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EFFECT OF WEANING METHODS ON GROWTH, FEED EFFICIENCY AND SOME BEHAVIOURAL TRAITS OF BROWN SWISS CALVES

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ABSTRACT

Twenty four Brown Swiss calves were assigned randomly at birth to treatments that evaluated the method of weaning on growth, feed intake, feed efficiency ratio as well as some behavioural traits such as percentage time spent for lying, standing, eating and drinking water. The two experimental treatments were 1) whole milk fed at 8 % of birth weight until abrupt weaning at 49 d of age (AW), 2) whole milk fed at 8% of birth weight until 35 d of age then at 4 % of birth weight until weaning at 49 d of age (GW). Commercial calf starter and dried hay were offered from 4 d of age. Body weights at weaning and 4 months of age were unaffected by the weaning methods. However, body weight gain in the postweaning period was influenced significantly ($P<0.05$) by the weaning methods and calves in GW group had higher daily weight gain than these in AW group. In the preweaning period, total feed and milk intake of the calves in AW group were significantly ($P<0.05$) greater than those in GW group. In the postweaning period, feed efficiency ratio of the gradually weaned calves was better ($P<0.01$) than these of calves in AW group. Percentage of time spent for eating feed and drinking water by the calves in GW group were higher ($P<0.05$) than those in AW group. Overall results of the study suggested that GW method is more appropriate than AW procedure for Brown Swiss calves.

Key words: Brown Swiss, calves, growth, weaning, behavioural traits.

INTRODUCTION

In dairy cattle production, calves must be weaned at some point through a practice that typically involves both a transition from a milk-based diet to solid food and separation from the dam. These alterations in ration, environment and social relationships are often stressful for the young animals and adverse physiological changes (declining of the growth rate, decreased feed intake, and gastrointestinal dysfunction) and behavioural responses (including increased activity and vocalizations) could be shown (Jasper *et al*. 2008; Sweeney *et al*. 2010). Thus weaning can have significant influence on both production and welfare of the dairy calves.

A new calf feeding scheme was suggested by Yanar *et al.* (1994) and this milk feeding program has been developed based upon results of the series of research projects (Yanar *et al.* 1997; Yanar *et al.* 2002; Bayram *et al.* 2007; Ugur *et al.* 2008; Kartal *et al*. 2011). Under natural conditions, the weaning process normally involves a gradual reduction in milk intake, accompanied by increasing social independence from the dam and increasing intake of solid feed. In contrast to weaning in nature, dairy calves in this milk feeding program are weaned abruptly.

In recent years, a number of studies were focused on investigation of effects of the weaning methods on growth, feed intake and behaviour of Holstein Friesian, Danish Red, Jersey calves (Jensen, 2006; Khan *et al*. 2007; Nielsen *et al*. 2008; Sweeney *et al.* 2010; Passille *et al*. 2010). However, there is lack of study investigating effects of the weaning methods on the growth performance of Brown Swiss calves reared under the new calf rearing program. Therefore, the present study was undertaken to compare growth and behavioural responses to gradual weaning (GW) and abrupt weaning (AW) of Brown Swiss calves reared eastern region of Turkey.

MATERIALS AND METHODS

A total of 24 Brown Swiss calves (10 male and 14 female) from the cattle herd of the Research Farm of the Agricultural College of Atatürk University, Erzurum, Turkey were used in the study. The calves were separated from their dams at fourth day of postpartum after they received colostrum from their dams for 3 days. Then, they were allocated randomly into the two different groups of weaning methods namely abrupt weaning (AW) and gradual weaning (GW). There were 5 male and 7 female calves in the AW group, while 5 male and 7 female calves were allocated in GW treatment group. Calves in AW group were offered whole milk at the rate of 8 % of birth weight as recommended by Yanar *et al.* (2002) and the quantity of the milk was kept constant during the milk feeding period (Ugur *et al.* 2008). The

calves were abruptly weaned at 49 d of age. Animals in second group (GW) were fed whole milk at the rate of 8 % of birth weight to 35 d of age and then offered milk at the rate of 4 % of birth weight until weaning at 49 d of age. Water was supplied by a water bucket in the calf pens during the trial.

