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GROWTH AND SURVIVAL PARAMETERS AND BLOOD IgG AND TOTAL PROTEIN LEVELS OF CALVES BORN IN THE FIRST PRODUCTION YEAR OF BROWN SWISS AND SIMMENTAL COWS

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ABSTRACT

The objectives of this study were to determine the growth and survival parameters and blood IgG and total protein levels of calves born in the first production year of Brown Swiss and Simmental cows imported from Austria to a newly-established dairy cattle enterprise in Manisa, Turkey. The study material consisted of 62 Brown Swiss and 266 Simmental calves. Calves were separated from their mothers after birth and put into individual sections and subjected to colostrum feeding. At the end of three days, calf grower feed was given. Calves were weaned around 60-days of age unless there was an abnormality with their development. Birth weights, weaning weights on the 65th day, and daily weight gains of calves were 40.31 kg and 41.76 kg, 77.16 kg and 83.9 kg, 0.56 kg and 0.64 kg for Brown Swiss and Simmental breeds respectively. Simmental calves were born heavier and had more weight gain until weaning. We determined that breed and sex affected calves' growth while delivery method only affected birth weight. Calves with high birth weights caused difficult birth, but this effect disappeared until weaning. Survival rates of calves until weaning were 98.39% for Brown Swiss and 95.49% for Simmental. The survival and mortality rates of Brown Swiss and Simmental calves at weaning were at normal levels, while the calves with difficult birth had losses around 10%.

Contribution/Originality: This study is one of the very few studies which have investigated the performance and adaptation levels of imported breeds in Turkey. It contributes in the existing literature by producing information on the growth, survival, immunity levels and locality adaptations of calves born in Turkey after heifers' importation.

1. INTRODUCTION

There are 13.994.071 recorded cattle in Turkey. 6.385.343 of them are culture cattle breeds (45.6%), 5.733.803 (41.0%) are culture cross breeds and 1.874.925 (13.4%) are native cattle breeds. While the ratio of culture breeds and culture cross breeds was 44.1% in 1991, it rose to 86.60% in 2014 [1]. The main reasons of this increase might be livestock imports and artificial insemination practices.

Cattle presence in Turkey has become controversial particularly since the 2000s. It was claimed that as a result of the fluctuations in raw milk prices in the country, breeding animals with high genetic value were

slaughtered, thus the number of newborn calves and cattle decreased due to uncontrollable reasons. As a solution to this, breeding and slaughtered animal imports were made possible, cattle carcass slaughtered abroad were imported as an urgent solution to the momentary problems in meat supply in domestic markets, and this had both positive and negative impacts on national economy [2-4].

The adaptation mechanisms of cattle imported to a new location develop in time. Adaptation problems of cattle might result in low performance, increase morbidity and mortality rates, and cause monetary losses for the enterprises.

This study focused on the calves born from pregnant Brown Swiss and Simmental heifers imported from Austria to a newly-established dairy cattle enterprise in Manisa, Turkey. Its objective was to identify their blood IgG (Immunoglobulin G) and total protein levels, and compare their adaptation abilities in order to determine their growth and survival parameters and natural immunity levels.

2. MATERIAL AND METHODS

The research protocol of our study was approved by the Ethics Committee of Istanbul University (Approval number: 2012/31)

2.1. Material Definition

This study was conducted in a newly-established private dairy cattle enterprise in Manisa. Manisa is located in Western Anatolia Region between 27 08' and 29 05' eastern longitudes and 38 04' and 39 58' northern latitudes. It has Mediterranean/continental climate. Precipitation generally occurs in winter, and summer is dry. The bare and steep side of the Spil Mountain in Manisa faces the city and creates a scorching climate in summer and a freezing one in winter. The temperature is below zero for an average of 26 days per year [5].

