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# ENERGY REQUIREMENTS OF LACTATING CROSSBRED CATTLE (*Bos indicus*)

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**ABSTRACT**
The present investigation has been carried out to determine the energy requirement of lactating crossbred cattle (50% Holstein Friesian X 50% Sahiwal) fed 0, 50 and 100 levels of di-ammonium phosphate in the mineral mixture of concentrates. Eighteen lactating crossbred cattle of nearly the same body weight (375.39 ± 23.43 kg), milk yield, parity and stage of lactation were divided into three groups of six animals in each. The chaffed mixed roughage (Berseem + Wheat straw) as well as fresh clean water was available *ad libitum*. A metabolic trial of seven days was conducted at the end of the experiment. The energy requirements of lactating crossbred cattle were estimated by partitioning the ME or TDN intake for maintenance and milk production by using multiple regression method. It was concluded that the daily maintenance requirement of energy for lactating crossbred was 29.63 g TDN and 107.15 Kcal ME/$W^{0.75}$kg and for per kg 4% FCM, energy requirement was 436 g TDN and 1082 Kcal ME. From the partitioning of energy, it appeared that about 44.55% TDN was utilized for maintenance of body and 55.45% diverted for milk production. Similarly 44.40% of ME was utilized for maintenance and 55.6% for milk production.

**KEYWORDS:** Diammonium phosphate, energy requirement, lactating, Crossbred cattle, milk yield, partitioning of energy.

## INTRODUCTION

In India feeding and animal husbandry practices are different in different agro-climate conditions (Paul *et al*., 2004). The energy requirements for maintenance and milk production of crossbred cows with 75% exotic and 25% indigenous blood have been reported by Nagchoudhary and Patle, 1990, but no work has been reported on 50% crossbred cattle. Hence, the studies were, conducted to learn the energy requirements of lactating crossbred cattle fed different levels of di-ammonium phosphate in the mineral mixture of their ration.

## MATERIALS & METHODS

Eighteen lactating crossbred cattle (50% Holstein Friesian X 50% Sahiwal) of early to mid lactation, having similar body weight, milk yield, parity and stage of lactation were divided into three groups of six animals in each. Fresh and clean water was available *ad libitum.* A digestion trial of seven days was conducted at the end of experiment. The animals were fed mixed roughage (green Berseem + Wheat straw) and concentrate mixture to supply their nutrient requirements as per ICAR (1998). The concentrate mixture consisted of yellow maize-40, wheat bran-22, mustard cake-35.5, mineral mixture-2, and salt-0.5 parts. In the mineral mixture of the control diet (C), di-calcium phosphate was used; this was replaced by diammonium phosphate at 50% in $T_1$ and 100% levels in $T_2$ (Table-1).

**TABLE 1** Composition of mineral mixtures

| Ingredients | C | $T_1$ | $T_2$ |
|---|---|---|---|
| DCP | 31.34 | 15.67 | - |
| DAP | - | 15.67 | 31.34 |
| LSP | 21.18 | 33.15 | 45.12 |
| Common salt | 21.66 | 21.66 | 21.66 |
| TM* | 1.87 | 1.87 | 1.87 |
| Urea | 14.26 | 7.13 | - |
| Filler | 9.67 | 4.84 | - |
| Ca% | 15.34 | 15.34 | 15.34 |
| P% | 6.58 | 6.42 | 6.26 |

*Trace mineral contained cobalt chloride-40g, copper sulphate-240g, ferrous sulphate-780g, manganese sulphate-780g, sodium selenite-8g and potassium iodide-24g

A calculated amount of urea was added to the mineral mixture of the C and $T_1$ diets and limestone powder in increasing amounts in C, $T_1$ and $T_2$ diets, to make all the diets identical in nitrogen and calcium content (Table-1).The phosphorus content was the same (21.8%) in the di-calcium phosphate and di-ammonium phosphate.

Samples of feed, faeces and urine were analyzed for proximate composition using A.O.A.C. (1990). The fat percentage in the milk was estimated by the Gerber's method (Agarwala and Sharma, 1961). The data obtained during experiment were analyzed by using randomized block design method as described by Snedecor and Cochran (1994). The chemical composition of the experimental diets (concentrate mixtures) and mixed roughage offered to the experimental animals are presented in Table-2.

