

Influence of parenteral administration of chamomile (*Matricaria recutita* L.) extract on colostral IgG absorption in neonatal calves

Mokhber Dezfouli, M.R.^{1*}; Mohammadi, H.R.¹; Nadalian, M.G.¹; Nazem Bokaei, Z.²; Hadjiakhoondi, A.³; Nikbakht Borujeni, G.R.⁴; Tajik, P.¹ and Jamshidi, R.⁵

¹Department of Clinical Sciences, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran. ²Department of Biology, Faculty of Basic Sciences, University of Alzahra, Tehran, Iran. ³Department of Pharmacognosy, Faculty of Pharmacy, Tehran University of Medical Sciences, Tehran, Iran. ⁴Department of Pathobiology, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran. ⁵Faculty of Veterinary Medicine, University of Semnan, Semnan, Iran.

Key Words:

Matricaria recutita L.; chamomile; calves; IgG absorption; colostrums.

Correspondence

Mokhber Dezfouli, M.R.
Department of Clinical Sciences,
Faculty of Veterinary Medicine,
University of Tehran, P. O. Box: 14155-
6453, Tehran, Iran.
Tel: +98(21)66923748
Fax: +98(21)66933222
Email: mokhberd@ut.ac.ir

Received: 04 March 2011,

Accepted: 12 June 2011

Abstract

In this study, the effect of chamomile extract on the ability of neonatal calves to absorb immunoglobulin G (IgG) was evaluated. An ethanolic extract of chamomile was obtained with the concentration of 111 mg/ml. Calves were randomly divided into four groups, each receiving one of four chamomile treatments; 1: low dose (LC; 5.5 mg/kg body weight); 2: moderate dose (MC; 11 mg/kg); 3: high dose (HC; 22 mg/kg); 4: a control (CO; normal saline). Chamomile extract was injected intravenously into the jugular vein 1 h after birth and before colostrum intake. There was no significant difference in concentration of serum IgG between LC and CO calves ($P = 0.792$). MC calves had a significantly higher serum IgG concentration at 48 h compared with LC and CO calves ($P = 0.002$, $P = 0.003$, respectively). There was no statistical difference between MC and HC calves at 48 h ($P = 0.264$). These results show that chamomile extract could promote colostral IgG absorption in neonatal calves if a suitable dose is given immediately after birth.

Introduction

Bovine neonates are essentially born hypogammaglobulinemic (Brambell, 1970; Kruse, 1970; Wells *et al.*, 1996), leaving them at risk of early bacterial infection. The process of acquiring passive immunity in the newborn calf begins with the absorption of immunoglobulin, especially immunoglobulin G (IgG), from colostrum (Kruse, 1970; Nocek *et al.*, 1984; Wells *et al.*, 1996). However, intestinal villi lose the ability to absorb macromolecules around 24 h after birth (Stott and Fella, 1983). Cessation of intestinal permeability to immunoglobulins was termed "gut closure" by Leece and Broughton (1973). Many factors have been investigated to determine their influence on colostral IgG absorption, passive immunity and prevention of diarrhea in newborn calves (Hardy, 1969; Jochims *et al.*, 1994; Mokhber Dezfouli and Lotfollahzadeh, 2002; Mokhber Dezfouli, 2007; Staley and Bush, 1985). Corticosteroids play an important role in the absorption of immunoglobulins by the intestinal epithelium and the timing of gut closure (Halliday, 1959; James *et al.*, 1979; Johnston and Oxender, 1979).

Chamomile (*Matricaria recutita* L.) has a wide geographical distribution (Salamon, 2009), and the

alcoholic extract of this plant contains mostly steroidal constituents (Hadjiakhoondi *et al.*, 2005; Morgan, 1996). The objective of this study was to investigate the effect of this chamomile extract on the absorption of IgG in newborn calves.

Materials and Methods

In this trial, an ethanolic extract of chamomile was obtained with the concentration of 111 mg/ml. Initially, a toxic dose of chamomile was obtained of 33 mg/kg body weight (BW). A cohort of 24 healthy newborn Holstein calves was randomly selected to receive one of four treatments. The first group received a low dose of chamomile (LC; 5.5 mg/kg BW); the second received a moderate dose of chamomile (MC; 11 mg/kg BW); the third a high dose of chamomile (HC; 22 mg/kg BW); and the fourth a control (CO; normal saline) (Susan *et al.*, 2007).