The first animal material of the enterprise comprised of 70 Brown Swiss and 282 Simmental (Fleckvieh) pregnant heifers imported from Innsbruck/Austria. The heifers had their first births between June and December and had 328 (62 Brown Swiss, 266 Simmental) live calves.

2.2. Management and Feeding of Calves

Calves were separated from their mothers' right after birth and put into individual sections where they were fed with colostrum via feeding bottles. Colostrum quality was measured by colostrometer, and only the colostrum with high specific weight (1035>mg/ml) was given. Calves consumed 10 liters of colostrum in the first 24 hours, and they were fed with milk two times a day in the following days. They were given calf grower feed and water when milk feeding started. Calves' appetites, body temperatures and stools were checked every day.

Healthy calves were taken into wider individual calf cabins in the open, and fed with calf grower feed. Calf grower feed was composed of a premix, which included 2600 kcal/kg metabolic energy and enriched with A, D, E vitamins and various minerals. They were weaned around 60-days of age. Dry alfalfa was started one week before weaning. After weaning, calves were grouped according to sex, age and weight. They were taken into semi-open young animal barn and raised in groups of 15.

After 60 days, calves were introduced to forage and also given young animal ration which had: net energy maintenance-NEm: 1.57 Mcal/kg, net energy gain-NEg: 0.96 Mcal/kg, crude protein-CP: 21%DM (dry matter), acid detergent fiber-ADF: 24%DM, neutral detergent fiber-NDF: 36%DM, starch 24%DM. Silage feeding started 6 months later.

2.3. Data Collection and Statistical Analysis

321 of the pregnant heifers had live births and delivered 328 live calves in the enterprise. 313 calves were single born, and 15 calves were twinborn (one of the twins was stillborn). All twinborn calves were from the

Simmental heifers. In the period until weaning, 13 single born calves died while all twinborn calves survived. We analyzed the data of 15 twinborn Simmental calves separately.

We examined the survival rates of calves until weaning according to breed, sex, birth type (single or twin) and delivery method. We calculated the calf deaths in the first 180 days cumulatively in periods of 15-days while we calculated the survival and periodical mortality numbers and rates separately.

We divided the birth weights, 60th and 65th day weaning weights, and daily weight gains into sub-groups according to breed, sex and delivery method. We applied "GLM (General Linear Models)" procedure in the within-group significance controls. Since we did not find any interaction between the factors addressed for growth parameters, we did not add interaction to the equations as an impact factor. We used "Duncan Multiple Range Test" for within-group significance controls. Since twin births occurred only in Simmental breeds, we did not add birth type to the equation as a factor in overall evaluation; we presented it as a separate table. We used T-test for the significance controls between twin male and female calves.

We applied the following model for calculating the growth parameters with GLM procedure:

$Y_{ijkl} = \mu + a_i + b_j + c_k + e_{ijkl}$

In this model,

Yijkl : Yield/production parameter of an individual

μ : Overall mean value

ai : Effect of breed (i = Simmental, Brown Swiss)

bj : Effect of sex (j = Male, Female)

ck : Effect of birth type (k = Spontaneous, with assistance, difficult)

eijkl : Random error

We randomly selected 18 Simmental (9 female, 9 male) and 17 Brown Swiss (10 female, 7 male) calves, which were born in the same period, to identify blood IgG and total protein levels. We took blood samples with vacuum tubes of 10 ml in the first 24 hours, 7th day and 30th day (after colostrum intake). The samples were centrifuged in 5000 rpm for 10 min., and blood serums were stored at -18. We sent the serums to a private lab where Bovine Immunoglobulin G Elisa Test was used to identify the blood IgG and total protein levels.

We used SPSS (Statistical Package for the Social Sciences) program package [6] to make a statistical analysis of the parameters in this study.

3. RESULTS

3.1. Growth Performances

Table 1 and Table 2 indicate the birth weights, 60th day weights, weaning weights (65.06 day) and daily weight gains for calves. Table 1 shows the growth performance results of the single born calves while Table 2 shows the same for twinborn Simmental calves.

