Asian-Aust. J. Anim. Sci.
Vol. 24, No. 7 : 952 - 956
July 2011

www.ajas.info
doi: 10.5713/ajas.2011.10348

Effects of Passive Transfer Status on Growth Performance in Buffalo Calves

V. Mastellone, G. Massimini, M. E. Pero[1], L. Cortese[2], D. Piantedosi[2], P. Lombardi[1,]*, D. Britti and L. Avallone[1]

Department of Experimental Clinical Medicine, School of Veterinary Medicine, University of Catanzaro Magna Græcia, Catanzaro, Italy

ABSTRACT : The objective of the study was to evaluate the effect of passive transfer status, determined by measuring serum immunoglobulin (Ig) concentration 24 hours after parturition, on growth performance in buffalo calves allowed to nurse the dam during the first month of life. Serum Ig concentration 24 hours after birth ranged from 28.1 to 35.9 mg/ml, birth weight ranged from 29 to 41 kg, body weight 30 days after birth ranged from 48.5 to 62.9 kg. The Average Daily Gain (ADG) from birth to day 30 ranged from 448 to 1,089 g/d. Significant linear associations were detected between serum Ig concentration 24 hours after birth and day-30 weight ($p< 0.05$; $R^2 = 0.31$) and between serum Ig concentration 24 hours after birth and ADG from birth to day 30 ($p<0.001$; $R^2 = 0.72$). Results indicated that passive transfer status was a significant source of variation in growth performance when buffalo calves nursed the dam. Maximizing passive transfer of immunity by allowing calves to nurse the dam can increase growth performance during the first month of life. (**Key Words :** Buffalo Calves, IgG, Growth)

INTRODUCTION

Colostrum ingestion in ruminants is the way to get maternal antibodies (Bogin et al., 1993; Lombardi et al., 1996). Calves start suckling soon after birth, and the absorption of immunoglobulins (Ig) lasts up to 24 hours. It is known that many diseases of neonatal calves are related to an insufficient colostrum intake and/or a poor colostrum quality, which is determined by the content of Ig (Matte et al., 1982). An inadequate ingestion or absorption of colostral Ig leads to a secondary immunodeficiency condition termed Failure of Passive Transfer (FPT) that predisposes ruminant neonates to the development of bacterial septicemia and common neonatal diseases (Weaver et al., 2000; Barrington and Parish, 2002; Massimini et al., 2006a). Calves with FPT have an increased risk of death until at least 10 weeks of age and in neonatal calves <7 days old, an increased risk of death is associated with serum IgG concentration <10 mg/ml (Tyler et al., 1998; Weaver et al., 2000; Barrington et al., 2002).

Passive transfer of immunity seems also to have predictive value for health and productivity outcomes (ie., subsequent growth and production) in juvenile calves, lambs, and kids, both before and after weaning (Denise et al., 1989; Wittum and Perino, 1995; Odle et al., 1996; Virtala et al., 1996; Robinson et al., 1998; Massimini et al., 2006b; Massimini et al., 2007). In dairy heifer calves, serum Ig concentration 24 to 48 hours after parturition was a significant source of variation in Average Daily Gain (ADG) through the first 180 days (Robinson et al., 1998). Additionally, calf serum Ig concentration 24 to 48 hours after parturition was a significant source of variation in mature milk and fat production, and heifers that survived despite FPT had lower milk production during their first lactation (Denise et al., 1989). In crossbreed calves, passive transfer status 24 hours after parturition was found to have an indirect effect on ADG and weaning weight because of the effect of FPT on calf morbidity rate (Wittum and Perino, 1995). In similar studies of the influence of passive transfer status on preweaning growth performance of dairy lambs

* Corresponding Author : Pietro Lombardi. Tel: +39-081-253 6103, Fax: +39-081-2536097, E-mail: pilombar@unina.it
[1] Department of Biological Structures, Functions and Technologies, School of Veterinary Medicine, University of Napoli Federico II, Napoli, Italy.
[2] Department of Clinic Veterinary Science, School of Veterinary Medicine, University of Napoli Federico II, Napoli, Italy.
Received September 29, 2010; Accepted December 29, 2010

Table 1. Serum IgG concentration at 24 hours, birth weight, day-30 weight, and ADG from birth to day 30 in buffalo calves allowed to nurse the dam

Day	IgG (mg/ml)	Body weight (kg)		ADG (g/d)
		0	30	0-30
M±SD	31.0±2.4	35.4±3.9	56.4±4.4	725.7±186.6

(Massimini et al., 2006b) and dairy goat kids (Massimini et al., 2007), passive transfer status as determined by measuring serum Ig concentration 24 hours after parturition was a significant source of variation in the measures of preweaning growth performance (ie., average daily gain from birth to day 30 and body weight at day 30) in these juvenile small ruminants.