Prior to the beginning of the trial, stalls were numbered and randomly ordered to reduce the potential effect of pen location. Calves had no physical contact with each other. Stalls measured 1.22 m by 1.83 m with wooden partitions and a concrete floor. Straw was added daily to maintain the condition of the stalls. Before the start of the experiment, the entire barn was

cleaned thoroughly using a solution containing 20% benzalkonium chloride. During the trial, stalls were cleaned, swept, and dried between calves.

At birth, each calf was weighed. The preparation of chamomile extract was injected intravenously into the jugular vein 1 h after birth and before feeding colostrum. The colostrum was collected from primiparous and multiparous parturient Holstein cows in different herds, and was stored in plastic containers at -20°C. Pooling was accomplished by thawing the colostrum in warm water and mixing it in a clean container. Samples were collected for IgG analysis, and the pool was divided into plastic bags each containing 1 L. The colostrum was given at 10% BW by nipple bottle within 3 h of birth. Colostral IgG concentration was 79 mg/ml and the quality of colostrum was considered good. On the third day, calves were fed milk at 10% of BW, three times daily, and were offered starter. Fresh alfalfa hay was available freely at this time. After day 29, the calves were released from the study.

Blood samples were taken from the jugular vein of each calf prior to feeding colostrum and at 0, 1, 3, 6, 12, 18, 24, 30, 36 and 48 h postpartum. They were centrifuged (3,000 g, 15 min) within 1-2 h after withdrawal. Serum samples were stored at -20°C until serum IgG concentrations were analyzed by Single Radial Immunodiffusion (SRID) (Chigerwe *et al.*, 2008; Mancini *et al.*, 1965). Colostral IgG concentrations also were analyzed by this method. A repeated-measures ANOVA test was carried out to compare serum IgG concentrations between the groups, using SPSS software (version 17.0; Chicago, IL, USA).

Results

Serum IgG concentration increased during the first 48 h across all groups, to reach levels of 23.32 mg/ml (LC), 29.79 mg/ml (MC), 26.46 mg/ml (HC) and 23.68 mg/ml (CO) (Table 1). No statistical difference was found between groups at 0 h (P = 0.778). The highest serum IgG concentration was found in MC calves at 48 h (Table 1). There was no significant difference at 48 h between MC and HC calves (P = 0.264), or between LC and CO calves (P = 0.792). Both MC and HC calves had a significantly higher IgG concentration at 48 h compared with CO calves (both P < 0.001). At 24 and 48 h, IgG concentration was higher in both MC and HC calves compared with LC and CO calves (Figure 1). At 24 h, IgG concentration was similar between HC and MC groups but higher for MC calves at 48 h (Figure 1).

Discussion

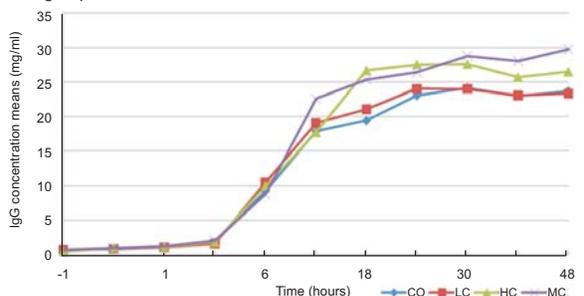
To the best of our knowledge, this is the first investigation of the effect of chamomile extract on colostral IgG absorption in neonates. The MC and HC groups had a greater IgG absorption at 24 and 48 h than

Table 1: Serum IgG concentrations (mg/ml) in four groups during the 48 h test period (mean ± SD).

Time (hours)	HC	MC	LC	CO
Before treatment	0.43 ± 0.51	0.711 ± 0.58	0.70 ± 0.40	0.64 ± 0.55
0	0.97 ± 0.24	0.93 ± 0.17	0.82 ± 0.13	0.80 ± 0.24
1	1.13 ± 0.16	1.18 ± 0.12	1.04 ± 0.24	1.04 ± 0.22
3	0.81 ± 0.37	2.04 ± 0.20	1.60 ± 0.43	1.81 ± 0.37
6	9.92 ± 1.34	8.75 ± 3.47	10.47 ± 0.96	9.21 ± 1.79
12	17.69 ± 1.91	22.58 ± 2.89	19.05 ± 1.90	17.86 ± 1.79
18	26.67 ± 3.36	25.35 ± 2.62	21.05 ± 2.17	19.04 ± 2.73
24	27.54 ± 1.79	26.42 ± 4.32	24.02 ± 2.07	23.04 ± 4.7
30	27.60 ± 0.78	28.78 ± 0.46	24.00 ± 1.61	24.15 ± 3.35
36	25.67 ± 2.85	28.03 ± 1.79	23.06 ± 2.96	23.00 ± 1.65
48	26.46 ± 3.50	29.79 ± 1.80	23.32 ± 1.52	23.68 ± 2.15

