Turk J Vet Anim Sci
25 (2001) 789-795

Growth and Survival of Simmental Calves Reared Outdoors in Individual Hutches

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Received: 04.03.2001

Abstract: The effects of outdoor raising on the survival and growth of Simmental calves in individual hutches were studied at Kazova State Farm, the location having a mixture of Black Sea and semiarid continental climate conditions. A total of 63 female calves born in each of the four seasons between March 1996 and February 1997 were used. The animals were kept in individual hutches for 3 months (preweaning period) and then in groups of 10 until 6 months of age (postweaning period). The mean birth weight was 38.92 kg, while average birth weights for the seasons ranged from 37.70 to 40.44 kg (P<0.05), being highest in spring and lowest in winter. The live weights for 1, 2, 3 and 6 months were 57.69, 74.93, 92.37 and 148.63 kg, respectively. The effect of seasons on live weights were statistically significant (P<0.05, P<0.01), with the only exception at 3 months live weight (P>0.05). The rate of health disorders were highest in the first month of life, and the overall health disorder rate was 25.4%. There was no calf death in the preweaning period and the mortality rate was 3.2% in the postweaning period. The results indicated that Simmental calves could be reared outdoors successfully on the Kazova State Farm conditions.

Key Words: Simmental, Calves, Outdoors Rearing, Growth, Survival

Açıkta - Bireysel Kulübelerde Barındırılan Buzağılarda Büyüme ve Yaşama Gücü

Özet: Açıkta - bireysel kulübelerde barındırılan Simental buzağılarda büyüme ve yaşama gücü araştırılmıştır. Araştırma, hem Karadeniz ve hem de yarı-kurak karasal iklim şartlarının etkili olduğu Kazova Tarım İşletmesinde Mart 1996 ile Şubat 1997 tarihleri arasında doğan toplam 63 dişi buzağı ile yürütülmüştür. Buzağılar ilk 3 ay (sütle besleme dönemi) bireysel kulübelerde, daha sonra da 6 aylık yaşa kadar 10 başlık gruplar halinde padoklarda büyütülmüşlerdir. Doğum ağırlığı ortalama olarak 38,92 kg bulunmuş ve mevsimlere bağlı olarak 37,70 ile 40,44 kg arasında değişmiştir (P<0,05). Doğum ağırlığı bakımından en yüksek değere ilkbahar, en düşük değere ise kış mevsiminde doğan buzağılar sahip olmuşlardır. Buzağıların 1, 2, 3 ve 6 ay canlı ağırlıkları, sırasıyla 57,69; 74,93; 92,37 ve 148,63 kg bulunmuştur. Mevsimin canlı ağırlıklar üzerine etkisi 3. ay hariç diğer dönemlerde istatistik olarak önemli (P<0,05; P<0,01) bulunmuştur. Buzağılar hastalığa en fazla doğumdan sonraki ilk ayda yakalanmışlar ve 6 aylık dönemde hastalığa yakalanma oranı %25,4 olmuştur. Sütle besleme döneminde ölüm olmamış, sütten kesim sonrası dönemde ise mortalite %3,2 bulunmuştur. Araştırmanın sonuçları, açıkta - bireysel kulübelerde barındırılan Simental buzağıların, Kazova Tarım İşletmesi şartlarında başarılı bir şekilde yetiştirilebileceğini göstermiştir.

Anahtar Sözcükler: Simental, Buzağı, Dışarıda Büyütme, Büyüme, Yaşama Gücü

Introduction

Heifer calves are generally raised as replacements and they are essential for the successful future of a herd. The highest morbidity and mortality period for calves is generally from birth to weaning. Management goals for the preweaning period should be to minimize disease and mortality conditions by providing a suitable environment, establishing a quality nutritional program and implementing a preventive health care plan. The health of a newborn calf depends on its genotype and environment. Calf housing should provide an environment that is clean, dry and free from stress. Protection from heat, cold, wind, and rain is also important (1).

