milk fat, protein, lactose and solids not fat from Criollo, Guzerat and F1 cows, to compare birth and weaning weight of their progeny, to estimate heterosis and direct and maternal genetic effects for all variables in the study, and to correlate milk components with weaning weight of calves.

## Material and methods

The study was carried out at El Verdineño Experimental Station (INIFAP-SAGARPA) in Santiago Ixc, Nayarit, Mexico. The region has a subhumid tropical environment ($Aw^2$), an average annual rainfall of 1,200 mm, an average annual temperature of 24 ºC and a dry season of seven to eight months (Secretaría de Programación y Presupuesto (2002)). Data were collected between 2001 and 2003 from Guzerat (G), Criollo (C), Guzerat x Criollo (GC), and Criollo x Guzerat (CG) cows (240, 166, 70 and 143 records, respectively).
Traits studied were percentage and kg of milk fat (%G and GP), protein (%P and PP), lactose (%L and LP) and solids not fat (%SNG and SNGP) from Criollo, Guzerat and F1 cows; birth weight (PN) and weaning weight adjusted to 210 d of age (PA210). Cows grazed llanero grass (*Andropogon gayanus*) and received molasses-urea from March to May of each year. Reproductive management included two breeding seasons beginning on March 15th and September 15th of each year. Cows were bred by AI using semen of Angus bulls during 45 days each breeding season. Milk samples were taken at an average of 70, 126 and 182 d postpartum. Cows and calves were separated at 1400 on the afternoon before sample collection and then allowed to suckle their dams at 1800. Suckling period did not exceed 20

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min. Milk samples were collected at 0600 of the following day by hand-milking the left front quarter completely after a 30 IU intramuscular injection of Oxytocin. Milk samples were sent to Mexican Holstein Association laboratory to be analyzed for milk fat, protein, lactose and solids not fat percentage using a Bentley 2000® equipment and medium infra-red technique. Milk components kg were estimated using total milk yield based on average percentage of each component. Total milk yield was estimated using the weigh-suckle-weigh technique and the procedure described by Jenkins and Ferrell (1984).
Statistical analysis was carried out using the general linear models procedure of SAS considering repeated measurements (SAS (2003)). Final models for %G, %P, %L, %SNG, GP, PP, LP and SNGP included the fixed effects of genotype of the cow (GEN), number of calving (NP), year of calving (A), season of calving (E), and days postpartum (D). Final models for PN and PA210 included fixed effects of GEN, NP, A and E. For all variables final models included interactions of two factors significant ($P<0.25$) in preliminary analyses. Contrasts were used to estimate individual ($h^i$) and maternal ($h^m$) heterosis and direct and maternal genetic effects for all variables in the study**.** Residual correlations were calculated between PA210 and milk components.

# Results and discussion

Least squares means and standard errors for PN, PA210, and milk components for cow genotype are given in Table 1. Difference among genotypes were not significant ($P>0.05$) for %G, %L, %SNG, GP or PP. Statistical differences ($P<0.05$) were detected for %P, LP, and SNG. In general, least squares means for milk components in kg suggest that GC and CG cows are better than G and C cows to produce milk fat, protein, lactose and solids not fat. Progeny from F1 cows had lighter PN ($P<0.05$) than progeny from G cows. However, weaning weights of calves from F1 and G cows were similar ($P>0.05$). Crossbred cows also weaned heavier calves (23 and 32 kg) than C cows. These results suggest the advantages of using crossbred cows to improve the efficiency of cow-calf system in the tropical region of Nayarit. Other studies have also pointed out the importance of using crossbred cows to increase productivity on commercial herds (Cundiff et al. (1992); BIF (2002)).

Estimates of $h^i$ for milk components and $h^m$ for PN and PA210, differences of direct (G–C) and maternal (C–G) genetic effects for PN, PA210 and milk components, and residual correlations between PA210 and milk components in percentage ($r_{\%}$) and kg ($r_{kg}$) are given in Table 2. Individual heterosis did not influence ($P>.05$) percentage of milk components but it was important ($P<.05$) for components in kg. $h^m$ was important and favorable diminishing PN ($h^m = -1.30\pm0.6$ kg) and increasing PA210 ($h^m = 12.65\pm4.2$ kg). Other studies have stated the non significance of $h^i$ to determine percentage of milk components (Daley et al. (1987); Cundiff et al. (1974)), and its importance ($P<.05$) determining kg of milk fat, protein, lactose and solids not fat (Daley et al. (1987)). On the other hand, Brown et al. (1997), and Olson et al. (1993) reported an important influence ($P<0.10$) of $h^m$ diminishing or increasing birth weight of calves from Brahman x Angus cows. Favorable effects of $h^m$ increasing PA210 agree with results published by other authors indicating the advantage of using crossbred dams to improve weaning weights of calves as a consequence of maternal heterosis (Brown et al. (1997); BIF (2002)). Differences between maternal genetic effects of C and G were not significant ($P>.05$). Differences between direct genetic effects were positive to G ($P<0.05$)

