

CONSTRUINDO SABERES, FORMANDO PESSOAS E TRANSFORMANDO A PRODUÇÃO ANIMAL

CALCIUM AND PHOSPHORUS REQUIREMENTS FOR PREWEANED DAIRY CALVES

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Abstract: The objective of this study was to estimate the requirements of calcium (Ca) and phosphorus (P) for dairy calves preweaned, using data from 5 studies developed at Federal University of Viçosa. A total of 210 calves were evaluated, which were separated into two genetic groups: Holstein and crossbreed Holstein x Gyr. The mineral requirements for maintenance were estimated by the regression of the mineral retained as a function of the intake mineral and minerals requirements for gain were obtained from the first derivative of the equation of the mineral content in the body, and the classificatory effect of bred was tested on intercept and inclination of models. Effect of genetic group was not observed for any variable analyzed ($P > 0.05$). Net requirements for maintenance were: 12.73 and 11.805, mg EBW^{-1} day for Ca and P, respectively. Coefficient of retention was 73.18% and 65.20% for Ca and P respectively. The following equations were used to estimate net requirements for gain ($g\ day^{-1}$): $NRG_{Ca} = 14.402 \times EBW^{-0.139} \times EBG$ and $NRG_P = 5.849 \times EBW^{-0.027} \times EBG$ for Ca and P respectively. Therefore, we suggest our equations to estimate the requirements of K, Mg and Na for dairy calves preweaned.

Key words: Holstein, Holstein x Gir, macrominerals, retention coefficient

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Introduction

The first weeks of calves life are a determining factor in the future efficiency of a milk production system, so that inadequate animal nutrition during the breeding phase may limit the growth of animals in the rearing phase, expression of genetic potential of milk production and cattle health (Moallem et al., 2010, Khan et al., 2011, Soberon et al., 2012).

The formulation of diets is based on providing the animals with nutrients necessary to achieve the desired performance. The knowledge of the nutritional demands of cattle, as well as the forms and efficiencies of the use of nutrients supplied, are the way to achieve satisfactory yields, with maximum economic return and use of resources (Rodrigues J.P.P., 2013).

The use of predictive models of the nutritional requirements of growing animals varies according to different forms of deposition in the life stages of the animal. In this way, it becomes important to segment studies in steps of the growth curve, generating more consistent and accurate data. In the nutrition of young animals, also stands out, the variation due to metabolic and digestive changes (Zantron & Heinrichs, 2008).

Recent research has been developed to modeling the nutritional requirements of cattle in Brazilian conditions. However, there is greater progress in beef cattle breeding (Valadares Filho et al., 2010), with scarce national data regarding dairy animal genetics (Carvalho et al., 2003; Nascimento et al. 2009).

In view of the existing gaps regarding the mineral requirements of dairy calves in Brazil. The objective of this study was to estimate the nutritional requirements of the macrominerals calcium (Ca) and phosphorus (P) for maintenance and growing crossbred dairy calves in tropical conditions, by means of meta-analysis.

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Materials and methods

This work was composed of 5 studies previously performed at the Federal University of Viçosa (Silva et al., 2017; Rodrigues et al., 2016, Chagas et al., 2016, Dias et al., 2017 and Jolomba, 2015), therefore was not required the approval by the ethics committee for use of animals in experimentation.

A total of 210 calves were used, being divided into two groups: 113 calves of the Holstein breed and 97 Holstein \pm Gyr. The net maintenance requirement and the retention coefficient were assumed to be the value of β_0 and β_1 of the following equation: $MR = \beta_0 + \beta_1 \times IM$, where MR = mineral retained (mg per EBW day⁻¹), IM = ingested mineral (mg per EBW day⁻¹), β_0 and β_1 are parameters of the equation.

The content of each mineral in the body was estimated by regression of the logarithm of mineral body content as a function of the logarithm of the EBW, according to the allometric model adopted by ARC (1980): $Y = \beta_0 + \beta_1 \times \log EBW$, where: Y = logarithm of the mineral content in the body (g), $\log EBW$ = log of empty body weight (kg); β_0 and β_1 parameters of the equation. From the estimated parameters, the net mineral requirements for gain were estimated by the first derivative of the previous equation multiplied by the EBG, according to the model: $NRg = \beta_1 \times 10^{\beta_0} \times EBW^{\beta_1 - 1} \times EBG$, where: NRg = net requirement of the mineral for gain (mg kg⁻¹ EBG day⁻¹); β_0 and β_1 are parameters of the previous equation; EBW = empty body weight (kg); EBG = empty body gain (kg d⁻¹).