Average birth weights were 40.31 kg and 41.76 kg; 60th day weights were 74.03 kg and 80.15 kg; weaning weights (65.06 day) were 77.16 kg and 83.59 kg; and daily weight gains were 0.56 kg and 0.64 kg for Brown Swiss and Simmental calves respectively. We found that Simmental calves had higher 60th and 65th day weights and more daily weight gains than Brown Swiss. Breed's impact on those parameters was statistically significant ($P<0.001$).

Male calves had higher weights than female calves in all parameters except for daily weight gains. The impact of delivery method was significant only in birth weight.

The birth weights of twinborn male and female Simmental calves were 34.43 kg and 31.06 kg; 60th day weights were 74.81 kg and 66.09 kg; weaning weights were 78.00 kg and 69.37 kg; and daily weight gains were 0.67 kg and 0.58 kg. The twinborn Simmental calves had lower birth and weaning weights compared to the single born calves of the same breed.

3.2. Survival and Mortality Rates

Table 3 indicates the survival rates of Brown Swiss and Simmental calves until weaning while Table 4 shows the mortality rates in 15-days periods. Table 3 covers the period from birth to weaning while Table 4 covers the period from birth to their 6th month.

The survival rates of Brown Swiss and Simmental calves until weaning were 98.39% and 95.49% respectively. The survival rate was 95.85% for single born and 100% for twinborn calves. The rates of male and female calves were 95.81% and 96.27%. The survival rates of calves with spontaneous birth were higher than other birth forms. The lowest survival rate was in the calves with difficult birth. The survival rates of all calves were 96.03% at weaning. The impact of breed, birth type, sex and birth form on the survival rates at weaning was not statistically significant (P>0.05).

Out of 328 calves born alive15 died in the first 6 months due to various reasons. Mortality rate for 0-180th day was 4.57%. The highest amount of deaths occurred in the first 15 days with 8 calves (2.44%). The impact of breed, birth type, sex and delivery method on mortality rates in 15-day periods was not statistically significant (P>0.05).

3.3. IgG and Total Protein Levels

We took blood samples (in 3 different periods) from 35 calves of both breeds that were born in the same month to investigate their natural immunity levels (blood IgG and total protein levels). Table 5 indicates the mean values and statistical significance controls identified according to breed, sex and measurement time. We found a statistically significant difference between Brown Swiss and Simmental calves on the 7th day in terms of IgG levels and on the 1st day in terms of total protein levels (P<0.05). Breed X sex interaction was significant in terms of the 1st day IgG levels (P<0.05).

4. DISCUSSION

4.1. Growth Performance

Average birth weights, 60th day weights, weaning weights and daily weight gains were higher in Simmental calves than Brown Swiss calves, and this difference was statistically significant. The main reason for this difference might be the fact that Simmental is a combined breed.

The values we found for birth weight were lower than the values found by Schnitzenlehner, et al. [7] and Köpf, et al. [8] for Simmental; higher than the values reported by Özlütürk, et al. [9] and Koçak, et al. [10] for Simmental, and by Uğur, et al. [11] for Brown Swiss; and consistent with the values reported by Koçyiğit, et al. [12] and Koçak, et al. [10] for Brown Swiss. The weaning weight was similar to the one reported by Sağsöz, et al. [13] for Brown Swiss calves; and higher than the one reported by Koçyiğit, et al. [12] for Brown Hybrid calves. The daily weight gains were similar to those reported by Sağsöz, et al. [13] and Koçyiğit, et al. [12] for Brown Swiss; and higher than those reported by Uğur, et al. [11] for Brown and Holstein calves. The differences between the growth values found in our study and the ones reported in literature might derive from the differences in calves' origins, local raising conditions, breeding care, calves' care, feeding and ration contents.

