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Original Research

Effect of lactoferrin on growth of Holstein calves in the middle of Iraq

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ABSTRACT:

The objectives of this study was to study the effect of lactoferrin (0, 3, and 6 g LF/day) added to colostrum and milk on the body weight and body measurements (wither height, body length, heart girth and body barrel) in 18 Holstein calves from the first day of birth to 60 days of age. The results showed that they were highly significant (P<0.01) in the average body weight of calves aged 30 and 60 days, for the calves fed 6 and 3 g of lactoferrin compared with the control calves (0 g of LF). The average weight gain was also affected (30 days old, and 30 to 60 days and from birth to 60 days) significantly (P<0.01) with the different lactoferrin levels. Achieved calves were fed with 6 g of lactoferrin and the next level calves were fed with 3 g of Lactoferrin and received best results with increased weight than the control calves. There seen a significant difference (P<0.05) in each of the wither height and body length in calves aged 30 and high significant (P<0.01) in 60 days depending on the treatment with lactoferrin, calves of the third treatments (6 g of LF) and the second (3 g of LF) highest rate of wither height and body length are compared with the control calves (0 g LF). The heart girth was also significantly affected (P<0.05) at the age of 30 days and high morale at 60 days, in both the ages results favoured the calves. In the two treatments *viz*., third (6 g of LF) and second (3 g of LF) compared with the control calves (0 g of LF), the variance in the body barrel was significantly higher at 30 and 60 days for calves fed on lactoferrin at 3 and 6 g/day. The study summarized that addition of lactoferrin protein in calves fed in early ages after birth had better performance in growth and dimensions of the body.

Keywords:

Lactoferrin, Calves, weight, Body measurements.

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INTRODUCTION

For the purpose of obtaining high production of milk and beef we must first show attention to calves. It is the basis of the herd and through which access to optimal production initiates. Intestinal diseases and insufficient function of the immune system in calves are partly responsible for the particularly high mortality and morbidity rates in the neonatal period (Sangild *et al.*, 2000). Therefore, neonatal calves are dependent on passive immunoprotection by the ingestion of various substances from colostrum like maternal immunoglobulins, immune competent cells and other substances (Barrington and Parish, 2001). The colostrum proteins include immunoglobulin, which the newborn calf can take advantage in the first three days after birth because of the intestinal tract of the receptor, or so-called sites of the absorption of immunoglobulin. Each of the immune concentration in colostrum and intestinal permeability gradually decreases rapidly during the first 24 hours after birth (Moore *et al.*, 2005), therefore, it is necessary in this short period of time to feed calves with enough colostrum to gain primary immune until the development of immune system for calves (Wheeler *et al.*, 2007). Components of colostrum are also working on the development of the digestive system (Odle *et al.*, 1996; Blum and Hammon, 2000), and absorptive capacity of the intestine (Rauprich *et al.*, 2000). Lactoferrin (LF) is among the bioactive components and present in high concentration in milk, especially in the colostrum and during mammary involution or inflammation (Hagiwara *et al.*, 2003; Prenner *et al.*, 2007) lactoferrin is found in relatively higher concentration in bovine milk than in other sources (Tomita *et al.*, 2009) and it has been reported that oral administration of lactoferrin exerts host-protective effects against various diseases in humans and animals (Tomita *et al.*, 2002). Lactoferrin is known for its characteristic iron binding and transferring abilities. Since iron deficiency is one of the most common nutritional deficiencies in the world (Centers for Disease Control and Prevention, 2002). Lactoferrin is increasingly viewed as an effective and safe ingredient to deliver iron to people with iron deficiency (Paesano *et al.*, 2010). Apart from this commonly known iron binding ability, lactoferrin has also been reported to facilitate absorption of sugars (Artym and Zimecki, 2005), provide defense against infection and inflammation (Britigan *et al.*, 1994; EI-Loly and Mahfouz, 2011), modulate cell growth and inhibit the formation of several toxic compounds (Baveye *et al.*, 1999). Due to these reasons, industrial manufacturing of bovine lactoferrin is continuously increasing for the last 25 years (Tomita *et al.*, 2009). The global market for lactoferrin has increased from 45 tons in 2001 to 185 tons in 2012 (Synlait, 2013). Due to the extensive biological importance of lactoferrin, it has attracted the attention of a large number of researchers to take advantage of its effectiveness, and held the first international conference on lactoferrin in the United States of America in 1992 and was followed by periodic international conferences, the second conference was held in the United States of America in 1995, France 1997, Japan 1999, Canada 2001, Italy 2003, United States of America 2005, France 2007, China 2009, Mexico 2011, Italy 2013, Japan 2015 and last the 13th international conference on lactoferrin in Italy (Shimazaki and Kawai, 2017). The present study aimed to show the effect of Lactoferrin on body weight and body measurements for Holsteins calves.