Chemical composition of calf starter and dried hay are presented in Table 1. While calves had ad libitum access to dried hay, the amount of the calf starter was limited maximum of 2 kg per day. Starter and dried hay intakes by each calf were measured daily by subtracting amount of starter and dried hay remained in the feeders from quantities of starter and dried hay given for each animal.

Calves were housed in individual pens (1.35 x 1.1 m; bedded with long wheat straw). All calves were fed whole milk kept in a milk tank at 4 °C after milking. The temperature of milk in steel buckets was raised to 36 to 37 °C using a water bath before feeding the calves. Milk was offered to the calves using plastic bottles fitted with soft rubber nipples. A steel bottle stand was attached at front side of the pens at 65 cm above the floor. At each feeding, a milk bottle was fitted into the stand and was removed after feeding.

The weights and body measurements (body length, height at withers, chest depth, heart girth and foreshank circumference) were determined and recorded at birth, weaning and 4 months of age. Behavioural measures were collected by using instantaneous sampling method as described by Martin and Bateson (1993). In this method, behaviour of a calf was determined and recorded once a week by walking through the calf barn, at a distance from the pen at least 2.1 m, every 15 min from 9.00 until 12.00 h. The behaviour was recorded for each of the following activities by a method used by Kartal and Yanar (2011) in which 1: eating (calf's head was in feed bucket), 2: drinking water (calf's head in water bucket), 3: lying (calf's body contacted bedding and ground), 4: standing (calf was inactive in upright position). Percentage time spent in each activity was calculated for pre- and postweaning stages of the growth.

Data were statistically analysed by using the GLM procedure of SPSS program (SPSS, 2004). A general model with fixed effects of weaning methods, sex and their interaction with each other was used to identify the main sources of variation for studied traits in preliminary statistical analysis. The interaction was excluded from final model since the effect of the interaction on the traits studied was not statistically significant. The statistical model was following as;

$Y_{ijk}=\mu + a_i + b_j + e_{ijk}$

Where;

Y_{ijk} = The measurement of a particular traits,

μ = The population mean,

a_i = effects of weaning methods [i = 1 (AW), 2 (GW)],

b_j = effects of sex [j = 1 (male), 2 (female)],

e_{ijk} = random error with a mean of zero and variance σ^2_e.

The Duncan method was applied for comparison of subclass means when F-tests for main effects were significant.

RESULTS AND DISCUSSION

Least square means with standard errors for weights obtained at birth, weaning and 4 months of age are presented in Table 2. The birth weight of the calves assigned for different treatment groups were not significant since the calves use in this research were randomly distributed to these treatment groups. The average birth weight of Brown Swiss calves in the present study was in accordance with finding of Guler *et al*. (2006) but lower than results of Yanar *et al*. (2000) and Kaygisiz *et al.* (2011). Weaning weight of the calves in this study was not significantly affected by the weaning methods and sex of the calves (Table 2). The average weaning weight of the Brown Swiss calves were close to result of a study in which Brown Swiss calves were weaned abruptly at 7 weeks of age (Yanar *et al.*, 1994). Calves fed milk through the GW procedure attained 94.90 kg of body weight compared with 87.17 kg for AW calves at 4 months of age. Although there was a numerical difference between the treatment groups, it was not statistically different (Table 2). Similarly, Quigley (1996) reported that body weights at 56 d of age of female Jersey calves weaned abruptly or gradually weaned did not differed significantly. However, Khan *et al*. (2007) indicated that the calves weaned gradually had higher body weight at 90 d of age than those weaned conventionally. The average body weight at 4 months of age in this study was higher than finding of Bayram *et al.* (2007).

Least square means with standard errors for weight gains of Brown Swiss calves are presented in Table 2. Calves in GW group gained 21.0 and 20.6 % more weight ($P<0.05$) than those in AW group between weaning and 4 months of age and between birth and 4 months of age respectively. Similarly, Khan *et al.* (2007) also reported that Holstein Friesian calves weaned gradually had higher ($P<0.05$) body weight gains during preweaning and postweaning periods compared with those weaned conventionally. However, Quigley (1996) noted that average weight gains of age of Jersey calves from 1 to 8 weeks of age were not significantly affected by the weaning methods, although the calves on treatment GW had numerically higher weight gain than those on treatment AW. The influence of the sex of calves on the weight gain during preweaning and postweaning periods were not statistically significant. The result is in accordance with findings of Yanar *et al.* (1997), Ugur *et al.* (2004) and Ugur *et al*. (2008).

