EFFECTS OF FEEDING COLOSTRUM AND MILK OF HOLSTEIN COWS ON GROWTH RATE, IMMUNOGLOBULIN LEVELS AND METABOLIC TRAITS IN JERSEY CALVES PRODUCED BY EMBRYO TRANSFER: COMPARISON WITH HOLSTEIN CALVES

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ABSTRACT

The aim of the present study was to assess the effects of Holstein dam's colostrum and milk on growth rate, immunoglobulin levels, and metabolic traits in Jersey calves produced by embryo transfer: comparison with Holstein calves. All calves received colostrum within half an hour after birth at the rate of 2.4-3.9 L were 10% BW basis, and continued for the first 3 days and milk from after that to weaning at 8 weeks; they were fed twice daily in equal amounts more or less 5-10% of their BW. Also, calves were provided water *ad libitum*, grass hay, and calf starter at 7 days after birth. Results exhibited the content and immunoglobulin levels of colostrum gradually decreased with increasing age after birth. Jersey calves had lower BW ($P<0.05$) at preweaning period and mean ADG over 56 days compared with Holstein calves ($P>0.05$). However, feed efficiency was higher in Jersey than in Holstein calves ($P>0.05$). The level of plasma IgG was over 10 mg/mL, which indicated the successful transfer of passive immunity in Jersey and Holstein calves. Indeed, feeding the milk of Holstein dams did not significantly affect plasma total protein, glucose, urea nitrogen, and NEFA concentrations of Jersey calves as compared with Holstein calves. Therefore, these data suggest that feeding Holstein dam's milk will not affect the growth performance, immunoglobulin level and metabolic traits of Jersey calves produced by embryo transfer.

Keywords: Embryo transfer, Holstein dam's milk, Growth rate, Immunoglobulin, Metabolic traits.

INTRODUCTION

Neonates must adapt to a new environment, so neonatal calves are isolated immediately from their mother; provide an inadequate quantity of colostrum (CO) and milk, generally twice a day by the bucket. Colostrum is the first milk for neonatal calves; it is the basis of nutrients and immunoglobulins (Ig) source, and also it consists numerous of biological molecules, like insulin, IGF, and growth hormones (Blum, 2006; Penchev Georgiev, 2008). Colostrum intake in ruminants is one of the most important ways to get maternal antibodies to a calf. An inadequate intake or absorption of colostral Ig has increased risks to the neonatal calves is called as a passive transfer (PT), that predisposes ruminant newborn calves have increased the risk to the development of preweaning depression and death than those with the adequate passive transfer (Weaver *et al.,* 2000). In the preweaning periods, the neonatal calves mortality rate has increased due to the failure of passive transfer, and this death rate is associated with immunoglobulin level <10 mg/mL (Barrington *et al.,* 2002).

The predictive value of immunity transfer is essential subsets for measurements of growth performance in neonates. (Massimini *et al.,* 2006; Massimini *et al.,* 2007). In newborns, plasma Ig plays a significant role of changes in average daily gain (ADG) during the first 6 months (Robinson *et al.,* 1998), in mature milk and fat production, and heifers that survived with FPT had lower milk production during their first lactation (Denise *et al.,* 1989). The passive transfer condition in crossbreed neonatal calves, 24 hour after the birth of neonates was established a considerable variation on ADG and weaning weight due to the FPT on calf death rate (Wittum and Perino, 1995). This PT status in neonatal calves, persistent by estimating plasma Ig level 24 hour after delivery was a significant source for the measurement of neonate's growth performance.

The embryo transfer (ET) technique has been used widely to produce the dairy herd production in the Republic of Korea, by using different dams. However, the calves born from dams of dairy breeds by ET have a weak organization, so it may require a delicate management to raise them. To best of our knowledge, there is no scientific report on the relationship between colostrum and milk on growth rate, immunoglobulin level and metabolite traits in Jersey calves produced by embryo transfer. Therefore the aim present research was to evaluate the efficacy of Holstein dam's colostrum and milk on growth rate, Ig levels and metabolites traits in Jersey neonatal calves produced by embryo transfer: comparison with Holstein neonatal calves.