HC = injected high dose chamomile; MC = injected moderate dose chamomile; LC = injected low dose chamomile; CO = injected saline only

Figure 1: Changes in serum concentrations of immunoglobulin G across four groups.



LC: low dose of chamomile (5.5 mg/kg BW); MC: moderate dose of chamomile (11 mg/kg BW); HC: high dose of chamomile (22 mg/kg BW); CO: control (normal saline solution)

the CO and LC groups. The MC group had higher serum IgG concentration than the HC group, but the difference was not significant. Thus, we suggest that the most effective dosage of ethanolic extract of chamomile is 11 mg/kg BW for intravenous injection. Researchers have found that corticosteroids have an important role in delaying gut closure and increasing IgG absorption. It has been reported that IgG absorption in calves is greater with higher serum corticosteroid concentration (Boyd and Hogg, 1981; Johnston and Oxender, 1979; Whitaker *et al.*, 1996). The high steroidal content and anti-inflammatory properties of chamomile extract (Hadjiakhoondi *et al.*, 2005; Morgan, 1996; Salamon, 2009) may explain the high serum IgG concentration in chamomile-treated calves, since these constituents delay gut closure. Since metyrapone has been found to decrease the production of cortisol, administration of metyrapone to newborn piglets and calves resulted in decreased absorption of colostral immunoglobulins compared to the control (Johnston and Oxender, 1979; Patt and Eberhart, 1976). In the current study, the LC group had a lower concentration of serum IgG at 24 and 48 h. Results showed that the differences in dosage of chamomile extract between the groups probably affected the response of intestinal enterocytes to elevated serum IgG concentration. The data from this trial suggest that the administration of chamomile extract after birth probably delays gut closure and enhances the

immune system following IgG absorption in calves. According to this research, feeding colostrum at 10% of BW along with a single dose of chamomile could be an effective method to ensure an adequate passive immunity in neonate calves. The exact mechanism behind the increased concentration of IgG in chamomile-treated calves is unclear. More work need to be done to complete our findings about the effects of factors such as route of administration (subcutaneous or intra-muscular injection) and types of extracts (alcoholic or water base).