As an indicator of the bone thickness, gains in foreshank circumference of the calves in GW group was

significantly higher (P<0.01) than that of abruptly weaned calves. Other gains in body measurements such as height at withers, body length, chest depth and heart girth between birth and 4 months of age were not influenced by the weaning methods and sex of the calves (Table 2).

Least square means with standard errors for dry feed intake throughout preweaning and postweaning periods are presented in Table 3. In the preweaning period, milk and total feed intake as dry matter were significantly affected by the weaning methods, and abruptly weaned calves consumed higher amounts of milk and total feed dry matter than those weaned gradually. The results are consistent with findings of Nielsen *et al*. (2008) and Sweeney *et al.* (2010) who indicated that the reduction in milk intake associated with gradual weaning decreased total digestible energy intake, showing that calves did not consumed sufficient starter to compensate for the loss of energy from the milk. In the postweaning period of the present study, although quantities of hay and concentrate consumed by the calves in AW group was higher than those in GW group, the differences were not statistically significant (Table 3).

Amounts of dry matter of concentrate, hay, milk and total feed consumed per kg live weight gain in a period between birth and weaning were not significantly influenced by GW and AW procedures (Table 3). The result was supported by findings of Quigley (1996). However, the feed efficiency ratios calculated for concentrate, hay and total feed during the postweaning period were better (P<0.01) for calves in GW group than for those in AW group. The result was in agreement with finding of Quigley (1996).

There were no significant differences in the percentage of time spend for lying and standing between two weaning methods. However, Brown Swiss calves in GW group were eating feed and drinking water for a higher percentage of observation (P<0.01) compared with those in AW group in pre- and post- weaning periods (Table 4). However, Nielsen *et al*. (2008) reported that total duration of the feeder occupancy was not significantly affected by weaning method.

Table 1. Chemical compositions of starter and dried hay used in this study

Nutrients (%)	Starter	Dried Hay
Dry Matter	92.5	94.1
Protein	18.1	6.0
Ether Extract	2.2	1.4
Ash	7.8	7.3
Cellulose	6.6	32.6

Table 2. Least squares means with standard errors for weights, weight gains and gains in body measurements

	Weaning Methods					Sex				
	Abruptly		Gradually			Male		Female		
	$\overline{X}$	$\pm S_{\overline{x}}$	$\overline{X}$	$\pm S_{\overline{x}}$	S	$\overline{X}$	$\pm S_{\overline{x}}$	$\overline{X}$	$\pm S_{\overline{x}}$	S
Weights (kg) at;										
Birth	36.25	1.57	36.99	1.62	NS	37.07	1.74	36.16	1.46	NS
Weaning	46.50	1.73	46.22	1.78	NS	45.77	1.91	46.95	1.61	NS
4 Months of Age	87.17	3.77	94.90	3.88	NS	89.97	4.17	92.09	3.51	NS
Daily Weight Gains (kg) Between;										
Birth and Weaning	0.21	0.02	0.19	0.02	NS	0.18	0.03	0.22	0.02	NS
Weaning and 4 Months of Age	0.57	0.04	0.69	0.04	*	0.62	0.04	0.64	0.03	NS
Birth and 4 months of age	0.34	0.02	0.41	0.02	*	0.37	0.02	0.38	0.02	NS
Gains in Body Measurements (cm) Between Birth and 4 Months of Age for;										
Body Length	19.67	1.58	21.35	1.63	NS	19.67	1.75	21.34	1.47	NS
Height at Withers	14.17	1.37	13.80	1.41	NS	13.26	1.52	14.70	1.28	NS
Chest Depth	8.04	1.05	7.99	1.08	NS	7.59	1.16	8.43	0.98	NS
Heart Girth	24.38	1.61	26.69	1.65	NS	24.98	1.77	26.08	1.50	NS
Foreshank Circumference	1.50	0.14	2.13	0.15	**	1.81	0.16	1.81	0.13	NS