MATERIALS AND METHODS

Experimental design: A total of 12 calves (6 breed Jersey calves and 6 Holstein calves) used in the current study. The study was conducted during September 2013 and October 2014 at the National Institute of Animal Science, Cheonan, Republic of Korea. All calves were maintained according to the standard guidelines approved by the Animal Testing Ethics Committee of the National Institute of Animal Science (Jeonju, South Korea). The neonatal calves were separated from their dams within 2 hour of birth, weighed, and placed in individual calf pens (1.5 by 2.5 m). Next, the calves were monitored in calf pens bedded with wood shavings for 8 weeks, and calves were fed the colostrum within 30 min after delivery and again within 6 hour. Colostrum and milk were given via bottles until 1 week and, then, accessible in stainless steel buckets. The calves received colostrum for the first 3 days at the rate of 2.4-3.9 L where 10 % BW. After that until weaning at 8 weeks, calves were fed twice daily (09.00 and 17.00 hours) in amounts were 10% of BW. Free-access calf starter was offered in stainless steel buckets during the first week of life. After 1 week, calf starter was supplied twice daily (09.30 and 17.30 hours) after the milk feeding; then, the calves were provided *ad libitum* access to water and grass hay (GH) from feeding buckets in each pen. However, the amount of water and MGH consumed by the calves was not quantitatively measured. Gradual weaning began in 7 weeks, when calves were decreased to one milk feeding (morning only) per day, and all calves were weaned at 8 weeks.

Sampling and analysis: Intake of the calf starter fed to calves was measured by subtracting leftovers from the daily supply and leftovers of calf starter. Calf starter and MGH were sampled for DM and analyzed according to the association of official analytical chemists (AOAC) (Helrich, 1995). The NDF and ADF levels were determined following the method of Van Soest *et al.* (1991). The nutrient profile of calf starter and MGH are presented in Table 1. BW of all neonates were noted every week from birth upto 8 weeks and used to adjust the amount of milk fed daily. The average body daily gain, feed intake and feed efficiency were analyzed for the Jersey and Holstein calves.

Analysis of chemical composition in colostrum and milk: Colostrum and milk samples were collected for the analysis of chemical composition and immunoglobulin concentrations by a LactoScope (MK2; Delta Instruments, the Netherlands). The chemical composition of colostrum and milk are presented in Table 2.

Analysis of biochemical constituents of blood serum: Blood samples were collected using Becton Dickinson Vacutainer CAT Plus REF 367896 (Becton, Dickinson and Co., Franklin Lakes, NJ) via disposable syringes every week (13.00 to 14.00 hours) until day 56. Followed by the blood was centrifuged at 1,763 × g at 4°C for 15 min. After that the serum was isolated and immediately stored at −80°C until further analysis. The serum glucose, total protein, blood urea nitrogen (BUN), triglycerides, and NEFA levels were analyzed by auto analyzer.

Quantitative analysis of immunoglobulins in serum and milk: Serum and milk IgA, IgG, and IgM concentrations were determined by the Quantitative Bovine IgG ELISA kit (Bethyl Laboratories Inc., Montgomery, TX). Add 1 μL of Ab and 100 μL of bicarbonate buffer in each well of the plate, then the plate was kept 1 hour at room temperature, wells were aspirated and washed with the washing solution 3 times. Followed by, 200 μL of post-coat solution was added to each well and then again the plate was incubated for 30 min at 37 °C. after that 100 μL of each sample were added into the plates and then the plate was incubated at room temperature for 1 hr, then the plate was rinsed 5 times using rinse solution. Followed by, the HRP Conjugate was poured into each well. The plate was incubated for 1 hr in the dark room and washed 5 times. One hundred microliters of enzyme substrate solution was added to each well and incubated for 10 to 12 min in the dark; after that, the reaction was stopped by adding 100 μL of 2 M H_2SO_4 to each well. Absorbance was noted at optical density 450 nm on a microplate reader. The level of IgG was deduced from the 4-parameter logistic curve fit created from the standards. Standards were done as manufacturer instructions.