Indoor raising of dairy calves has been the most common practice in many countries. However, calves raised indoors may have more health disorders than those

raised outdoors because it is often difficult to properly regulate air and humidity in enclosed systems. Outdoor rearing has been practised in many countries (2,3). The calves are housed in individual hutches of various types, made of wood or a man-made material. The hutches are portable and are moved to a new location, usually once a year (4,5).

Newborn calves are born with a profoundly limited ability to resist diseases because of a lack of effective maternal immunity at birth. Calves should acquire maternal antibodies from consumption of the colostrum in the first 24 hours after birth. These antibodies give the calf the opportunity to survive until its own immune system becomes effective. The first two months of life is the most critical stage for the survival ability of a calf (6,7).

Individual hutches separate calves and reduce the spread of communicable diseases. The transmission of enteric pathogens causing disease in preweaned calves is mainly through inter-animal contact or transmission through improperly cleaned utensils or the animal caretakers. The concept of isolating calves to reduce the transmission of pathogens to preweaned calves is one of the most fundamental principles of calf rearing. Group housing, especially in the preweaning period, increases the risk of the widespread dissemination of pathogens (8).

Many researchers reported that calves raised in individual hutches showed equal or superior performance to those in enclosed housing in terms of growth rate and health (7,9-13). However, outdoor raising has some disadvantages, such as increased labour costs, increased bedding requirements, more starter feed, and occasional undesirable weather conditions (5,9).

The Simmental breed has become common in the central and western regions of Turkey because of their utility in producing both meat and milk. In recent years, some research has been carried out to investigate the possibilities of using Simmental bulls for commercial crossing with local breeds (14,15).

The aim of this study was to determine the growth, health status and survival of Simmental calves raised outdoors in individual hutches in north-central Anatolia, which has partly Black Sea and partly semiarid continental climate conditions.

Materials and Methods

The study was carried out at the dairy unit of Kazova State Farm in the Middle-Black Sea Region of Turkey. The farm has a mixture of Black Sea and semiarid continental climate conditions. The geographical coordinates of the farm are 40º N and 36º E. The size of the herd was around 150 milking cows. All 63 female calves born in one year between March 1996 and February 1997 were included in the study. The Simmental calves were the products of a few generations of descendants of pregnant heifers imported from Germany. The calves were placed in individual hutches within 6 hours of parturition. The hutches were built of wood and each had a surface area of 2.2 m^2. Each hutch had a 1.2 m^2 covered and a 1 m^2 outer fenced area. The floor was of sand and gravel and wheat straw was used as the bedding material. The bedding material was changed weekly and the hutches were moved to a new location after use for one year. The calves were housed in the hutches for 3 months and then they were moved to semi-open shelters with groups of 10 calves in each pen, where they were raised to 6 months of age.

The calves were fed colostrum in the first week, followed by whole milk until they were at three months of age. Milk feeding was twice daily and the total milk used per calf was 240 kg whole milk and 110 kg skimmed milk. Good quality alfalfa hay and a type of calf starter were given to the calves *ad libitum* after they reached two weeks of age, and this feeding practice was continued during the hutch rearing period. After weaning in the semi-open pens, roughage was given *ad libitum*, but the grower concentrate was fed at a rate of 2.5 kg per calf, per day. The calves had free access to water at all times.

The birth weights of the calves were taken before they were placed in the hutches. Body weights and four body measurements (wither height, body length, heart girth circumference and cannon bone circumference) were taken monthly, until the calves were 6 months of age. The average daily gains were estimated for the pre- and post- weaning periods using initial and final body weights.

Environmental temperatures (minimum and maximum) and relative humidities were recorded daily during the study. The health conditions of calves were kept under constant surveillance. Every health

disturbance, its diagnosis, treatment, as well as the duration of the problem and its results were recorded. The labour time used for rearing calves in individual hutches was estimated.

The SPSS package program (16) was used for the statistical analysis of the data. The differences among the seasons for body weights, growth rates and body measurements were tested by analysis of variance and Duncan's multiple range test. For the incidence of diseases non-parametric tests were employed.