for lactose (11.08±3.7 kg), solids not fat (16.98±6.6 kg), PN (3.80±1.1 kg) and PA210 (37.60±7.6 kg). Differences between direct genetic effects for birth and weaning weights have been detected in other studies (Dearborn et al. (1987); Olson et al. (1993)). Correlations between percentage of milk components and PA210 were not important (P>0.05), except for %P ($r_{\%}$ = -0.18). This result suggests that milk quality was not important in its influence on weaning weight. On the other hand, significant correlations (P<0.05) were detected between kg of milk components and PA210 for GP ($r_{kg}$ = 0.16), LP ($r_{kg}$ = 0.21) and SNGP ($r_{kg}$ = 0.19), suggesting that quantity of milk fat, lactose and solids not fat were important to weaning weight. In agreement with this study, other experiments have detected higher correlations between milk components expressed in kg and weaning weight of calves (Daley et al. (1987); Marston et al. (1992); Quiroz (1994)). In general, correlations from this study and from literature point out that percentage of milk components have little or no influence on weaning weight of calves. In contrast, kg of milk components are important factors to determine weaning weight of calves.

## Conclusion

Milk components expressed in kg suggest that Guzerat x Criollo and Criollo x Guzerat cows have higher potential than Guzerat and Criollo cows to produce milk fat, protein, lactose and solids not fat. Estimates of birth weight, weaning weight and heterosis influencing kg of milk components suggest a better productive performance from birth to weaning of F1 cows and their progeny. Results indicate the importance of using crossbred cows, instead of Zebu or Criollo cows, to take advantage of beneficial heterosis effects to improve the production of beef calves in tropical regions. Correlations between PA210 and milk components suggest that quantity rather than quality was important to obtain heavier calves at weaning.

**Table 1: Least squares means and standard errors for birth weight (PN), weaning weight (PA210), and percentage and kg of milk fat, protein, lactose and solids not fat (SNG) for genotype of the cow**

| Cow genotype | | Fat | PN | Protein | Lactose | PA210 | SNG |
|---|---|---|---|---|---|---|---|
| G | % | 2.80±0.2 | | 3.56 ±0.1[a] | 4.79 ±0.1 | | 9.09±0.1 |
| | kg | 25.9±1.6 | 33.45±0.6[a] | 33.9±1.3 | 47.1±1.8[a] | 188.08±3.7[a] | 88.2±3.3[a] |
| GC | % | 2.98±0.2 | | 3.83±0.1[b] | 4.82±0.1 | | 9.36±0.1 |
| | kg | 29.5±2.4 | 30.98±0.8[b] | 38.2±1.8 | 52.1±2.6[a] | 190.39±4.9[a] | 98.9±4.7[a] |
| CG | % | 3.09±0.2 | | 3.72 ±0.1[b] | 4.75 ±0.1 | | 9.19±0.1 |
| | kg | 28.8±1.8 | 30.24±0.6[b] | 37.2±1.4 | 48.6±2.0[a] | 181.93±3.7[a] | 93.2±3.7[a] |
| C | % | 2.81±0.1 | | 3.88 ±0.1[b] | 4.71 ±0.1 | | 9.29±0.1 |
| | kg | 22.3±1.7 | 30.38±0.7[b] | 31.6±1.3 | 39.5±1.8[b] | 158.93±4.2[b] | 76.9±3.3[b] |

[ab] Different letters superscripts in same column and same measurement unit indicate significant differences P<0.05).
G = Guzerat, C= Criollo; GC= Guzerat x Criollo; CG= Criollo x Guzerat.

