

## Comparison of Lactoferrin Content in Colostrum Between Different Cattle Breeds

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### ABSTRACT

Lactoferrin content of colostrum obtained from cows within 24 h after parturition was measured using a single radial immunodiffusion test and was compared among cows of two dairy breeds (Holstein-Friesian, Jersey) and two beef breeds (Japanese Black and Japanese Brown). Average lactoferrin content in colostrum of dairy breeds was 2 mg/ml and in colostrum of beef breeds was .5 mg/ml. Lactoferrin content of colostrum due to lactation number was also different among breeds. In dairy breeds, multiparous cows had lactoferrin content two to three times higher than that of primiparous cows; beef breeds showed no obvious differences between lactation years. Lactoferrin content also varied considerably within breed. In beef breeds, half the cows had values of nearly zero. Transferin content in colostrum was fairly constant (.9 mg/ml) and was not as variable among and within breeds. There was no correlation between lactoferrin and transferrin contents in colostrum. Examination of cows lacking lactoferrin suggested that transferrin plays an important role as an iron carrier from a cow to her newborn calf.

(Key words: lactoferrin, colostrum, breed)

### INTRODUCTION

Lactoferrin as the major part of the red protein fraction in milk whey. Two possible physiological functions of lactoferrin are based on its protein chemical function: 1) an iron source for infants and 2) a potent antimicrobial factor in the milk cistern and in the alimentary tract of infant (1, 2, 4). Despite these functions, lactoferrin content in colostrum or milk is variable among species and among individuals within a species (8). Content changes during cow lactation and is highest during the dry period (13). It also dramatically increases with mastitis, but the response differs among cows (5). Thus, many efforts have attempted to reveal why lactoferrin content of cow milk differs under different physiological conditions. However, few papers have reported the difference in lactoferrin content in colostrum. The comparison may offer important information when considering physiological functions of lactoferrin.

The objectives were to measure the lactoferrin concentration of colostrum and change with lactation number among beef and dairy breeds.

### MATERIALS AND METHODS

#### Animals

Colostrum was obtained within 24 h after parturition from 119 cows of four breeds, consisting of 45 Holstein-Friesian, 20 Jersey, 27 Japanese Black, and 27 Japanese Brown cows.

#### Lactoferrin Quantitation

The fat fraction was removed from colostrum by centrifugation at 10,000 rpm for 10

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Received March 17, 1989.  
Accepted July 20, 1989.

min at 4°C to yield fat-free secretion; the latter was employed in the lactoferrin assay. The single radial immunodiffusion method was used to determine the lactoferrin and transferrin contents of fat-free samples (7). Immunodiffusion took place within 24 h at room temperature on glass plates covered with 1% agarose in .05 M potassium phosphate-buffered saline, pH 7.5, containing .1% NaN<sub>3</sub> and 2% antiovine lactoferrin rabbit serum or 1% antiovine transferrin rabbit serum. Purified lactoferrin, purified transferrin, and each antiserum were prepared as described (11, 12). Using purified lactoferrin or purified transferrin as standards, lactoferrin and transferrin contents of each colostrum sample were determined in triplicate.

#### Statistical Analysis

Data shown in Table 1 and in Figure 1 were analyzed by least squares analysis (6). Comparison with individual means of Table 1 was made by Duncan's multiple range test (3).

#### RESULTS AND DISCUSSION

As lactoferrin has a primary sequence homology with transferrin (9), double reciprocal immunodiffusion tests were performed to test if antilactoferrin serum reacted with transferrin in colostrum and if the reverse took place in the presence of antitransferrin with lactoferrin. Antilactoferrin reacted with purified transferrin with a poor precipitin line. The precipitin line was detectable only when a large quantity of transferrin was used (.4 mg/8  $\mu$ l of each well) (data not shown). Therefore, lactoferrin in colostrum was detectable without interference of transferrin, although colostrum samples usually contained considerable amounts of transferrin (Table 1).

Table 1 compares the lactoferrin and transferrin contents in colostrum from four breeds. Dairy cows had significantly higher lactoferrin content than did beef cows: 2 mg/ml [nearly the same as the 1.82 mg/ml at parturition presented by Nonnecke and Smith (10)] for dairy cows and .5 mg/ml for beef cows. There are few reports about constituents of milk of beef breeds. Lactoferrin decreased daily after parturition (13). Suckling may be the cause of this decrease. In general, dairy cows, when compared with beef cows, had higher lactoferrin