Results

Meteorological values

The average minimum and maximum temperatures and relative humidities taken during the study are given in Table 1. The average minimum and maximum temperatures in the winter were 0.49 and 13.19ºC. Below zero temperatures were recorded on 6 nights in the autumn, 32 nights in the winter and 7 nights in the spring months, while the lowest average monthly minimum temperature was -3.46ºC in February. The average maximum temperature for the summer season was 30.19ºC with the highest monthly average being 34.06ºC in August. The mean seasonal relative humidities ranged from 74.03% in summer to 86.89% in winter.

Table 1. Average Seasonal Temperatures and Relative Humidities at the Farm.

Season	Daily Temperatures (ºC)		Relative Humidity (%)
	Minimum $\bar{X} \pm S_{\bar{X}}$	Maximum $\bar{X} \pm S_{\bar{X}}$	$\bar{X} \pm S_{\bar{X}}$
Winter	0.49 ± 0.58	13.19 ± 0.69	86.89 ± 1.15
Spring	7.59 ± 0.41	19.96 ± 0.58	75.02 ± 0.89
Summer	15.84 ± 0.33	30.19 ± 0.44	74.03 ± 0.76
Autumn	9.03 ± 0.60	25.93 ± 0.64	80.24 ± 0.95

Body weights and weight gains

The average weights at birth, 1, 2, 3 and 6 months of age were 38.92, 57.69, 74.93, 92.37 and 148.63 kg, respectively (Table 2). The differences in weights among the seasons were significant (P<0.05) at birth, 1 and 2 months and highly significant (P<0.01) at 6 months. The spring born calves had the highest birth weights (40.44 kg) and weaning weights (96.77 kg) while winter born calves were the heaviest (166.77 kg) at 6 months. The differences in daily weight gains among the seasons were significant for the post weaning period (P<0.001) and from birth to 6 months of age (P<0.01). Calves born in spring were superior to others in terms of daily gains in the preweaning period. In the postweaning period, however, winter born calves made the highest daily gains (Table 3).

Body measurements

The means for wither height, body length, heart girth and cannon bone circumference were highest by spring born calves at 1, 2 and 3 months of ages and by winter born calves at 6 months of age (Table 4). The seasons had a significant effect on wither height at 1, 2 and 3 months (P<0.05), body length at 2 and 3 months (P<0.05; P<0.01), and heart girth at 2 and 6 months of ages (P<0.05; P<0.01), and cannon bone circumference at all measurement periods (P<0.001; P<0.01).

Table 2. Mean Live Weights (kg) of Simmental Calves at birth, 1, 2, 3 and 6 Months of Age.

Live Weights (kg)	Season of Birth								Total		F
	Winter		Spring		Summer		Autumn				
	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	
Birth	9	37.76 ± 0.62a	16	40.44 ± 1.02b	21	37.78 ± 0.65a	17	39.53 ± 0.59ab	63	38.92 ± 0.40	*
1 Month	9	53.11 ± 1.83a	16	61.21 ± 1.80b	21	56.86 ± 1.54ab	17	57.81 ± 1.69ab	63	57.69 ± 0.91	*
2 Months	9	70.84 ± 3.62a	16	80.03 ± 2.42b	21	74.28 ±1.65ab	17	73.09 ± 1.91a	63	74.93 ± 1.14	*
3 Months	9	92.28 ± 5.95	16	96.77 ± 2.94	21	91.80 ± 2.16	17	88.98 ± 2.35	63	92.37 ± 1.48	-
6 Months	9	166.77 ±5.71a	16	150.56±4.22ab	20	136.25 ±5.64b	16	151.22 ±5.01ab	61	148.63 ± 2.89	**

*: P<0.05 ; ** : P<0.01

a, b: Differences were statistically significant in the same row (P<0.05).

Table 3. Average Daily Gains (g) in Different Periods.