Statistical Analysis: Each laboratory measurement was carried out in replicate. Statistical differences were performed using with SPSS version 17.0 software (2008). Data were presented as means ± standard error of the mean. Each experiment mean differences in feed consumption, feed efficiency, BW gain, immunoglobulin level, and metabolic traits data were evaluated by Student's t-test ($P < 0.05$).

RESULTS AND DISCUSSION

Chemical composition and immunoglobulins status of colostrum and whole milk: The chemical composition and immunoglobulin levels of colostrum and milk are represented in Table 2. The contents of fat (7.90, 4.96, 4.52%), total protein (14.04, 6.44, 4.11%), lactose (3.15, 4.18, 4.49%), total solids (25.63, 16.01, 13.83%), free fatty acid (1.08, 0.63, 0.58%), citrate (1.84, 2.38, 2.31%) and milk urea nitrogen (5.06, 5.95, 8.34%) were decreased gradually in a day 1, 2 and 3 colostrum respectively. Total milk consists of 4.38% fat, 3.12% protein, 4.71% lactose, 12.94% total solid, 0.76% FFA, 2.79% citrate and 11.56% MUN. Indeed, the concentration of IgG, M and A in a first day colostrum was 88.53, 5.42, 2.23 mg/mL, second day colostrum was

41.71, 2.63, 1.14 mg/mL, third day colostrum was 15.20, 1.02, 0.40 mg/mL, total milk 9.13, 0.54, 0.26 mg/mL respectively, it shown decreased (P<0.05) concentration with increasing days of lactation. We performed to investigate the effects of Holstein dam's colostrum and milk on consumption, feed efficiency, growth rate, immunoglobulin level, and associated metabolic traits in Jersey neonatal calves produced by embryo transfer compared with Holstein neonatal calves. These studies of the chemical composition of colostrum and milk could be a logical starting point to understanding the nutrient requirements of the neonatal calves because the biological function of colostrum and milk is to provide nutrition and immunity to the neonatal calves (Jenness, 1985). According to Monika et al. (2013) the first milk colostrum of the Jersey cows had the higher content of total protein and fat (17.50 and 6.46%) than that of Holstein-Friesian cows (13.87 and 5.70%). The results of the current study showed that the total protein and fat content was relatively higher in colostrum and lower in normal milk of Holstein dams, as compared with the results of the study by Monika *et al.* (2013).

Colostrum provides antimicrobial peptides and, in particular, immunoglobulins for the neonatal calves. In bovine colostrum and milk IgG, IgA and IgM are the major immunoglobulins classes (Gapper *et al.,* 2007; Hurley and Theil, 2011). In the transition from colostrum to regular milk, the concentrations of these 3 categories of immunoglobulins decrease sharply during the first 3 days after calving, so, this study results agreed with similar to previous data (Oyeniyi and Hunter, 1978; Guidry *et al.,* 1980). A few of studies indicated that the breeds might be differing in immunoglobulin levels of colostrum, regular milk, and calves serum (Murphy *et al.,* 2005). Adequate colostrum quality has been defined as IgG concentrations over >50 g/L and a total plate count <100,000 cfu/mL and is associated with enhanced calf health (Weaver *et al.,* 2000; Morrill *et al.,* 2012). Newstead (1976) reported 0.32 and 0.46 g/L immunoglobulin in the colostrum of Jersey and Holstein dams, respectively. However, Muller and Ellinger (1981) reported that Jersey cows had 1.6 times more immunoglobulin than Holstein (9.04% for Jersey and 5.59% for Holstein) cows, although the concentrations of 3 major immunoglobulins, IgG, IgM, and IgA, decreased with each successive postpartum milking. In our study, calves had 88.53 ± 40.13 mg/mL IgG at parturition, which is within the range of Weaver et al. (2000). Numerous research reports advised the intake of 4 L of colostrum in the first 12 hours after delivery for adequate passive immunity transfer (Stott *et al.,* 1979; Morin *et al.,* 1997; Gomes, *et al.,* 2011).

