

Colostrum Immunoglobulins Absorption in Canchim and Nelore Calves

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ABSTRACT - The efficiency of absorption of colostrum immunoglobulins was evaluated in five Canchim and seven Nelore calves. They received colostrum pools with concentration of 70.20 ± 6.14 mg/mL through esophageal feeder at 2, 12, 24 and 36 hours after birth. The immunoglobulins concentrations of the pools were estimated through specific gravity and measured by radial immunodiffusion. In the blood collection at birth and during the first 70 days of life, the total protein was assayed by biuret method and the immunoglobulins were assayed by radial immunodiffusion. Data were analysed as a randomized split-plot statistical model. The highest concentrations of serum immunoglobulins and total protein were observed at 24 hours of age. No significant differences ($P > 0.5484$) were observed for immunoglobulins concentration at 24 hours, with concentrations of 28.80 ± 7.24 mg/mL for Canchim and 27.32 ± 9.54 mg/mL for Nelore. The efficiency for immunoglobulins absorption was not significantly different ($P > 0.8715$) between breeds, $64.04 \pm 7.74\%$ for Canchim and $62.30 \pm 6.93\%$ for Nelore. The lack of statistical significance persisted until the fortieth day of life, period of maternal immunoglobulin predominance in the calves blood circulation. In the following period, from 40 to 70 days of age, phase of establishment of the endogenous production of immunoglobulin, differences in the IgG concentrations between the two groups were detected reflecting a possible breed effect difference. The process of colostrum IgG absorption by the newborn calves was not affected by breed. The differences between breeds in the calves serum IgG were related to the phase of endogenous production of antibodies.

Key Words: antibodies, colostrum, newborn calves, passive immunity

Absorção de Imunoglobulinas do Colostrum em Bezerros das Raças Canchim e Nelore

RESUMO - A eficiência de absorção de imunoglobulinas do colostro foi avaliada em cinco bezerros da raça Canchim e sete bezerros da raça Nelore. Os bezerros receberam colostro de "pools" com concentração média de $70,20 \pm 6,14$ mg/mL, por sonda esofágica, às 2, 12, 24 e 36 horas após o nascimento. As concentrações de imunoglobulinas dos "pools" foram estimadas por gravidade específica e quantificadas por imunodifusão radial. No sangue obtido ao nascimento e durante os primeiros 70 dias de idade, a proteína total foi analisada pelo método do biureto e as imunoglobulinas séricas, quantificadas por imunodifusão radial. O delineamento experimental foi inteiramente casualizado em parcelas subdivididas no tempo. As concentrações máximas de imunoglobulinas séricas e de proteína total foram observada às 24 horas de idade. Não foi observada diferença significativa quanto à concentração de imunoglobulinas às 24 horas ($P > 0,5484$), com valores médios de $28,80 \pm 7,24$ mg/mL para Canchim e de $27,32 \pm 9,54$ mg/mL para Nelore. A eficiência de absorção das imunoglobulinas não diferiu significativamente ($P > 0,8715$) entre as raças, sendo $64,04 \pm 7,74\%$ para Canchim e $62,30 \pm 6,93\%$ para Nelore. A ausência de diferença significativa estendeu-se até o 40º dia, período de predominância de anticorpos maternos na corrente sanguínea do bezerro. No período seguinte, dos 40 aos 70 dias de idade, fase de estabelecimento da produção endógena de anticorpos, verificaram-se diferenças na concentração de IgG entre os dois grupos de animais, refletindo provavelmente o comportamento diferenciado das raças. O processo de absorção das imunoglobulinas provenientes do colostro pelos bezerros recém-nascidos não foi afetado pela raça. As diferenças entre raças na concentração sérica de IgG foram relacionadas à fase endógena de produção de anticorpos.

Palavras-chave: anticorpos, bezerros recém-nascidos, colostro, imunidade passiva

Introduction

In bovines, the passive immunity transference from mother to the newborn is done through the colostrum, since the type of placenta found in these

animals impairs the transport of maternal immunoglobulins to the fetus in development. The process of transference includes the concentration of maternal immunoglobulins in the mammary gland during the gestation resulting in the formation of a

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very special secretion, colostrum, and a temporary permeability of the newborn intestinal cells, allowing absorption of intact immunoglobulins (Larson & Kendall, 1957; Brambell, 1958).