Stages	Season of Birth								Total		F
	Winter		Spring		Summer		Autumn				
	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	
Birth-1 Month	9	511.11±55.37	16	692.50±43.12	21	636.67±33.59	17	609.22±58.78	63	625.50±24.15	-
1-2 Months	9	591.11±79.36	16	627.08±29.70	21	580.63±29.66	17	509.61±37.19	63	574.76±19.36	-
2-3 Months	9	714.44±89.42	16	558.13±29.86	21	584.13±36.42	17	529.61±32.26	63	581.43±21.73	-
Birth-3 Months	9	605.56±63.95	16	625.90±27.05	21	600.48±20.80	17	549.48±28.77	63	593.90±15.42	-
3-6 Months	9	827.65±52.04a	16	597.64±32.14bc	20	493.68±43.21c	16	690.36±43.06b	61	624.31±25.64	***
Birth-6 Months	9	716.60±32.02a	16	611.77±20.45b	20	546.40±29.91b	16	620.66±29.78b	61	609.17±15.71	**

**: P<0.01 ; *** : P<0.001

a, b, c: Differences were statistically significant in the same row (P<0.05).

Table 4. Mean Body Measurements (cm) at 1, 2, 3 and 6 Months of Age.

Age (Month)	Season of Birth								Total		F
	Winter		Spring		Summer		Autumn				
	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	
					Wither Heights						
1	9	72.93 ± 1.59a	16	78.24 ± 0.85b	21	75.18 ± 0.92a	17	74.21 ± 0.57a	63	75.37 ± 0.51	**
2	9	77.32 ± 1.64a	16	82.89 ± 0.74b	21	78.87 ± 0.84a	17	80.14 ± 0.64a	63	80.01 ± 0.50	**
3	9	82.84 ± 1.31a	16	87.22 ± 0.81b	21	83.30 ± 0.91a	17	86.18 ± 0.63b	63	85.01 ± 0.49	**
6	9	98.66 ± 0.98	16	97.40 ± 0.90	20	95.50 ± 1.34	16	96.69 ± 0.52	61	96.78 ± 0.53	-
					Body Lengths						
1	9	71.42 ± 1.56	16	74.99 ± 1.17	21	73.83 ± 0.70	17	73.29± 0.56	63	73.64 ± 0.47	-
2	9	77.12 ± 1.21a	16	80.76 ± 1.01b	21	78.53 ± 0.76ab	17	79.82± 0.49ab	63	79.24 ± 0.44	*
3	9	82.99 ± 1.40a	16	86.68 ± 0.92b	21	83.39 ± 0.79a	17	86.19 ± 0.60b	63	84.92 ± 0.47	**
6	9	100.76 ±0.91	16	99.46 ± 1.07	20	96.82 ± 1.29	16	98.32 ± 0.60	61	98.49 ± 0.56	-
					Heart Girth						
1	9	82.82 ± 1.64	16	86.38 ± 1.00	21	83.72 ± 0.92	17	84.06± 1.01	63	84.36 ± 0.55	-
2	9	90.87 ± 1.86a	16	95.32 ± 1.14b	21	92.72 ± 0.84ab	17	91.91± 0.91ac	63	92.90 ± 0.56	*
3	9	99.80 ± 2.60	16	102.28 ± 1.21	21	100.40 ± 0.88	17	98.66 ± 1.04	63	100.32 ± 0.63	-
6	9	123.70±1.46a	16	119.94± 1.24a	20	115.23 ± 1.86b	16	119.91± 1.42a	61	119.01 ± 0.87	**
					Cannon Bone Circumference						
1	9	11.29 ± 0.21a	16	12.28 ± 0.11b	21	11.88 ± 0.12c	17	11.72± 0.11c	63	11.85 ± 0.08	***
2	9	11.86 ± 0.18a	16	12.69 ± 0.11b	21	12.28 ± 0.12c	17	12.15± 0.09ac	63	12.29 ± 0.07	***
3	9	12.23 ± 0.22a	16	13.14 ± 0.12b	21	12.59 ± 0.14a	17	12.62 ± 0.10a	63	12.69 ± 0.08	***
6	9	14.26±0.14ac	16	14.18 ± 0.15a	20	13.49 ± 0.18b	16	13.73± 0.11bc	61	13.85 ± 0.09	**

*: P<0.05; **: P<0.01 ; ***: P<0.001 a, b,c : Differences were statistically significant in the same row (P<0.05).