The consumption of whole milk and calf starter of Jersey calves produced by embryo transfer and Holstein calves: The consumption of whole milk and calf starter of Jersey and Holstein calves during preweaning periods (8 weeks) are given in Table 3. Weekly mean consumption of whole milk of Jersey and Holstein neonatal calves was showed no statistically significant difference between them (P < 0.05). Although, weekly mean intake of calf starter of Jersey and Holstein calves was showed significant difference during 2nd week (20.38 vs. 61.56 g/d), 3rd-4th week (134.33 vs. 172.91 g/d), 5th to 7th week (458.10 vs. 503.97 g/d) and 8th week (847.62 vs. 903.97 g/d) respectively. The controlled milk feeding to calves decreased their growth performance, health, and behavior because of inadequate nutrient supply (Jasper and Weary, 2002; Huzzy *et al.,* 2005; Khan *et al.,* 2007). Moreover, the higher quantity of milk to neonates found delayed ruminal fermentation process and development by depressing solid feed consumption such as a starter diet. Solid feed consumption plays a significant role in health development of rumen to ferment the organic matter (OM) and to absorb its end products (Jasper and Weary, 2002; Baldwin *et al.,* 2004; Lee *et al.,* 2008). Therefore, this study was conducted using traditional calf feeding management. The liquid portion of the calves' diet was supplied to encourage the intake of calf starter, as calves were fed whole milk daily at approximately 10% of their BW measured each week until 4 weeks after birth. The starter intake of all breed calves increased rapidly after 29 days of age because insufficient milk was offered. The starter intake of Jersey calves was 88.90% of that of Holstein calves through the preweaning period.

The effects of colostrum and whole milk on BW, ADG and feed efficiency of Jersey calves produced by embryo transfer and Holstein calves: Body weight, ADG, feed efficiency of Jersey and Holstein neonates of each at birth, 7, 14, 21, 28, 35, 42, 49 and 56 day are given in Table 4. The BW of Jersey calves were increased by 25.40 kg, from 24.00 kg at birth to 49.40 kg at 8 weeks after birth, and that of Holstein calves increased by 29.8 kg, from 39.33 kg at birth to 69.13 kg at 8 weeks after birth. Jersey calves showed a lack of BW gain from birth to 14 day but steadily began to increase after 3 weeks than those compared with Holstein calves. The ADG of Jersey calves was 480 g during 8 weeks, which was quite lower than the 530 g ADG of Holstein calves. During the preweaning periods, feed efficiency was higher in Jersey calves (1.48) as compared with Holstein calves (1.33). During the preweaning periods, the greater BW at Holstein calves fed with Holstein dam's colostrum and milk compared with those fed to Jersey calves produced by embryo transfer, may be attributed to better bioavailability (digestion and utilization) of nutrients in Holstein calves than Jersey calves. The ADG of Jersey calves during preweaning was significantly lower than Holstein calves. The feeding efficiency of neonates is relatively higher in the first week than older calves; this may be due to the proteins absorption sensitivity during preweaning periods of calves' life. Our study results are supported with who have reported that during the preweaning periods, the ADG of Holstein was greater than Jersey calves when treated with higher and lower planes with MR (Ballou, 2012). Stanley *et al.* (2002) also documented that the ADG of Holstein was greater than Jersey calves weaned at 6 wk of age when fed MR twice daily.