The random effect of the study on the regression parameters ($P > 0.05$) was considered, followed by the technique described by St-Pierre (2001) for meta-analysis, using the MIXED procedure of the SAS (SAS, version 9.3, Institute Inc., 2011, Cary, NC, USA). The breed classificatory effect was tested on the intercept, slope of the models and differences were declared when $P < 0.05$.

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Results and discussion

The effect of breed was not observed on net requirements of maintenance and gain, as well as on retention coefficient ($P > 0.05$).

The obtained net Ca requirements for maintenance were $12.72 \text{ mg kg}^{-1} \text{ EBW d}^{-1}$ or $11.28 \text{ mg kg}^{-1} \text{ BW d}^{-1}$. NRC (2001) suggested a value of $15.40 \text{ mg kg}^{-1} \text{ BW d}^{-1}$. The recommendation of this study was close to the BR-CORTE (2016), however, when compared to the estimates of the NRC (2001), it was 26.7% lower.

The retention coefficient of Ca obtained in this study was 73.18%, a value higher than BR-CORTE (2016) which is 56.8% for Zebu beef cattle. The NRC (2001) and the AFRC (1991) recommended values of 70% and 68% as absorption coefficient, respectively.

The net Ca requirements for gain can be estimated by the following equation: $\text{NRG}_{\text{Ca}} = 14.402 \times \text{EBW}^{-0.139} \times \text{EBG}$. Where: NRG_{Ca} = net Ca requirement for growth; EBW = empty body weight (kg) and EBG = empty body gain (kg d^{-1}). The net Ca requirements for gain proposed in this study were lower than those reported by the NRC (2001) and the BR-CORTE (2016) (Figure 1).

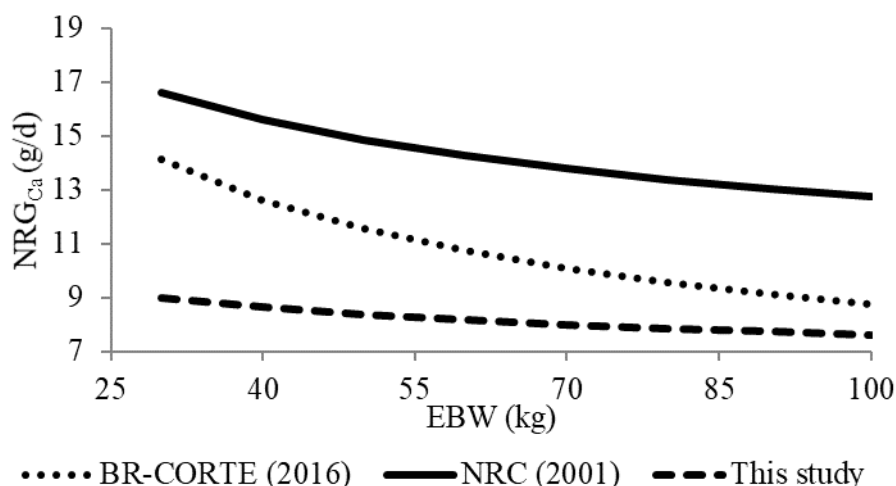


Figure 1: Net calcium requirements for gain proposed by the present study, BR-CORTE 3.0 (2016) and NRC (2001), considering EBW = 1.0 kg / day

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The net P requirements for maintenance obtained in this study were 11.81 mg kg⁻¹ EBW d⁻¹ or 10.47 mg kg⁻¹ BW d⁻¹. The observed value is lower than those reported by the NRC (2001) and the BR-CORTE (2016), of 16.00 and 13.50 mg kg⁻¹ BW d⁻¹, respectively.

The retention coefficient of P obtained in this study was 65.2%. According to NRC (2001), the recommended P absorption coefficient for calves consuming only milk is 90%. For animals with BW between 100 and 200 kg, the value suggested by this council was 78%.