In the newborn calf, the passive immunity obtained from colostrum reaches the maximum blood serum concentration at the first 48 hours of life. Thereafter, the concentration of serum immunoglobulins declines in consequence of the catabolism and transference of the antibodies to different metabolic pools. The establishment of endogenous production of IgG increases its concentration until normal levels are reached (Tennant et al., 1969; Bush et al., 1971; Husband et al., 1972; Ribeiro et al., 1983; Machado Neto & Packer, 1986; Baracat et al., 1997).

The concentration of serum IgG in the first 48 hours of life does not reflect the efficiency of absorption during the period of intestinal permeability. The apparent efficiency of absorption (AEA) of immunoglobulins is calculated considering the serum IgG concentration, plasma volume and the amount of IgG consumed by the newborn. Several studies indicates that among innumerable factors that can influenced serum protein absorption the most importants are quality and time of the first consumption of colostrum (Comline et al., 1951; Kruse, 1970; Bush et al., 1973; Besser et al., 1985; Quigley et al., 1998; Klobasa et al., 1998). Vann et al. (1995), studying the process of colostrum antibodies absorption in calves, found an efficiency of 26% for IgG, 62% for IgM and 19% for IgA, in the first 6 hours of life. Husband et al. (1972), Boyd & Boyd (1987) and Klobasa et al. (1998) observed values between 42 and 46% for immunoglobulin G, when colostrum was consumed between two and seven hours post-partum. Higher values of absorption efficiency were found by Bush et al. (1973) e Matte et al. (1982), 66% and 65,8%, respectively.

The purpose of the present study was to evaluate the efficiency of immunoglobulin G absorption and the following serum fluctuation of it in Canchim and Nelore calves.

Materials and Methods

Seven calves of Nelore breed and five of Canchim breed were separated from their mother, without the opportunity of ingesting any maternal colostrum, and received colostrum from pools previously prepared, with average concentration of immunoglobulins of

70.20 ± 6.14 mg/mL. Four meals equivalent to a 5% of live weight each, were offered at 2, 12, 24 and 36 hours after birth. Before the storage at -20°C , the IgG concentration of the pools were quantified and adjusted. Blood samples from jugular vein were collected at birth, 12, 24, 36 and 48 hours post-partum, and 5, 10, 15, 17, 20, 25, 30, 40, 50, 60 and 70 days of life.

The apparent efficiency of absorption (AEA) was determined using the formula established by Husband et al. (1973) and modified by Besser & Osborn (1993).

$$\text{AEA (\%)} = \frac{[\text{Serum IgG} \times \text{Plasmatic volume}]}{\text{Colostrum IgG Concentration} \times \text{Colostrum volume}} \times 100$$

For the plasmatic volume was used the value 8,9% in relation to live weight, value found by Besser & Osborn (1993), using the method *Evan Blue dye* with blood samples collected from calves at 12 hours of life.

The concentration of serum immunoglobulins was determined by radial immunodifusion (Mancini et al., 1965). The concentration of immunoglobulins in the pools of colostrum was also determined by radial immunodifusion according to Mancini et al., 1965, modified by Fleenor & Stott (1981). The total protein was quantified by biuret method (Reinhold, 1953). Data were analysed as a randomized split-plot statistical model through the PROC GLM SAS (1999) procedure.

Results and Discussion

The average concentration of serum total protein (TP) and serum IgG are shown in Figure 1 and Figure 2.

The peak of TP concentration obtained at 24 hours of life differed significantly between the breeds ($P < 0.0105$), with values of 7.01 ± 0.72 g/100 mL for Nelore and 7.91 ± 0.37 g/100 mL for Canchim. A peak at 24 hours was also found for IgG with no statistical differences between breeds ($P < 0.5458$), with values of 27.32 ± 9.54 mg/mL for Nelore and 28.80 ± 7.24 mg/mL for Canchim.