**TABLE 2.** Chemical composition of concentrate mixtures and mixed roughage on DM basis (%)

| Particular | Concentrate mixtures | | | Mixed roughage |
|---|---|---|---|---|
| | C | $T_1$ | $T_2$ | |
| DM | 92.96 | 92.48 | 93.01 | 39.86 |
| CP | 19.96 | 19.88 | 20.15 | 6.24 |
| EE | 4.39 | 4.48 | 4.74 | 2.23 |
| CF | 6.21 | 6.76 | 6.54 | 30.29 |
| Ash | 11.08 | 11.57 | 11.76 | 9.76 |
| NFE | 58.36 | 57.31 | 56.81 | 51.48 |
| Ca | 1.09 | 0.91 | 1.02 | 0.34 |
| P | 0.82 | 0.77 | 0.86 | 0.22 |

Due to replacement of DCP at 50% in $T_1$ and 100% in $T_2$ diet, the chemical composition in respect of CP, EE, CF, ash, Ca and P content did not vary as compared to the control (C)**.** The energy requirements of lactating crossbred cattle were estimated by partitioning the ME or TDN intake for maintenance and milk production using the following model described by Moe *et al*. (1970).

$Y = a + b_1X_1 + b_2X_2$

Where, Y is TDN intake (kg) or ME intake (Mcal), $X_1$ is metabolic body size ($w^{0.75}$kg) and $X_2$ is 4% FCM production (k/d). In the above model, $b_1$ represents the energy requirement for maintenance (kcal/ $W^{0.75}$kg) and $b_2$ represents the energy required or spared for 1 kg 4% FCM production (k/d). The constant 'a' represent an amount of energy which is not attributable to any specific variable in this model. This amount of energy was assigned to the maintenance term (Moe *et al.,* 1970). This was done by dividing 'a' by the average metabolic body size and adding it to the coefficient $b_1$.

## RESULTS & DISCUSSION

Intake of all the nutrients (Table 3) was similar in the control (C) and the experimental feed ($T_1$ and $T_2$) group. During the experimental period, the animals showed very little body weight changes, which were negligible and not considered in partitioning of energy. All the three diets (C, $T_1$ and $T_2$) were comparable in dry matter intake, digestibility of organic nutrient and balances of nutrients (nitrogen, calcium and phosphorus), hence the data were pooled for eighteen lactating crossbred cattle and the energy requirement was calculated by using multiple regression method.The maintenance requirement (Table-4) of lactating crossbred cattle was found to be 29.63 g TDN /$W^{0.75}$kg. This was similar to that 49.85 g (Neville and McCullough, 1969) for exotic pure breed cows. The daily maintenance requirement of ME was 107.15 kcal /$W^{0.75}$kg, which was near about 136-178 kcal ME/$W^{0.75}$kg in exotic milch crossbred cows (Neville and McCullough, 1969)

The energy requirement for production of 1 kg 4% FCM was 0.436 kg TDN (Table 4). This value was very close to 0.323 kg TDN as reported by Shtivastava (1970). The energy requirement for production of 1 kg 4% FCM was 1.082 Mcal ME which was similar to the values(1.122 Mcal ME) suggested by Neville (1974) in Hereford cows and Patle and Mudgal (1976) in crossbred cows. Partitioning of energy was also worked out and is presented in Table-5. It appeared that about 44.55% TDN was utilized for maintenance of body and 55.45% diverted for milk production. Similarly, 44.40% ME was utilized for maintenance and 55.6 % ME for milk production. From the experiment, it was concluded that the daily maintenance requirement of energy for lactating crossbred cattle was 29.63 g TDN and 107.15 kcal ME/$W^{0.75}$kg and for per kg 4% FCM was 436 g TDN and 1,082 kcal ME.