** : P<0.01, NS: Non-Significant, S:Significance

Table 3. Least squares means with standard errors for dry feed intake and feed efficiency ratios of calves

	Weaning Methods					Sex				
	Abruptly		Gradually			Male		Female		
	$\overline{X}$	± $S_{\overline{x}}$	$\overline{X}$	± $S_{\overline{x}}$	S	$\overline{X}$	± $S_{\overline{x}}$	$\overline{X}$	± $S_{\overline{x}}$	S
Dry Feed Intake (kg) between Birth and Weaning for;										
Milk	16.96	0.67	14.91	0.69	*	16.10	0.74	15.77	0.62	NS
Hay	2.84	0.19	2.39	0.20	NS	2.58	0.21	2.65	0.18	NS
Concentrate	11.78	0.80	11.35	0.82	NS	9.63	0.88	13.50	0.75	**
Total Feed	31.58	0.99	28.65	1.02	*	28.31	1.09	31.91	0.92	*
Dry Feed Intake (kg) Between Weaning and 4 Months Period for;										
Hay	32.07	2.58	25.88	2.65	NS	30.90	2.85	27.04	2.40	NS
Concentrate	107.70	7.50	108.21	7.72	NS	102.57	8.29	113.34	6.99	NS
Total Feed	139.77	8.39	134.09	8.63	NS	133.47	9.27	140.38	7.81	NS
Dry Feed Intake (kg) Between Birth and 4 Months Period for;										
Hay	34.91	2.69	28.27	2.76	NS	33.48	2.97	29.69	2.50	NS
Concentrate	119.48	7.98	119.56	8.21	NS	112.20	8.81	126.84	7.43	NS
Total Feed	171.35	9.21	162.73	9.47	NS	161.78	10.17	172.30	8.58	NS
Feed Efficiency Ratio[1] Between;										
Birth and Weaning	5.40	1.50	3.91	1.54	NS	5.99	1.66	3.32	1.40	NS
Weaning and 4 Months of Age	3.53	0.16	2.75	0.17	**	3.06	0.18	3.23	0.15	NS
Birth and 4 Months of Age	3.46	0.15	2.83	0.15	**	3.12	0.16	3.16	0.14	NS

[1] Feed efficiency ratio: kg of body weight gain / kg of dry feed intake, * : P<0.05, ** : P<0.01,
NS: Non-Significant, S: Significance

Table 4. Least squares means with standard errors for some behavioural traits of Brown Swiss calves

Behaviours (% of observation)	Weaning Methods					Sex				
	Abruptly		Gradually			Male		Female		
	$\overline{X}$	± $S_{\overline{x}}$	$\overline{X}$	± $S_{\overline{x}}$	S	$\overline{X}$	± $S_{\overline{x}}$	$\overline{X}$	± $S_{\overline{x}}$	S
In Preweaning Period;										
Lying	43.3	2.1	36. 7	2.8	NS	37.4	2.6	42.6	2.2	NS
Standing	39.0	1.4	39.1	1.9	NS	42.6	1.8	35.5	1.5	**
Eating	17.0	1.5	22.2	2.0	*	18.7	1.9	20.5	1.6	NS
Drinking Water	0.5	0.4	2.0	0.5	*	1.4	0.5	1.2	0.4	NS
In Postweaning Period;										
Lying	34.8	5.0	19.8	6.6	NS	28.9	6.2	25.6	5.3	NS
Standing	31.3	3.7	28.2	4.9	NS	25.8	4.6	33.6	3.9	NS
Eating	32.7	4.0	46.9	5.3	*	42.1	5.0	37.5	4.3	NS
Drinking Water	1.4	0.5	5.2	0.6	**	3.4	0.6	3.1	0.5	NS

* : P<0.05, ** : P<0.01, NS: Non-Significant, S: Significance

Conclusion: Based upon growth, feed efficiency ratio and behavioural parameters investigated in the present study, it could be suggested that milk feeding program with GW is more appropriate than these with AW for Brown Swiss calves.

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