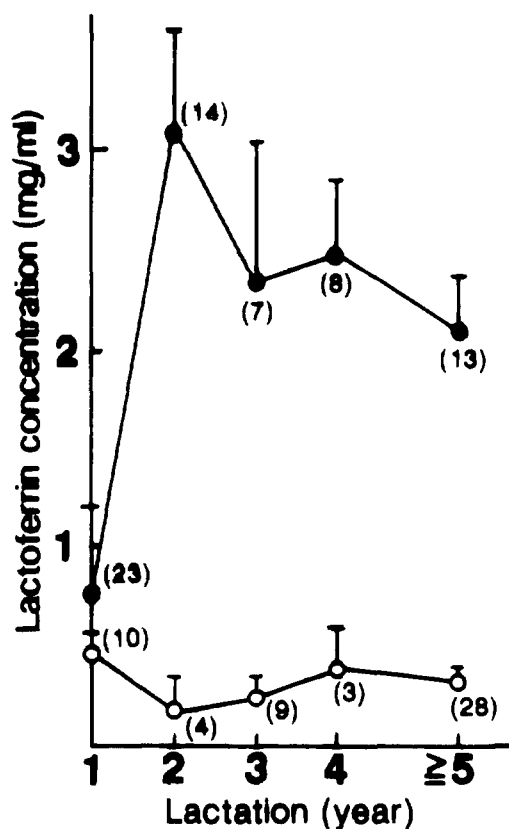


Figure 1. Changes in lactoferrin concentration in colostrum by lactation number. Average lactoferrin concentration of two beef breeds (○) and of two dairy breeds (●). Values are least square means and standard errors (vertical bar). Numbers in parentheses show the number of cows tested. Lactation number  $\geq 5$  includes all cows more than fifth calving.

content 24 h or longer after parturition, so suckling frequency would be less of an effect than the difference between breeds.

As shown in Table 1, data for the lactoferrin had higher standard errors than data for transferrin. Lactoferrin content among individuals was variable, especially those in dairy breeds. The highest was 11.77 mg/ml and the lowest was not detectable. The content in normal milk increases markedly during coliform infection (5); therefore, the variation in colostrum of dairy cow may reflect infection status. Lactoferrin content in beef breeds was low, and almost all cows showed less than 1 mg/ml.

TABLE 1. Comparison of lactoferrin and transferrin concentrations in colostrum<sup>1</sup> between cattle breeds.

Breed	No. of cows	Concentration (mg/ml)			
		Lactoferrin		Transferrin	
		$\bar{X}$	SE	$\bar{X}$	SE
Holstein-Friesian	45	1.96 <sup>a</sup>	.27	.98	.09
Jersey	20	2.11 <sup>a</sup>	.36	1.06	.11
Japanese Black	27	.56 <sup>b</sup>	.31	.93	.10
Japanese Brown	27	.40 <sup>b</sup>	.30	.83	.10

<sup>a,b</sup>Values are least square means  $\pm$  standard errors. Means in the same column with different superscripts differ ( $P < .01$ ).

<sup>1</sup>Colostrum samples were obtained from cows within 24 h of parturition.

Beef cows produce less milk than dairy cows, so the difference between breeds in the total amount of lactoferrin secreted per day is large. Beef cows frequently lacked lactoferrin in colostrum. It is speculated that lactoferrin is not an essential protein for newborn calves, although no data are available to indicate that lactoferrin has a physiological role in infants. Transferrin content in colostrum was less variable than lactoferrin both between and within breeds. There was no difference of transferrin content between breeds. Therefore, transferrin may play a more important role than lactoferrin as an iron donor in newborn calves, although sow lactoferrin acts as an iron donor in piglets (4). There was no correlation between lactoferrin and transferrin content in colostrum ( $r = .03$ ), although Masson and Heremans (8) observed a negative correlation between the content of the two proteins.

Figure 1 compares lactoferrin content between the colostrum of primiparous and multiparous cows. There is a significant difference between the dairy and beef breeds at each lactation. In dairy breeds, lactoferrin content in colostrum in first lactation cows was significantly lower than in multiparous cows. The average lactoferrin content in colostrum of the first lactation cows was between one-half and one-third of that of subsequent lactations in dairy breeds. The highest lactoferrin content in colostrum was observed in the second lactation period. After the third lactation, no differences in lactoferrin content were observed between lactations. The cause of difference in lactoferrin content between the second lactation and subsequent periods is not obvious. An intramammary infection in the cow causes dramatic increases

in the lactoferrin content of milk (5). Differences in lactoferrin content of colostrum from primiparous and multiparous cows may, therefore, reflect an increased incidence of infection in the multiparous cows.

In beef breeds, differences in lactoferrin content among lactations were not significant. Even in the first lactation period, the lactoferrin content of colostrum from dairy cows was significantly higher than for beef cows (Figure 1).

We have described two different molecules of lactoferrin of different sizes (12). This phenomenon, however, had no relation to the difference of lactoferrin content between breeds, as beef breed colostrum contains two lactoferrin molecules of large and small size, similar to that of dairy breeds. Physiological and biochemical processes that cause differences in lactoferrin content between breeds are still unknown.

#### ACKNOWLEDGMENTS

We thank the following persons for providing colostrum samples from Japanese Brown, Jersey, and Japanese Black: T. Ueda and his colleagues of Kochi prefectural government; T. Adachi of Hirusen dairy farming cooperation; and K. Kadota of Awaji Agricultural Institute, respectively. Thanks are also due to N. Goto for his critical reading of the manuscript and helpful discussions.

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