**TABLE 3.** Daily nutrient intake, live weight changes and milk production in lactating crossbred cattle.

| Particulars | $T_1$ | $T_2$ | $T_3$ | Average |
|---|---|---|---|---|
| DMI(g/$W^{0.75}$kg) | 130.94± 7.55 | 129.90 ± 7.64 | 126.91 ± 4.84 | 129.25 |
| DCP(g) | 623.71± 26.92 | 617.51± 34.96 | 625.28± 29.05 | 622.16 |
| TDN(kg) | 6.05± 0.26 | 5.53 ± 0.30 | 5.43± 0.20 | 5.67 |
| ME(Mcal) | 21.07± 1.49 | 20.01 ± 1.40 | 20.66 ± 1.38 | 20.58 |
| Gain/loss(g/d) | 78.44± 22.53 | 41.76± 34.51 | 25.99 ± 18.00 | 48.73 |
| 4% FCM production (kg/d) | 9.85 ± 0.19 | 9.55 ± 0.13 | 9.77 ± 0.16 | 9.72 |

**TABLE-4**. Requirement of energy for maintenance and milk production

| Energy | Maintenance/$w^{0.75}$kg | Per kg 4% FCM production |
|---|---|---|
| TDN | 29.63 g | 436 g |
| ME | 107.15 kcal | 1082 kcal |

**TABLE 5.** Partitioning of energy intake

| Energy intake | Maintenance | | Milk Production | |
|---|---|---|---|---|
| | Total | Percentage | Total | Percentage |
| TDN (kg) - 5.673 | 2.527 | 44.55% | 3.146 | 55.45% |
| ME (Mcal) - 20.580 | 9.138 | 44.40% | 11.442 | 55.60% |

**REFERENCES**

A.O.A.C. (1990) *Official Methods of Analysis*, 15th ed. Association of Official Analytical Chemists. Arlington, Va. USA.

Agarwala, A. C. and Sharma, R.M. (1961) *A Laboratory Manual of Milk Inspection*, 4th ed. Asia Publishing House, Bombay.

ICAR (1998) *Nutrient Requirement of Livestock and Poultry*, 2nd Revised ed. Indian Council of Agricultural Research. Krishi Anusandhan Bhawan, Pusa, New Delhi, India.

Kearl, L.C. (1982) *Nutrient Requirements of Ruminants in Developing Countries*. International Feed Stuffs Institute, Utah Agricultural Experiment station, Utah state University, Logan Utah, USA.

Moe, P.W., Tyrrell, H.F. and Flatt, W.P. (1970) Energy metabolism of farm animals, p. 65. *In* Schurch, A. and C. Wenk, Juris, Verlag Zurich (eds.) *Proc. 5th Symp. Energy Metal. Vitzan, Switzerland.* EAAP. Publ. No. 13.

Nagchoudhary, P.K. and Patle, B.R. (1991) Energy requirements of lactating crossbred cows. *Indian J. Anim. Nutr*., **8** (3): 175-178.

Neville, W. E. (Jr.) and McCullough, M. E. (1969) Calculated energy requirement of lactating and non-lactating Hereford cows. *J. Anim. Sci***., 29**: 823.

Patle, B. R. and Mudgal, V. P. (1977) Utilization of dietary energy for maintenance and milk production by lactating cross-bred cows (Brown Swiss X Sahiwal) during their early stage of lactation. *Indian J. Dairy Sci*., **46**: 1.

Paul, S. S., Mandal, A. B., Mandal, G.P., Kannan, A. and Pathak, N.N. (2004) Deriving nutrient requirements of lactating Indian cattle under tropical condition using performance and intake data emanated from feeding trials cinducted in different institutes. *Asian Aust. J. Anim. Sci*., **17**(6): 769-776.

Ranjhan, S. K., Mohan, D.V. and Singh, R. (1977) Energy and protein requirement of Holstein-Friesian and Holstein-Friesian X Hariana crosses for maintenance and milk production. *Indian J. Anim. Sci*., **45**: 71.

Sen, K.C., Ray, S.N. and Ranjhan, S.K. (1977) *Nutritive Value of Indian Feeds and Fodder*, ICAR, New Delhi.

Snedecor, G.W. and Chochran, W.G. (1989) *Statistical Method*, 8th ed. The lowa State University Press, Ames, lowa, USA.

Srivastava, J. P. (1970) *(Title not available*). Ph.D. Dissertation, Agra. Univ., Indian Veterinary Research Institute, Izzatnagar, India. (cited by Ranjhan, personal communication).

Tiwari, D.P. and Patle, B.R. (1983) Utilization of Mahua seed cake by lactating buffaloes. *Indian J. Dairy Sci.*, **36**: 394.