The effects of colostrum and whole milk on immunoglobulins status of Jersey calves produced by embryo transfer and Holstein calves: The concentrations of all Ig subclasses of Jersey and Holstein neonatal calves during preweaning periods are represented in Table 5. The current study results showed that the IgG concentration was highest (23.79 mg/mL) at birth and lowest (18.58 mg/mL) at 56 day of Jersey calves produced by embryo transfer than those compared with Holstein calves (26.27 and 19.62 mg/mL). However, the concentration of IgM and IgA was at almost the same level in Jersey and Holstein calves of each group at birth, 7, 14, 21, 28, 35, 42, 49 and 56 day. Feeding colostrum to neonates ensure sufficient adequate transfer of immunity. However, dairies that well manage the quality of colostrum may, at times, experience a shortage of first-milking colostrum. The fundamental objective was to evaluate the effect of colostrum and milk during the preweaning periods on passive transfer of immunity and blood metabolites levels in Jersey and Holstein calves. We found no significant difference of maternal IgG between the Jersey and Holstein calves, but we noted the decreased the levels of IgG from birth to 56 day within the same group. Serum IgG levels of Jersey calves in this study (21.79 mg/mL) were similar to those reported by Quigley *et al.* (1995). This indicated that serum IgG was 24.4 mg/mL at 24 h for Jersey calves fed colostrum by nipple-bottle and housed in a barn, similar feeding conditions that were similar to those in this study. However, Jones *et al.* (2004) reported decreased values of plasma IgG, 9.90 and 16.75 g/L for female Holstein and Jersey calves, respectively, at 24 hour of age. Previous studies reported that plasma IgG was higher for Jersey calves than for Holstein calves, suggesting differences in IgG absorption between breeds, body size, and plasma level (Quigley *et al.,* 1998; Jones *et al.,* 2004). Although on single day IgG concentrations were not significantly different between Jersey and Holstein calves, mean levels were slightly but significantly lower in Jersey than Holstein. Differences in previous research may result from milk being delivered from another breed of dam, as Jersey calves fed the milk of Holstein dams received a greater volume of liquid than those fed the milk of Jersey dams or milk replacer. Plasma IgM concentrations of Jersey calves were similar to those of Holstein calves, however, and were lower than the values (2.6 to 3.5 mg/mL) reported by Quigley *et al.* (1995). Also, plasma IgA concentrations were similar between Jersey and Holstein calves; however, for Holstein calves, plasma IgA levels were lower than those (0.09 to 0.22 mg/mL) reported by Khan *et al.* (2007).

Table 1. Chemical composition of calf starter (CS) and mixed grass hay (MGH) on a DM basis

Composition (%)	CS	MGH[1]
DM	90.10 ± 2.76	89.44 ± 2.63
CP	21.39 ± 0.74	9.14 ± 1.88
EE[2]	3.85 ± 0.20	2.19 ± 0.76
CF	7.40 ± 0.39	32.74 ± 1.28
NDF	26.07 ± 4.10	62.83 ± 6.18
ADF	12.76 ± 1.25	36.12 ± 4.20
Ash	6.92 ± 0.30	7.09 ± 1.08
TDN[3]	76.51 ± 3.22	37.57 ± 3.72

[1]Mixed grass hay comprised 50% orchard grass and 50% tall fescue grass.
[2]EE = ether extract.
[3]Total digestible nutrients (%) = tdNFC + tdCP + (tdFA × 2.25) + tdNDF − 7 (NRC, 2001).

The effects of colostrum and whole milk on biochemical constituent's status of Jersey calves produced by embryo transfer and Holstein calves: No significant differences were observed in the levels of blood metabolites including total protein, glucose, etc., between Jersey and Holstein calves during preweaning periods. However, plasma glucose and BUN concentrations in Jersey calves showed decreased (76.50 vs. 10.40 mg/dL) as compared with Holstein calves (100.8 mg/mL; 10.30 mg/dL) as numerically at birth to 56 day of preweaning periods. Also, we noted the numerically decreased level of NEFA in Jersey calves (62.68 μEq/L) than those compared with Holstein calves (95.8 μEq/L) of each group at the preweaning period (Table 6). All calves had 5.87 to 7.98 g/dL total plasma protein concentration, although no significant differences were observed between Jersey and Holstein calves. As reported by Tyler et al. (1996), the overall mean total plasma protein during the preweaning period was higher for Jersey calves compared with Holstein calves. Our study result agreed with Ballou (2012) which reported that total protein of Jersey calves was greater than that of Holstein calves, due to the absorption efficiency of IgG than Holstein calves, and the colostrum of Jerseys contains a higher IgG concentration than the colostrum of Holsteins. Glucose and urea nitrogen levels in the plasma of Jersey calves were significantly lower than those in the plasma of Holstein calves; due to the low concentration of leucocytes primarily consume glucose and glutamine as an energy source; therefore, Holstein calves showed the greater level of glucose than Jersey calves. The result of the current study was supported by Lee et al. (2008). Plasma NEFA concentrations were significantly greater in Jersey calves than in Holstein calves, and this agrees with which was reported by Stanley *et al.* (2002). Webb *et al.* (1969) reported that NEFA is organized to maintain the homeostasis.