**Table 2: Individual ($h^i$) and maternal ($h^m$) heterosis and differences between direct[a] and maternal[b] genetic effects for birth weight (PN), weaning weight (PA210), milk components and correlations between PA210 and milk components in percentage($r_{\%}$) and kg ($r_{kg}$)**

| | | Genetics Effects | | | | | |
|---|---|---|---|---|---|---|---|
| | | Direct | Maternal | $h^i$ | $h^m$ | $r_{\%}$ | $r_{kg}$ |
| Fat | % | -0.118±0.228$^{ns}$ | -0.108 ± 0.186$^{ns}$ | 0.226±0.1$^{ns}$ | | 0.04$^{ns}$ | 0.16$^{*}$ |
| | kg | 4.34±3.4$^{ns}$ | 0.68±2.8$^{NS}$ | 5.07±1.9* | | | |
| Protein | % | -0.207±0.102* | 0.108 ± 0.0842$^{ns}$ | 0.0529±0.1$^{ns}$ | | -0.18$^{*}$ | 0.13$^{ns}$ |
| | kg | 3.38±2.5$^{ns}$ | 1.06±2.1$^{ns}$ | 4.97±1.5* | | | |
| Lactose | % | 0.148±0.100$^{ns}$ | 0.0710 ± 0.0825$^{ns}$ | 0.0298±0.6$^{ns}$ | | -0.0$^{ns}$ | 0.21$^{*}$ |
| | kg | 11.08±3.7* | 3.48±3.0$^{ns}$ | 7.04±2.1* | | | |
| SNG[c] | % | -0.034±0.143$^{ns}$ | 0.165 ± 0.117$^{ns}$ | 0.0870±0.1$^{ns}$ | | -0.13$^{ns}$ | 0.19$^{*}$ |
| | kg | 16.98±6.6* | 5.64±5.4$^{ns}$ | 13.48±3.8* | | | |
| PN | | 3.80±1.1* | 0.74±0.8$^{ns}$ | | -1.30±.6* | | |
| PA210 | | 37.60±7.6* | 8.45±5.6$^{ns}$ | | 12.65±4.* | | |

*(P<0.05); [ns]Non significant

[a]Direct genetic effects = Guzerat–Criollo; [b]Maternal genetic effects = Criollo–Guzerat.; [c]SNG = Solids not fat.

## References


BIF. Beef Improvement Federation. (2002). *8th ed. University of Georgia,* Georgia. USA.

Brown, M.A., Brown, H.A. (2002). *J. Anim. Sci.,* 80:2522-2527.

Brown, M.A., Brown Jr, A.H., Jackson, W.G., *et al.* (1997). *J. Anim. Sci.,* 75:920–925.

Cerdótes, L., Restle, J., Filho, D.C.A., *et al.* (2004). *R. Bras. Zootec.*, 33:610-622.

Chenette, C.G., Frahm, R.R. (1981). *J. Anim. Sci.,* 52:483-491.

Clutter, A.C., Nielsen, M.K. (1987). *J. Anim. Sci.,* 64:1313- 1325.

Cundiff, L.V., Gregory, K.E., Schwulst, J., *et al.* (1974). *J. Anim. Sci.,* 38:728-745.

Cundiff, L.V., Nuńez-Dominguez, R., Dickerson, G.E., *et al.* (1992). *J. Anim. Sci.,*70:2397-2410.

Daley, D.R., Mccuskey, A., Bailey, C.M. (1987). *J. Anim. Sci.,* 64:373-784.

Dearborn, D.D., Gregory, K.E., Lunstra, D.D., *et al.* (1987). *J. Anim. Sci.,* 64:963-968.

Jenkins, T.G., Ferrell, C.L. (1984). *Anim. Prod.,* 39:479.

Mallinckrodt, C.H., Bourdon, R.M., Golden, B.L., *et al.* (1993). *J. Anim. Sci.,* 71:355-364.

Marston, T.T., Simms, D.D., Schalles R.R., *et al.* (1992). *J. Anim. Sci.,* 70:3304-3310.

Mondragon, I., Wilton, J.W., Allen, O.B., *et al.* (1983). *Can. J. Anim. Sci.,* 63:751-761.

Neville Jr, W.E. (1962). *J. Anim. Sci.,* 21:315-320.

Olson, T.A., Peacock, F.M., Koger, M. (1993). *J. Anim. Sci.,* 71:2322-2329.

Quiroz, V.J. 1994. [Tesis de Maestría FMVZ]. *UNAM,* México

Rutledge, J.J., Robison, O.W., Ahlschwede, W.T. *et al.* (1971). *J. Anim. Sci.,* 33:563.567.

SAS. SAS User´s Guide: Statistics; *SAS Inst. Inc.,* Cary, NC. USA. 2003.

Secretaría de Programación y Presupuesto. 2002. *Síntesis Geográfica de Nayarit.* México.