While daily weight gains were similar in male and female calves, weight difference at birth between sexes continued until weaning. The weights of male calves were higher than those of female calves, and this might be associated with the hormonal structure in intra and post uterine growth phases.

In our study, calves' birth weights were 39.78 kg, 40.53 kg and 42.79 kg; weaning weights were 79.36 kg, 80.66 kg and 81.11 kg; daily weight gains were 0.60 kg, 0.62 kg and 0.58 kg according to birth forms (namely: spontaneously/without help, easily/with help, and with difficulty/C-section) respectively. The higher birth weights of calves with difficult birth might be a result of intra uterine growth mechanisms. However, we found that birth form had neither positive nor negative impact on growth until weaning, and the calves with difficult birth compensated their weight losses in the following periods.

The birth weight of twinborn Simmental calves was lower than single born calves, which was expected. However, in the weaning period, particularly the male calves reached the same weights with the single born calves, so our study found that the negative impact of being twinborn disappeared.

The weaning weights of twinborn Simmental calves were lower than the values reported by Wyatt, et al. [14] for the twin calves weaned at 240 days, by Shimada, et al. [15] for the twin calves weaned at 26 weeks, and by Echternkamp, et al. [16] for the twin calves weaned at 172 days. Those differences occurred due to the weaning times of calves. Considering the overall growth performance of calves until weaning, our study found that Simmental and male calves were born heavier, reached the 60th day with higher weight, birth form was effective on calves' birth weight, but this effect disappeared until weaning.

4.2. Survival and Mortality Rates

Calves' survival rates until weaning, which do not go below 95%, are generally considered normal in dairy cattle enterprises. In our study, first 60-day survival rates of Brown Swiss and Simmental calves were between 98.39% and 95.49%. Survival rates at weaning were higher than the survival rate found by Koçak, et al. [10] for Brown Swiss and Simmental breeds, and similar to the survival rate found by Özlütürk, et al. [9] for Simmental calves. Survival rates of single and twinborn calves at weaning were higher than the survival rates found by Echternkamp, et al. [16] for single and twinborn calves. The suitability of first period care, feeding and health programs implemented in the enterprise were reflected on survival and 1st period mortality rates, and resulted in achieving the rates targeted by cattle enterprises for the 1st year.

4.3. IgG and Total Protein Levels

Blood samples from randomly-selected calves indicated that IgG levels were between 19.48–38.45 mg/ml, and total protein levels were between 5.38–6.54 g/dl in different periods. IgG (which occurs in blood and colostrum in the highest concentration and which is the immunoglobulin with the longest half-life) was 20mg/ml or higher in calves, and total protein level was 5g/dl or higher. These results showed that immunity was at normal levels.

The IgG levels found in this study were similar to the levels reported by Yüceer and Özbeyaz [17] for Holstein, by Uzlu, et al. [18] for Brown Swiss at 30-days, by Yüceer and Özbeyaz [17] for Brown Swiss at 30-days, by Akbulut, et al. [19] for Holstein in the first 24-48 hours, and by Akbulut, et al. [19] for Brown Swiss and Holstein Friesian calves at 30-days. However, they were higher than the levels reported by Genç [20] for Brown Swiss in 24 hours, by Akbulut, et al. [19] for Brown Swiss in 24 hours, by Genç [20] for Brown Swiss in 24 hours, and by Akbulut, et al. [19] for Brown Swiss and Holstein Friesian at 2 days. Total serum protein levels were similar to the levels reported by Yüceer and Özbeyaz [17] for Holstein and by Uzlu, et al. [18] for 30-day; and lower than the levels reported by Yüceer and Özbeyaz [17] for Holstein in the first 24-48 hours. In general, we think that IgG absorption might vary depending on calves' body size, breed, dry periods feeding, spaciousness of shelters, feeding types (bucket, feeding bottle, mother), morbidity rate while Total Serum Protein level might vary depending on calves' body weight, breed, and IgG rate.