Table 2. Chemical composition and immunoglobulin levels of colostrum and milk

Composition	Colostrum[1]			Whole milk[2]
	Day 1	Day 2	Day 3	Whole milk
Composition				
Fat, %	7.90 ± 1.64	4.96 ± 1.08	4.52 ± 1.03	4.38 ± 1.04
Protein, %	14.04 ± 6.17	6.44 ± 3.64	4.11 ± 1.12	3.12 ± 0.40
Lactose, %	3.15 ± 0.68	4.18 ± 0.63	4.49 ± 0.40	4.71 ± 0.23
TS, %	25.63 ± 6.40	16.01 ± 3.79	13.83 ± 1.57	12.94 ± 1.24
FFA, mEq/dL	1.08 ± 0.99	0.63 ± 0.77	0.58 ± 0.53	0.76 ± 0.33
Citrate, mg/L	1.84 ± 1.06	2.38 ± 0.37	2.31 ± .75	2.79 ± 0.32
MUN, mg/dL	5.06 ± 6.21	5.95 ± 5.48	8.34 ± 4.10	11.56 ± 2.74
Immunoglobulins (mg/mL)				
IgG	88.53 ± 40.13	41.71 ± 21.58	15.20 ± 4..95	8.55 ±1.34
IgM	5.42 ± 2.52	2.63 ± 1.30	1.02 ± 0.46	0.77 ± 0.28
IgA	2.23 ± 0.86	1.14 ± 0.70	0.40 ± 0.19	0.35 ± 0.12

[1]Each day, morning and afternoon/evening colostrum samples were composited for analysis from Holstein dams (*n* = 12).
[2]Milk storage tank samples fed to calves of Jersey and Holstein.

Table 3. Average daily intake of milk and calf starter of Jersey calves produced by embryo transfer and Holstein calves

Parameter	Jersey (*n* = 6)	Holstein (*n* = 6)	SEM	*P*-value
	Milk intake, kg/d, as fed			
Day 0–1	2.40 ± 0.23	3.93 ± 0.41	0.84	0.00
Day 2–28	3.04 ± 0.40	4.79 ± 0.37	0.95	0.00
Day 29–56	4.00 ± 0.00	4.00 ± 0.00	0.00	0.00
	Calf starter intake, g/d DM			
Day 8–14	20.38	61.56	42.01	0.00
Day 15–28	134.33	172.91	88.83	0.01
Day 29–49	458.10	503.97	188.86	0.05
Day 50–56	847.62	903.97	80.63	0.00
Total intake (d 8–56), kg	17.58	19.74	2.16	0.10
Starter intake, % of BW	35.75	28.55	5.34	0.16

Table 4. Body weight, ADG, and feed efficiency of Jersey calves produced by embryo transfer and Holstein calves

Parameter	Jersey (*n* = 6)		Holstein (*n* = 6)		*P*-value	
	BW (kg)	ADG (kg/d)	BW (kg)	ADG (kg/d)	BW	ADG
Day of age						
1	24.00 ± 2.31	0.00 ± 0.00	39.33 ± 4.07	0.00 ± 0.00	0.00	0.00
7	27.33 ± 3.02	0.48 ± 0.18	43.72 ± 2.46	0.63 ± 0.42	0.00	0.48
14	29.27 ± 3.16	0.28 ± 0.27	46.18 ± 2.94	0.35 ± 0.37	0.00	0.72
21	31.43 ± 3.62	0.31 ± 0.34	48.72 ± 2.17	0.36 ± 0.23	0.00	0.78
28	33.75 ± 2.90	0.33 ± 0.24	51.45 ± 1.62	0.39 ± 0.15	0.00	0.65
35	37.23 ± 2.36	0.50 ± 0.25	55.28 ± 2.90	0.55 ± 0.25	0.00	0.76
42	40.97 ± 2.59	0.53 ± 0.27	60.55 ± 2.26	0.75 ± 0.25	0.00	0.21
49	46.03 ± 2.74	0.72 ± 0.25	65.45 ± 2.10	0.70 ± 0.32	0.00	0.90
56	49.40 ± 2.13	0.48 ± 0.13	69.13 ± 2.29	0.53 ± 0.15	0.00	0.63
ADG (kg/d)						
0–7	0.48 ± 0.18		0.63 ± 0.42		0.48	
0–14	0.38 ± 0.14		0.49 ± 0.24		0.39	
0–21	0.35 ± 0.16		0.45 ± 0.17		0.39	