Nevertheless, to our knowledge no data on the effects of passive transfer status on growth performance in buffalo calves has yet been reported. The lack of similar data in buffalo calves is critical because of the effect of FPT and colostrum management strategies on calf morbidity rate (Lombardi et al., 2001). The objective of the study was to evaluate the effect of passive transfer status, determined by measuring serum Ig concentration 24 hours after parturition, in buffalo calves during the first month of life.

MATERIALS AND METHODS

Experimental materials and procedures

Twelve neonatal buffalo calves from a single dairy farm in southern Italy were used in the study. Buffalo calves were allowed to suckle naturally and remained with their dams until 30 days old, following a natural non intensive breeding system. All dams were housed under standard management procedures for the farm. No drugs or other compounds were administered to the dams during gestation or parturition. Drugs and other compounds were not administered to the buffalo calves during the study.

The 12 buffalo calves included in the study were considered by the producer to be healthy, and no clinical abnormalities were detected during physical examinations. The passive transfer of immunity status (classified as failure, marginal, or adequate), health status, management interventions, and other animal factors (ie, age of the dam, sex of the calf, duration of gestation, and dam or neonatal behaviour) were not considered as continuous or categorical predictor variables in the study.

Analysis

Blood samples were collected by means of jugular venipuncture from the buffalo calves 24 hours (ie, 23.5 to 24.5 hours) after parturition. Serum was harvested after centrifugation and stored at 4°C until analyzed. After total protein determination (Fleury and Eberhard, 1951), serum Ig concentration was determined by use of a semiautomated agarose gel electrophoresis system (Hydragel 30 Protein Assay and Hydrasys agarose gel electrophoresis system, Sebia Inc, Norcross, GA) and body weight was measured at birth and at 30 days after birth. The ADG from birth to day 30 and day-30 weight were used as measures of growth performance.

Statistical analysis

Mean±SD values for serum Ig concentration at 24 hours, birth weight, day-30 weight, and ADG from birth to day 30 were calculated. Linear regression analyses was used to evaluate associations between serum Ig concentration 24 hours after birth (continuous independent variable) and measures of growth performance (continuous dependent variables). Serum Ig concentration at 24 hours and birth weight were also compared by means of simple linear regression analysis. Calculations were performed with the assistance of a statistical software package (GraphPad Prism version 4.01 for Windows, GraphPad Software Inc, San Diego, CA).

RESULTS AND DISCUSSION

Results of descriptive analysis for serum Ig concentration at 24 hours, birth weight, day-30 weight, and ADG from birth to day 30 in buffalo calves are shown in Table 1. Serum Ig concentration 24 hours after birth ranged from 28.1 to 35.9 mg/ml, birth weight ranged from 29 to 41 kg, body weight 30 days after birth ranged from 48.5 to 62.9 kg. The ADG from birth to day 30 ranged from 448.3 to 1089.7 g/d.

As depicted in Figure 1, a significant ($p<0.001$) negative association was detected between birth weight and serum Ig concentration 24 hours after birth. Each 1 kg increase in birth weight was associated with a 0.3 mg/ml decrease in serum IgG concentration 24 hours after birth in buffalo calves allowed to nurse the dam ($p<0.001$, $R^2 = 0.50$).

Significant linear associations were detected between serum Ig concentration 24 hours after birth and day-30 weight ($p<0.05$; $R^2 = 0.31$) and between serum Ig concentration 24 hours after birth and ADG from birth to day 30 ($p<0.001$; $R^2 = 0.72$) (Figure 2).