5. CONCLUSION

Simmental calves were born heavier and gained more weight until weaning. We found that breed and sex affected growth parameters; birth form (single or twin) only affected birth weight and calves with high birth weight caused difficult birth but this effect disappeared until weaning. Similarly, being twinborn had a negative effect on birth weight but twinborn calves reached the same daily weight gain levels with single born calves until weaning.

Survival and mortality rates for Brown Swiss and Simmental calves at weaning were at normal and ideal levels while there were 10% losses in calves with difficult birth. Natural immunity levels of calves born in the enterprise were seen at normal levels due to the care and feeding standards implemented there.

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Table-1. Mean values and significance controls for the birth, 60th-day and weaning weights and daily weight gains of single born Brown Swiss and Simmental calves (kg)

PARAMETERS		BREED		SEX		BIRTH TYPE			GENERAL	SIGNIFICANCE		
		Brown Swiss	Simmental	Male	Female	Spontaneous	With assistance	Difficult		Breed	Sex	Birth Type
Birth weight	**N**	62	251	160	153	105	144	64	313			
	x±s$_x$	40,31±0,68^b	41,76±0,35^a	42,56±0,47^a	39,51±0,51^b	39,78±0,55^b	40,53±0,50^b	42,79±0,70^a	41,03±0,39	*	***	**
60th-day weight	**N**	61	239	153	147	102	139	59	300			
	x±s$_x$	74,03±1,06^b	80,14±0,55^a	78,45±0,74^a	75,72±0,81^b	76,17±0,86	77,31±0,78	77,78±1,14	77,09±0,61	***	**	N.S.
Weaning weight (65,06 days)[1]	**n**	61	239	153	147	102	139	59	300			
	x±s$_x$	77,16±1,10^b	83,59±0,57^a	81,67±0,77^a	79,08±0,83^b	79,36±0,89	80,66±0,81	81,11±1,17	80,38±0,63	***	**	N.S.
Daily weight gain (kg)[2]	**n**	61	239	153	147	102	139	59	300			
	x±s$_x$	0,56±0,01^b	0,64±0,01^a	0,60±0,01	0,60±0,01	0,60±0,01	0,62±0,01	0,58±0,01	0,60±0,01	***	N.S.	N.S.

[1] Mean weaning age was calculated as 65.06 days.
[2] It was calculated for the period between birth and 60th day.
N.S.: Not Significant, * P<0.05; ** P<0.01; *** P<0.001.

Table-2. Mean values for the birth, 60th-day and weaning weights and daily weight gains of twinborn Simmental calves (kg)

PARAMETERS		MALE	FEMALE
Birth weight	n	7	8
	x±s$_x$	34,43±2,37	31,06±2,24
	S	6,26	6,34
60th-day weight	n	7	8
	x±s$_x$	74,81±4,07	66,09±3,49
	S	10,76	9,87
Weaning weight (65,06 days) [1]	n	7	8
	x±s$_x$	78,00±4,57	69,37±3,81
	S	12,1	10,78
Daily weight gain [2]	n	7	8
	x±s$_x$	0,673±0,04	0,584±0,02
	S	0,11	0,07

1 Mean weaning age was calculated as 65.06 days.
2 It was calculated for the period between birth and 60th day.
S: Standard deviation

Table-3. Survival rates and significance controls of Brown Swiss and Simmental calves until weaning (%)

PARAMETERS	BIRTH			WEANING						SIGNIFICANCE
	Brown Swiss	Simmental	GENERAL	Brown Swiss		Simmental		GENERAL		
	n	n	n	n	%	n	%	n	%	
General	62	266	328	61	98,39	254	95,49	315	96,03	N.S.
Single born	62	251	313	61	98,39	239	95,22	300	95,85	N.S.
Twinborn	0	15	15	0	0	15	100,00	15	100,00	N.S.
Male	36	131	167	35	97,22	125	95,42	160	95,81	N.S.
Female	26	135	161	26	100,00	129	95,56	155	96,27	N.S.
Spontaneous birth	25	80	105	25	100,00	77	96,25	102	97,14	N.S.
Birth with assistance	26	133	159	26	100,00	128	96,24	154	96,85	N.S.
Difficult birth	11	53	64	10	90,91	49	92,45	59	92,19	N.S.