MATERIALS AND METHODS

Calves, feeding and treatments

This study was conducted at the Al-Salam Farm For Dairy Cows, Private sector (Latifia, 25 km south of Baghdad), for the period from September 3, 2017 until December 11, 2017. Eighteen Holstein calves (12 heifers and 6 bulls) were randomly assigned at birth to one of three treatments in a 60 day experiment. Four heifers and two bulls were assigned to each treatment. Colos-

Table 1. Body Weight (BW) for calves fed with different amounts of lactoferrin from birth to 60 days

S. No	Treatment	Average BW ± standard error (kg)		
		At birth	30 days	60 days
1	Control	36.45 ± 0.45^{a}	43.23 ± 0.50^{b}	59.63 ± 0.62^{b}
2	3 g of LF	36.03 ± 0.52^{a}	46.53 ± 0.63^{a}	65.01 ± 0.66^{a}
3	6 g of LF	35.71 ± 0.45^{a}	47.43 ± 0.57^{a}	66.41 ± 0.54^{a}
4	Level of s.g	NS	**	**

NS: Not significant, **: (P<0.01); The averages with different letters within the same column significantly differ between them

trum and milk were supplemented with either 0 (control), 3 or 6 g/d of lactoferrin fed daily in two equal feedings. Lactoferrin is a commercially prepared product (Sgonek biological technology co.). The iron saturation of the lactoferrin was 10-20%. At birth, calves were removed from their mother's dams and placed in an individual pen bedded with kiln-dried sawdust. Calves received 2 l of good quality colostrum (tested by a colostrometer), supplemented with the appropriate amount of lactoferrin (±LF) within 3 hours after birth, and another 2 L of colostrum within 8 to 12 hours later. The calves remain in their pens for the duration of the study. On days 2 and 3, calves received 2l of colostrum and supplemented with the appropriate amount of lactoferrin in the morning days and another 2l colostrum within the 12 hours later. On 4^{th} day until 60 day calves received 2l of milk ±LF in the morning, and another 2l of milk within 12 hours later. Fresh water was provided continuously to the calves throughout the study period, and at the beginning of the second week, calves received small quantities of roughages and concentrate diets.

Measurements

Within 24 hours after birth, calves were weighed, withers height, body length, heart girth, and body barrel were measured. These measurements were repeated in 30 d and 60 d for aged calves.

Statistical analysis

The data were analyzed statistically using the Statical Analysis System (SAS, 2012) to study the effect of treatments on the studied traits according to the Completely Randomized Design (CRD). Moral differences between the averages were compared with the application of the Duncan's new multiple range test (1955).

$Yij = \mu + Ti + eij$

where, Yij: Value of the view 'j' of the treatment 'i'; μ: The general mean of the trait; Ti: Effect of treatment 'i' (0, 3 or 6 g/d of LF); Eij: Random error which is naturally distributed at an average of zero and a variation of '$\sigma^2 e$'.

RESULTS

The results of the study showed a significant difference (P<0.01) in the body weight (Table 1) for the calves in second treatment (3 g/day of LF) and the third treatment (6g/day of LF) compared with the control calves (0 g/day of LF) in 30 days of age calves, as the average body weight of calves in each of the second and third treatments were 46.53±0.63 and 47.43±0.57 kg, respectively, while the average body weight for the control calves were 43.23±0.5 kg. No significant difference between the calves of the second and third treatments at the 30 days of age calves were seen. Body weight was higher (P<0.01) at 60 days for calves fed with 3 and 6 g/d of LF (65.01±0.66 and 66.41±0.54 kg, respectively) compared with the control calves (59.63±0.62 kg), and no difference between calves fed with 3 or 6 g/d of lactoferrin in the average body weight at 60 days (Table 1).

Table 2 shows Average Daily Gain (ADG) was higher (P<0.01) from the birth to 30 days for calves fed with 6 g of lactoferrin (11.71±0.25 kg) compared with the calves fed with 3 g of LF (10.50±0.13 kg) which was higher from the control calves (6.78±0.07 kg). The ADG from 30 d to 60 d was highly significant (P<0.01)

Table 2. Average Daily Gains (ADG) for calves fed with different amounts of Lactoferrin from birth to 30 days, 30 to 60 and from birth to 60 days

S. No	Treatment	Average Daily Gains (ADG) ± standard error (Kg)		
		From birth to 30 days	From 30 to 60 days	From birth to 60 days
1	Control (No LF)	6.78 ± 0.07[c]	16.40 ± 0.13[b]	23.18 ± 0.14[c]
2	3 g of LF	10.50 ± 0.13[b]	18.48 ± 0.20[a]	28.98 ± 0.18[b]
3	6 g of LF	11.71 ± 0.25[a]	18.98 ± 0.21[a]	30.70 ± 0.11[a]
4	Level of s.g	**	**	**

NS: Not significant, **: (P<0.01); The averages with different letters within the same column significantly differ between them

for calves fed with 3 and 6 g of LF (18.48±0.20 and 18.98±0.21 kg, respectively) compared with the control calves (16.40±0.14 kg). From birth to 60 d higher ADG was seen in calves fed with 6 g of LF (30.70±0.11 kg), and calves fed with 3 g (28.98±0.18 kg) overtook the control calves (23.18±0.14 kg) at the same time.