Results of this study indicated a significant negative association between birth weight and serum Ig concentration 24 hours after parturition in buffalo calves allowed to nurse the dam. A similar negative association between birth weight and serum Ig concentration few hours

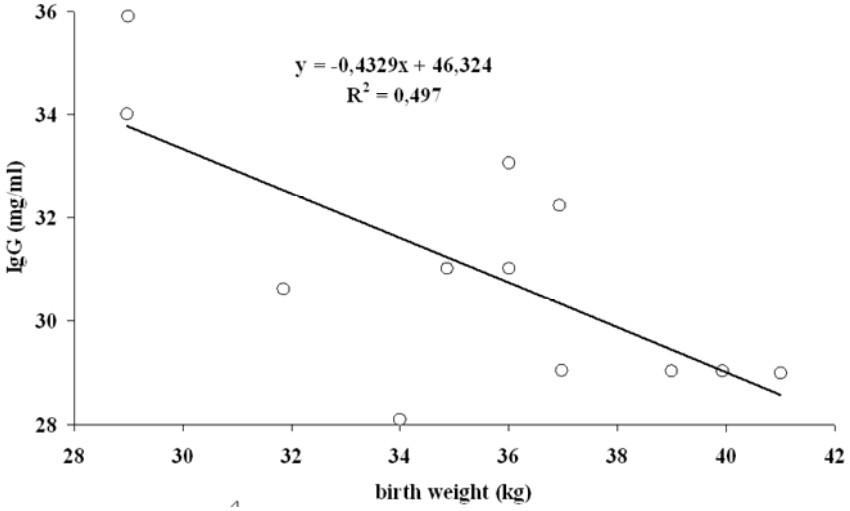

Figure 1. Scatter plot of birth weight versus serum Ig concentration 24 hours after birth in 12 healthy buffalo calves allowed to nurse the dam. The solid line represents the best fit for the data, as determined by means of simple linear regression.

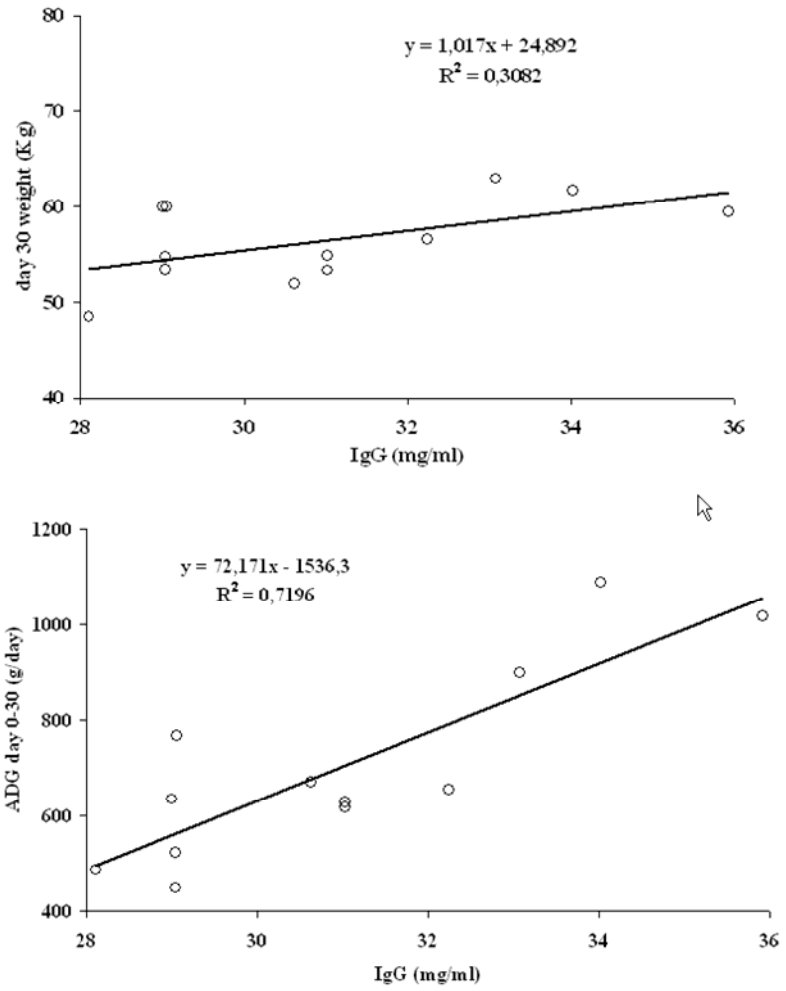

Figure 2. Scatter plots of serum Ig concentration 24 hours after parturition versus body weight at day 30 (A) and ADG from birth to day 30 (B) in 12 healthy buffalo calves allowed to nurse the dam. In each graph, the solid line represents the simple linear model as determined by means of simple linear regression.