N.S.: Not Significant

Table-4. Mortality rates and significance controls of Brown Swiss and Simmental calves between 0-180 days* (%)

DAY INTERVALS		BREED		SEX		BIRTH FORM		BIRTH TYPE			GENERAL
		Brown Swiss	Simmental	Male	Female	Single	Twin	Spontaneous	With assistance	Difficult	
0-15	n	1	7	3	5	8	0	2	2	4	8
	%	1,61	2,63	1,80	3,11	2,56	0	1,90	1,26	6,25	2,44
16-30	n	0	2	1	1	2	0	1	1	0	2
	%	0	0,75	0,60	0,62	0,64	0	0,95	0,63	0	0,61
31-45	n	0	1	1	0	1	0	0	1	0	1
	%	0	0,38	0,60	0	0,32	0	0	0,63	0	0,30
46-60	n	0	0	0	0	0	0	0	0	0	0
	%	0	0	0	0	0	0	0	0	0	0
61-75	n	0	1	1	0	1	0	0	0	1	1
	%	0	0,38	0,60	0	0,32	0	0	0	1,56	0,30
76-90	n	0	0	0	0	0	0	0	0	0	0
	%	0	0	0	0	0	0	0	0	0	0
91-105	n	0	2	2	0	2	0	1	1	0	2
	%	0	0,75	1,20	0	0,64	0	0,95	0,63	0	0,61
106-180	n	1	0	1	0	1	0	0	0	1	1
	%	1,61	0	0,60	0	0,32	0	0	0	1,56	0,30
GENERAL	n	2	13	9	6	15	0	4	5	6	15
	%	3,23	4,89	5,39	3,73	4,79	0	3,81	3,14	9,38	4,57
Calves born	n	62	266	167	161	313	15	105	159	64	328

* The effect of Breed, Sex, Birth type and Delivery method on mortality rates in 15-day periods was not significant (P>0.05)

Table-5. Mean values for IgG and total protein levels and significance controls of Brown Swiss and Simmental calves

PARAMETERS	MEASUREMENT TIME	BREED		SEX		SEM	SIGNIFICANCE		
		BROWN SWISS (n:17)	SIMMENTAL (n:18)	MALE (n:16)	FEMALE (n:19)		Breed	Sex	Breed x Sex
IgG (mg/ml)	1.day	28,48±4,29	19,48±4,10	22,61±4,39	25,35±4,00	2,97	N.S.	N.S.	*
	7. day	38,45±5,54	22,04±5,30	31,17±5,66	29,32±5,16	3,83	*	N.S.	N.S.
	30. day	27,11±5,23	18,24±5,00	22,29±5,35	23,06±4,88	3,62	N.S.	N.S.	N.S.
		N.S.	N.S.	N.S.	N.S.				
Total Protein (g/dl)	1.day	5,45±0,34	6,49^{a}±0,33	5,77^{ab}±0,35	6,17^{ab}±0,32	0,24	*	N.S.	N.S.
	7. day	6,08±0,23	6,54^{a}±0,22	6,05^{a}±0,24	6,58^{a}±0,22	0,16	N.S.	N.S.	N.S.
	30. day	5,38±0,13	5,50^{b}±0,13	5,38^{b}±0,13	5,51^{b}±0,12	0,09	N.S.	N.S.	N.S.
		N.S.	**	*	**				

N.S.: Not Significant, * P<0.05; ** P<0.01.

a, b: Differences between the means of the measurement times marked with different letters in the same column are significant (P<0.05).