0–28	0.35 ± 0.13	0.43 ± 0.11	0.39
0–35	0.38 ± 0.10	0.46 ± 0.07	0.20
0–42	0.40 ± 0.10	0.51 ± 0.05	0.08
0–49	0.45 ± 0.06	0.53 ± 0.05	0.06
0–56	0.45 ± 0.06	0.53 ± 0.04	0.03
Feed efficiency	1.48 ± 0.32	1.33 ± 0.09	0.78

Table 5. Immunoglobulins status of Jersey calves produced by embryo transfer and Holstein calves

Parameter,	Jersey	Holstein	SEM	*P*-value
Day of age				
IgG, mg/mL				
1	23.79	26.27	2.30	0.07
7	22.18	25.66	2.56	0.02
14	21.40	24.24	2.35	0.03
28	20.19	23.68	2.41	0.00
42	19.38	21.09	3.53	0.51
56	18.58	19.62	0.83	0.31
Mean	21.11	23.77	2.93	0.00
IgM, mg/mL				
1	1.09	1.08	0.10	0.84
7	1.02	1.06	0.11	0.63
14	0.99	1.04	0.08	0.32
28	0.98	1.00	0.09	0.72
42	0.92	0.97	0.08	0.72
56	0.80	0.83	0.02	0.10
Mean	0.97	1.01	0.12	0.18
IgA, mg/mL				
1	0.15	0.15	0.02	0.91
7	0.14	0.14	0.02	0.99
14	0.14	0.14	0.02	0.82
28	0.13	0.13	0.01	0.63
42	0.11	0.12	0.01	0.04
56	0.10	0.11	0.01	0.09
Mean	0.13	0.14	0.02	0.48

Table 6. Biochemical constituents status of Jersey calves produced by embryo transfer and Holstein calves

Parameter,	Jersey	Holstein	SEM	*P*-value
Day of age				
Total protein, g/dL				
1	7.60	6.82	0.96	0.31
7	6.90	7.98	1.06	0.09
14	5.87	7.78	2.14	0.20
28	7.03	7.65	0.76	0.25
42	7.52	7.49	1.77	0.98
56	6.32	6.87	1.62	0.66
Mean	6.89	7.50	1.51	0.12
Glucose, mg/dL				
1	76.00	155.70	40.37	0.00
7	112.80	117.30	20.66	0.79
14	59.70	95.50	25.73	0.03
28	76.70	79.00	18.05	0.86
42	73.60	86.30	16.01	0.29
56	56.60	76.80	21.34	0.20
Mean	76.50	100.80	31.45	0.00

Urea nitrogen, mg/dL				
1	10.20	9.80	1.65	0.81
7	10.60	8.70	3.57	0.20
14	11.60	9.00	3.79	0.33
28	9.30	10.80	2.48	0.42
42	9.00	12.50	2.96	0.14
56	9.30	12.20	2.72	0.50
Mean	10.00	10.30	3.03	0.76
NEFA, μEq/L				
1	112.00	67.7	28.54	0.35
7	99.50	72.7	32.57	0.40
14	52.70	70.00	15.76	0.10
28	58.50	62.80	32.86	0.15
42	35.83	72.00	19.42	0.09
56	44.50	35.00	15.38	0.20
Mean	75.50	63.36	61.15	0.04

Conclusion: The present research showed that the chemical composition and immunoglobulin level of Holstein dams' milk significantly decreased with increasing age after birth and that the Jersey calves showed significantly lower BW at 8 weeks of age compared with Holstein calves. However, we found increased levels of feed efficiency in Jersey calves compared with Holstein calves. Indeed, feeding Holstein dams' milk did not alter the plasma protein, and showed significantly decreased a level of glucose, BUN, and increased level of NEFA in Jersey calves. Hence, these results suggest that feeding Holstein dams' milk will not negatively affect the growth performance and immunity response and blood metabolites traits of Jersey calves produced by embryo transfer.

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