after parturition has been previously reported in neonatal lambs (Cabello and Levieux, 1981; Massimini et al., 2006b). Negative relationships between birth weight and duration of gestation and between birth weight and plasma thyroxine concentration have also been reported for lambs (Cabello and Levieux, 1981). Consequently, it appears that the negative relationship between birth weight and acquisition of passive immunity in newborn lambs could be an indirect link that reflects the effects of other important physiologic factors, such as duration of gestation and hormonal status at birth. However, the potential influence of these independent variables were not evaluated in the present study and so, the negative relationship between birth weight and passive immunity remains to be elucidated in neonatal buffalo calves. Nevertheless, the negative association between birth weight and serum Ig concentration 24 hours after parturition could be an adaptive response to provide protection for lighter weight calves.

Significant linear associations were detected between serum Ig concentration 24 hours after birth and day-30 weight and between serum Ig concentration 24 hours after birth and ADG from birth to day 30. These results suggest that passive transfer status, determined as serum Ig concentration 24 hours after birth, is a significant source of variation in growth performance during the first month of life when buffalo calves nursed the dam. Further, the effect of passive transfer status on the measures of preweaning growth performance of buffalo calves allowed to nurse the dam also indicated that improving serum Ig concentration within the first 24 hours after parturition may enhance the calf growth until a threshold serum Ig concentration is achieved, which seems be concentrated in the highest passive transfer strata. However, colostrum is rich in antibodies, lymphocytes, cytokines, acute-phase proteins, hormones (growth factors), vitamins, minerals, and enzymes (Odle et al., 1996; Galyean et al., 1999; Britti et al., 2005). Colostral cytokines, along with other immune regulatory proteins such as complement and lactoferrin, are also believed to play an important role in the innate immunity of ruminant neonates (Galyean et al., 1999). Considerable research effort has been directed in recent years at determining the relationships between development of neonatal calves and various growth factors, such as insulin-like growth factor-I (IGF-1) and growth hormone (GH) (Odle et al., 1996). Consequently, many of these nonimmunoglobulin factors in colostrum/milk (ie., cytokines, GH, IGF-1) might have interacted in conjunction with Ig concentration or acted directly to influence the growth response or to advance the immune and metabolic systems of the buffalo calves allowed to nurse the dam in this study. Other factors also influence calf growth during weaning, including health status, management interventions, nutrition, environment, dam age, calf sex, litter number, behaviour, absorptive ability, and inherent differences among individuals (Odle et al., 1996; Galyean et al., 1999). However, some of the potential source of variation due to these factors in buffalo calf growth could be removed in our study, such as health status (ie., all buffalo calves included in the study were considered to be healthy by the producer and by clinical evaluation) and all farm management procedures (all dams and buffalo calves were housed under standard management procedures for a single dairy farm); other animal factors (ie, age of the dam, sex of the calf, duration of gestation, and dam or neonatal behaviour) were not considered as predictor variables in the study.

Overall, our results indicated that passive transfer status, determined as serum Ig concentration 24 hours after birth, is a significant source of variation in growth performance when buffalo calves nursed the dam. Moreover, maximizing passive transfer of immunity by allowing buffalo calves to nurse the dam can improve growth performance during the first month of life. This is consistent with results of other studies involving dairy and beef calves (Wittum and Perino, 1995; Virtala et al., 1996). Proper neonatal management programs that enhance the likelihood that buffalo calves receive a sufficient volume and concentration of colostrums within the first hours of life should be developed and used to meet this need. Passive transfer monitoring programs can identify buffalo calves suffering from FPT, but because the causes of FPT are multifactorial (eg., inadequate concentration of IgG in colostrum fed, inadequate volume of colostrum ingested, retarded age of the neonate at first colostral feeding, and failure of the neonate to suckle or absorb ingested colostrum) (Weaver et al., 2000; Barrington and Parish, 2002), programs designed simply to identify affected neonates will not replace comprehensive flock management programs (Massimini et al., 2006b). Colostrum and immunization management strategies should receive appropriate attention by producers and veterinarians in order to optimize passive transfer status and improve growth performance of buffalo calves raised in a production environment.