References

- Boyd, J.W.; Hogg, R. A. (1981) Field investigations on colostrum composition and serum thyroxine, cortisol, and immunoglobulin in naturally suckled dairy calves. *J. Comp. Path.* 91: 193-203.
- Butler, J. E. (1983) bovine immunoglobulins: An augmented review. *Vet. Immunol. Immunopathol.* 4: 43-156.
- Brambell, F.W.R. (1970) The transmission of passive immunity from mother to young. *Biology.* North Holland Publ. Co., Amsterdam, The Netherlands. 18: 201-365.
- Chigerwe, M.; Tyler, J.W.; Schultz, L.G.; Middleton, J.R.; Steevens, B.J. and Spain, J.N. (2008) Effect of colostrum administration by use of oesophageal intubation on serum IgG concentrations in Holstein bull calves. *Am. J. Vet. Res.* 69: 1158-63
- Hadjiakhoondi, A.; Saeidnia, S. and Gohari, A.R. (2005) *Rational Phytotherapy.* 1st edition. Tehran Medical Science University Press. Tehran, Iran, pp. 337-338.
- Halliday, R. (1959) The effect of steroid hormones on the absorption of antibody in the young rat. *J. Endocrinol.* 18: 56-66.
- Hardy, R.N. (1969) Proteolytic activity during the absorption of γ -globulin in the newborn calf. *J. Physiol.* 205: 453-470.
- James, R.E.; Polan, C.E. and McGilliard M.L. (1979) Distributional uptake of γ -globulin in the small intestine of neonatal calves. *J. Dairy Sci.* 62: 1415-1419.
- Jochims, K.F.J.; Kaup, W.; Drommer, R. and Pickel, M. (1994) An immunoelectron microscopic investigation of colostrum IgG absorption across the intestine of newborn calves. *Res. Vet. Sci.* 57:75-80.
- Johnston, N.E.; Oxender, W.D. (1979) Effect of altered serum glucocorticoid concentrations on the ability of the newborn calf to absorb colostrum immunoglobulin. *Am. J. Vet. Res.* 40: 32-34.
- Kruse, V. (1970) Yield of colostrums and immunoglobulin in cattle at the first milking after parturition. *Anim. Prod.* 12: 619-626.
- Leece, J.G.; Broughton, C.W. (1973) Cessation of uptake of macromolecules by neonatal guinea pig, hamster and rabbit intestinal epithelium (closure) and transport into blood. *J. Nutr.* 103: 744-750.
- Mancini, G.; Carbonara, A.O. and Heremans, J.F. (1965) Immunochemical quantitation of antigens by single radial immunodiffusion. *Immunochemistry.* 2: 235.
- Mokhber Dezfouli M.R.; Lotfollahzadeh, S. (2002) A study on the effect of oral administration of vitamin C on serum gamma globulin concentration of neonatal calves, 22 World Buiatrics Congress, Abstract P: 169.
- Mokhber Dezfouli, M.R. (2007) *Cow Calf Health and Diseases.* 1st edition. University of Tehran, Tehran. pp: 42-53.
- Morgan, M. (1996) Chamomile from a clinical perspective. *Modern Phytotherapist.* 3: 17-19.
- Nocek, J.E.; Braund, D.G. and Warner, R.G. (1984) Influence of neonatal colostrums administration, immunoglobulin, and continued feeding of colostrums on calf gain, health, and serum protein. *J. Dairy Sci.* 67: 319-333.
- Patt, J.A.; Eberhart, R.J. (1976) Effect of metyrapone and ACTH on intestinal absorption of immunoreactive bovine IgG in cesarean-derived pigs. *Am. J. Vet. Res.* 37: 1409.
- Pourjafar, M.; Badieli, K.; Nadalian, M.Gh. and Jafari Jozani, R. (2011) Effect of long term administration of frozen and fermented colostrums of vaccinated cows on the performance and prevention of neonatal calf diarrhea. *Pak. Vet. J.* 31: 1-4.
- Roy, J.H.B. (1990) *The calf.* Vol. 1. 5th edition. Butterwords, London. pp: 10-22.
- Salamon, I. (2009) Chamomile biodiversity of the essential oil qualitative-quantitative characteristics, In: B. Sener (Ed). *Inovations in Chemical Biology.* Springer. The Netherlands. pp: 83-90.
- Seifi, H.A.; Mokhber Dezfouli, M.R. and Bolurchi, M. (1995) The effectiveness of ascorbic acid in the prevention of calf neonatal diarrhea. *J. Vet. Med. B.* 42: 931.
- Staley, T.E.; Bush, L.J. (1985) Receptor mechanisms of the neonatal intestine and their relationship to immunoglobulin absorption and disease. *J. Dairy Sci.* 68:184-205.
- Stott, G.H.; Fellah, A. (1983) Colostral immunoglobulin absorption linearly related to concentration for calves. *J. Dairy Sci.* 66:1319-1328.
- Stott, G.H.; Marx, D.B.; Menefee, B.E. and Nightengale, G.T. (1979) Colostral immunoglobulin transfer in calves. The rate of absorption. *J. Dairy Sci.* 62: 1766-1773.
- Susan, G.; Barbara, J. and Fougère, P. (2007) *Veterinary herbal medicine.* 1st edition. Mosby Elsevier. Philadelphia. pp: 488-492.
- Wells, S.J.; Dargatz, D.A. and Ott, S.L. (1996) Factors associated with mortality to 21 days of life in dairy heifers in the United States. *Prevent. Vet. Med.* 29: 9-19.
- Whitaker, S.M.; Jeffrey, S.L.; Willett, L.B.; Borger, D.C.; Neiswander, R.L.; Schanbacher, F.L. and Weiss, W.P. (1996) The effect of cortisol and time of first feeding on immunoglobulin absorption in Holstein calves. *Anim. Sci. Res. Rev.* 156: 87-92