The net P requirement for gain can be estimated by the following equation: $NRG_P = 5.849 \times EBW^{-0.027} \times EBG$. Where: NRG_P = net P requirement for gain; EBW = empty body weight (kg) and EBG = empty body gain (kg d⁻¹). The estimates for P, requirements for gain were lower than those reported by the NRC (2001) and the BR-CORTE (2016)(Figure 2). The net P requirements for gain proposed by this study, by the BR-CORTE (2016) and by the NRC (2001) decreased with the increase in BW, due to lower proportion of bone tissue in the body, since 80% of P is found in bone tissue (Coelho da Silva, 1995).

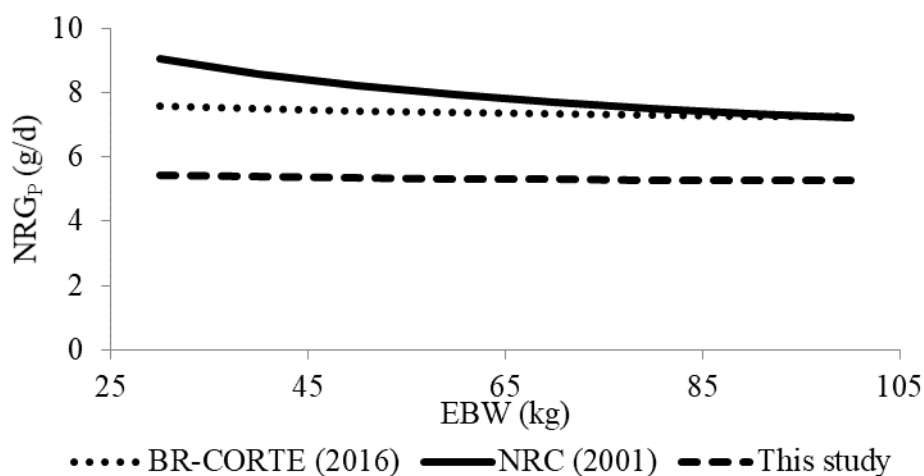


Figure 2 - Net phosphorus requirements for gain proposed by the present study, BR-CORTE 3.0 (2016) and NRC (2001), considering EBW = 1.0 kg day⁻¹

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Conclusion

Thus, we conclude that the requirements of calcium and phosphorus for preweaned dairy calves can be estimated from the equations presented in the present study.

References

- AGRICULTURAL RESEARCH COUNCIL. **The nutrient requirements of ruminant livestock**. Bureau, Farnham Royal, UK. 1980.
- NATIONAL RESEARCH COUNCIL. **Nutrient requirements of dairy cattle**. 6ed. Washington, DC, USA. 2001.
- RODRIGUES, J.P.P. Exigências nutricionais de proteína e macrominerais de bezerros da raça holandesa. **Dissertação de mestrado apresentado à Universidade Federal de Viçosa**. Viçosa, Minas Gerais, Brasil. 2013.
- SIGNORETTI, R.D., DA SILVA, J.F.C., VALADARES FILHO, S.C., PEREIRA, J.C., DE ARAÚJO, G.G.L., CECOM, P.R., and DE QUEIROZ A.C. 1999. Body composition and net and dietary inorganic macroelements (Ca, P, Mg, K and Na) requirements of Holstein calves fed diets with different levels of forage. **Revista Brasileira de Zootecnia**. Vol. 28, págs. 205–213.
- VALADARES FILHO, S.C.; SILVA, L.F.C.; GIONBELLI, M.P.; ROTTA, P.P.; MARCONDES, M.I.; CHIZZOTTI, M.L.; PRADOS, L.F. Exigências de minerais para bovinos de corte. **Exigências nutricionais de zebuínos puros e cruzados (BR-CORTE)**. 3ed. Viçosa, Minas Gerais, Brasil. 2016.
- WILSON, B.K., VAZQUEZ-ANON, M., STEP, D.L., MOYER K.D., HAVILAND C.L., MAXWELL C.L., O'NEILL C.F., GIFFORD C.A., KREHBIEL C.R., and RICHARDS C.J. Effect of copper, manganese, and zinc supplementation on the performance, clinical signs, and mineral status of calves following exposure to bovine viral diarrhoea virus type 1b and subsequent Mannheimia haemolytica infection. 2016. **Journal of Animal Science**. Vol. 94, págs. 1123–1140.

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