REFERENCES

Barrington, G. M. and S. M. Parish. 2002. Ruminant immunodeficiency disease. In: Large animal internal medicine (Ed. S. P. Smith). 3rd ed. St Louis: CV Mosby Co, 1600-1602.

Bogin, E., Y. Avidar, S. Shnkler, B. A. Israeli, N. Spiegel and R. Cohen. 1993. A rapid field test for the determination of colostral ingestion by calves. Eur. J. Clin. Chem. Clin. Biochem. 31:695-699.

Britti, D., G. Massimini, A. Peli, A. Luciani and A. Boari. 2005. Evaluation of serum enzyme activities as predictors of passive transfer status in lambs. J. Am. Vet. Med. Assoc. 226:951-955.

Cabello, G. and D. Levieux. 1981. Absorption of colostral IgG1 by the newborn lamb: influence of the length of gestation,

birthweight and thyroid function. Res. Vet. Sci. 31:190-194.

Denise, S. K., J. D. Robison, G. H. Stott and D. V. Armstrong. 1989. Effects of passive immunity on subsequent production in dairy heifers. J. Dairy Sci. 72:552-554.

Fleury, P. and R. Eberhard. 1951. Determination of proteins by photometric, biuret according to the technique of Gornall. Ann. Biol. Clin. 9:453-466.

Galyean, M. L., L. J. Perino and G. C. Duff. 1999. Interaction of cattle health/immunity and nutrition. J. Anim. Sci. 77:1120-1134.

Lombardi, P., L. Avallone, A. d'Angelo and E. Bogin. 1996. Gamma-glutamyltransferase and serum proteins in buffalo calves following colostral ingestion. Eur. J. Clin. Chem. Clin. Biochem. 34:965-968.

Lombardi, P., L. Avallone, U. Pagnini, D. d'Angelo and E. Bogin. 2001. Evaluation of buffalo colostrum quality by estimation of enzyme activity levels. J. Food Prot. 64:1265-1267.

Massimini, G., A. Peli, A. Boari and D. Britti. 2006a. Evaluation of assay procedures for prediction of passive transfer status in lambs. Am. J. Vet. Res. 67:593-598.

Massimini, G., D. Britti, A. Peli and S. Cinotti. 2006b. Effect of passive transfer status on preweaning growth performance in dairy lambs. J. Am. Vet. Med. Assoc. 229:111-115.

Massimini, G., V. Mastellone, D. Britti, P. Lombardi and L. Avallone. 2007. Effect of passive transfer status on preweaning growth performance in dairy goat kids. J. Am. Vet. Med. Assoc. 231:1873-1877.

Matte, J. J., L. Girard, J. R. Seoane and J. G. Brisson. 1982. Absorption of colostral immunoglobulin G in the newborn dairy calf. J. Dairy Sci. 65:1765-1770.

Odle, J., R. T. Zijlstra and S. M. Donovan. 1996. Intestinal effects of milkborne growth factors in neonates of agricultural importance. J. Anim. Sci. 74:2509-2522.

Robinson, J. D., G. H. Stott and S. K. De Nise. 1988. Effects of passive immunity on growth and survival in the dairy heifer. J. Dairy Sci. 71:1283-1287.

Tyler, J. W., D. D. Hancock, S. E. Wiksie, S. L. Holler, J. M. Gay and C. C. Gay. 1998. Use of serum protein concentration to predict mortality in mixed-source dairy replacement heifers. J. Vet. Int. Med. 12:79-83.

Virtala, A. M. K., G. D. Mechor, Y. T. Gröhn and H. N. Erb. 1996. The effect of calfhood diseases on growth of female dairy calves during the first 3 months of life in New York State. J. Dairy Sci. 79:1040-1049.

Weaver, D. M., J. W. Tyler, D. C. VanMetre, D. E. Hostetler and G. M. Barrington. 2000. Passive transfer of colostral immunoglobulins in calves. J. Vet. Int. Med. 14:569-577.

Wittum, T. E. and L. J. Perino. 1995. Passive immune status at postpartum hour 24 and long-term health and performance of calves. Am. J. Vet. Res. 56:1149-1154.