These results indicate that the differences found between breeds related to TP at 24 hours are not dependent of IgG portion. This fact could be justified by the maternal origin of IgG in this early phase of life of the newborn calf, obtained from colostrum which

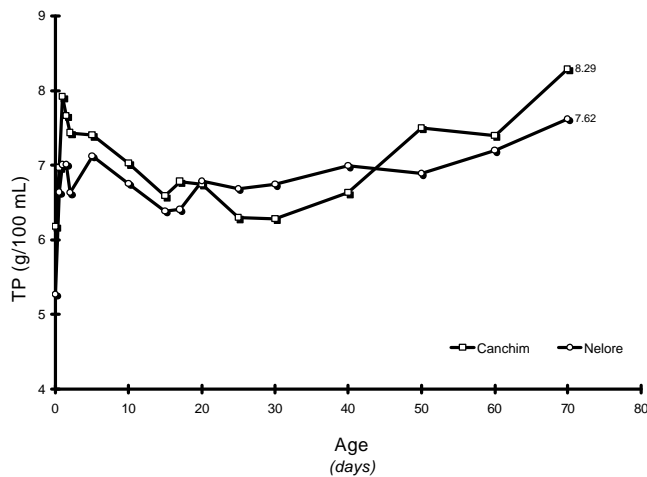


Figure 1 - Serum total protein (TP) (g/100 mL) in Canchim and Nelore calves.

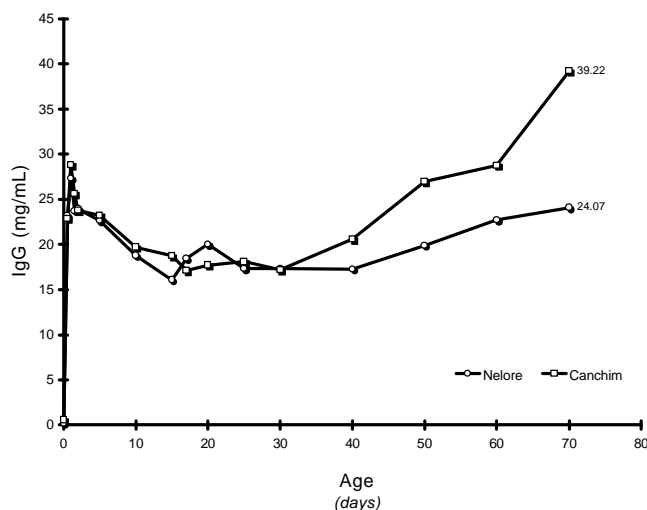


Figure 2 - Serum IgG concentration (mg/mL) in Canchim and Nelore calves.

was provided in uniform quantity and concentration and at a specific time. These procedures indicate that the differences found in TP are related to other proteins different than IgG.

Serum TP and IgG were significantly correlated ($P < 0.0001$) considering the entire experimental period ($r = 0.607$). The correlation between TP and IgG ($r = 0.732$) in the first 24 hours of life was also positive ($P < 0.0068$). Several authors also verified a positive correlation between TP and IgG in calves during the initial period of life (Machado Neto & Packer, 1986; Daniele et al., 1994; Nocek et al., 1984; Baracat et al., 1995; Pauletti et al., 2002).

The calculated minimum average concentration of serum IgG was 10.12 ± 2.22 mg/mL for Nelore and 13.96 ± 1.33 mg/mL for Canchim, without significant difference ($P < 0.2314$). The dates of occurrence of the minimum serum concentration of IgG, 29.25 ± 4.71 days for Canchim and 31.17 ± 8.77 days for Nelore, were also not significantly different ($P < 0.8727$).

The efficiency of absorption of IgG at 12 hours of age was $64.04 \pm 7.74\%$ for Canchim and $62.30 \pm 6.93\%$ for Nelore, without significant difference ($P < 0.8715$). These results agree with those obtained by Bush et al. (1973) and Matte et al. (1982).

The results obtained for the absorption efficiency, as well the general pattern of serum antibodies are comparable to the values obtained for dairy calves in other studies (Husband et al., 1972; Bush et al., 1973; Matte et al., 1982; Machado Neto & Packer, 1986; Pauletti et al., 2002).

The curve of IgG fluctuation was divided in two periods: the exogenous period, from birth to the minimum point, corresponding to the phase of predominance of circulating antibodies acquired from maternal colostrum, and endogenous period starting at around 40 days of life, when the of IgG concentration starts to reflect the calf own synthesis. From this point on, it was possible to verify differences in IgG concentration between Nelore and Canchim, condition that can be detected in the dates 40 days ($P < 0.1237$), 50 days ($P < 0.0918$), 60 days ($P < 0.2642$) and 70 days ($P < 0.0842$), (Figure 2).

Conclusions

The process of colostrum IgG absorption by the newborn calves was not affected by breed.

The differences between breeds in the calves serum IgG were related to the phase of endogenous production of antibodies.

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Recebido em: 28/08/03

Aceito em: 06/02/04