Results represented in Table 3 showed a significant difference (P<0.05) in each of the wither height, body length, and heart girth for the calves fed with 3 and 6 g of lactoferrin compared to the control calves in 30 days, as the rate of wither height for the control calves, 76.70, 78.51, and 79.84 cm, respectively, and the average of body length for three treatments of calves (control, 3 and 6 g fed of lactoferrin) was 70.36, 72.11, and 74.65 cm, respectively. The heart girth was 78.01, 80.98, and 82.05 cm, respectively for the calves in three treatments. In 60 days there was a significant effect (P<0.01) in each of the wither height, body length, and heart girth for the calves fed with 3 and 6 g of lactoferrin compared with the control treatment. Calves fed with 6 g of lactoferrin achieved the best results in each of the wither height (89.31±1.11 cm), body length (82.46±0.79 cm), and heart girth (90.86±0.90 cm), followed by calves fed with 3 g of lactoferrin (wither height 88.21±0.92 cm, body length 81.97±1.03 cm, and heart girth 90.71±1.14 cm). While the results of the control calves for wither height, body length, and heart girth were 83.68±0.50 cm, 76.05±0.60 cm and 85.51±0.26 cm, respectively.

Results also showed a significant difference (P<0.01) in body barrel for the calves fed 6 and 3 g of LF (87.78±0.52 and 87.15±0.91 cm, respectively) at 30 days compared with the control calves (83.01±0.55 cm). In 60 days the body barrel was significant difference (P<0.01) for the calves fed with 6 g of lactoferrin (95.21±0.89 cm), then come calves fed with 3 g of lactoferrin (94.61±1.14 cm) compared to the control calves (90.46±0.58 cm).

Table 3. Body measurements for the calves fed different amounts of lactoferrin at birth, 30 and 60 days of age

S. No	Item	Treatment			Level of significance
		Control	3 g of LF	6 g of LF	
1	**Height wither (cm)**				
	At birth	74.73±0.36[a]	74.25±0.45[a]	73.90±0.36[a]	NS
	30 days	76.70±0.47[b]	78.51±0.89[a]	79.84±0.46[a]	P<0.05
	60 days	83.68±0.50[b]	88.21±0.92[a]	89.31±1.11[a]	P<0.01
2	**Body length (cm)**				
	At birth	66.31±0.54[a]	65.83±0.62[a]	64.61±0.62[a]	NS
	30 days	70.36±0.46[b]	72.11±0.80[ab]	74.65±0.58[a]	P<0.05
	60 days	76.05 ± 0.60[b]	81.97±1.03[a]	82.46±0.79[a]	P<0.01
3	**Heart girth (cm)**				
	At birth	71.96±0.40[a]	71.11±0.44[a]	70.78±0.37[a]	NS
	30 days	78.01±0.40[b]	80.98±1.23[a]	82.05±1.08[a]	P<0.05
	60 days	85.51±0.26[b]	90.71±1.14[a]	90.86±0.90[a]	P<0.01
4	**Body barrel (cm)**				
	At birth	72.53±0.35[a]	72.18±0.42[a]	71.20±0.33[a]	NS
	30 days	83.01±0.55[b]	87.15±0.91[a]	87.78±0.52[a]	P<0.01
	60 days	90.46±0.58[b]	94.61±1.14[a]	95.21±0.89[a]	P<0.01

DISCUSSION

The results of the present study seem to be consistent with the study of Prenner *et al*. (2007), which showed that the addition of lactoferrin to the colostrum or milk in the feeding of the Holstein calves showed a high weight gain for the newborn calves. He added that this increase may be because of the effect of positive lactoferrin on the health of calves and the improvement of the amount of the diet intake and the low incidence of diseases, as well as reduced cases of severe diarrhoea 31%. This is also consistent with the results of the study of Joslin *et al*. (2002) and Robblee *et al*. (2003), who found that the addition of lactoferrins improved the digested diet , growth, and health of calves. Increased growth responses are probably related to the ability of LF to increase intestinal growth and nutrient absorption, and therefore, feed efficiency (Zhang *et al*., 2001). Further research is needed to evaluate the role of lactoferrin when fed to newborn calves.

CONCLUSION

It can be concluded that adding 3 and 6 gm of lactoferrin protein in calves fed at the early ages, after birth, had significant improvement on the growth performance and body dimensions (withers height, body length, heart girth, and body barrel).

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