Health disorders and mortality

The number of calves with disorders were grouped into digestive, respiratory and the combination of these two and others, along with the number of mortalities, are given in Table 5. Half of the health disorders appeared in the first month of life. Digestive system diseases were higher than the incidence of respiratory system diseases in the first month, but they were practically the same in the 6 months period. There were no significant differences among the seasons for the number of affected

Table 5. Number of Health Disorders and Mortalities.

Season of Birth	0-1 Month			1-3 Months			3-6 Months			0-6 Months			Total
	RSD	DSD	RSD+ DSD+ Others	RSD	DSD	RSD+ DSD+ Others	RSD	DSD	RSD+ DSD+ Others	RSD	DSD	RSD+ DSD+ Others	
						Health Disorders							
Winter	1	-	-	1	-	-	-	-	-	2	-	-	2
Spring	-	4	1	-	-	-	1	-	-	1	4	1	6
Summer	-	-	-	2	-	-	2	-	-	4	-	-	4
Autumn	-	2	-	-	-	2	-	-	-	-	2	2	4
Total	1	6	1	3	-	2	3	-	-	7	6	3	16
						Mortalities							
Winter		-			-			-			-		-
Spring		-			-			-			-		-
Summer		-			-			1			1		1
Autumn		-			-			1			1		1
Total		-			-			2			2		2

RSD: Respiratory System Diseases DSD: Digestive System Diseases

calves in the 6 months period. The mortality rate was zero in the preweaning and 3.2% in the postweaning periods. Two calves died in the postweaning period, one of them died of a mixed infection of pneumonia and gastroenteritis, and the other died of physical trauma in the pen at night.

Labour

The average occupancy of the calf raising unit was 44 calves per day. Since two part-time workers were employed at the unit for a total of 8 hours per day, the average daily labour time per calf was estimated to be 10.9 minutes.

Discussion

Individual outdoor calf hutches are a common management practice in many countries around the world. However, the use of individual outdoor calf hutches in Turkey is relatively new. Cattle breeders, especially in the western parts of Turkey, show a warm interest to shift their practice from indoors to outdoors (1,17).

Temperature and relative humidity are very important weather factors affecting young calves. The zone of thermal neutrality for a newborn calf is quite narrow, ranging from 13 to 20ºC and an optimal relative humidity 60-80% (1). However, the calves adjust readily to temperatures which are substantially higher or lower than the above given limits if they have dry bedding, are protected from drafts, wind and rain, and relative humidity is moderate (1,18). The farm where the study was conducted has convenient climatic conditions for dairy farming. The spring and autumn seasons provide the most suitable environment for the animals. Thirty-two nights in the winter months recorded below zero temperatures, but winter born calves appeared not to be affected by this condition. Only one calf had a health disorder in the preweaning period during the winter months (Table 5). It can be stated that the area has favourable outdoor living climate conditions for young calves.

The calves in this study had higher body weights at birth, 1, 2 and 3 months of ages than the same breed of calves raised indoors on the same station previously (36, 44, 59 and 76 kg, respectively), while 6 months weights were similar (148 kg) (19). The average weights at birth and 6 months in this study were also higher than those reported earlier for the same breed at Karacabey State Farm (35 and 125 kg) (20). The Simmental calves also had higher growth rates than Brown Swiss and Holstein calves reared outdoors in individual hutches at Karacabey State Farm (463 and 508 g for the preweaning period, 391 and 473 g for the postweaning period) (13). Rosu

and Stanciu (21) reported higher values for birth, 3 and 6 months weights of Simmental calves (41, 110 and 177 kg) than the corresponding values in this study. The highest average birth weight was in the spring, while the lowest value was obtained in the winter. Summer born calves had the lowest weights both at 3 and 6 months. These findings are generally in agreement with the study on Holstein and Brown Swiss calves reported by Ertuğrul *et al.* (13).

Spring born calves had the highest weight gains from birth to weaning. This may indicate that favourable climatic conditions in spring stimulate the biological system of the calf to grow faster. The winter born calves, on the other hand, made the highest weight gains from weaning to 6 months of age. This also supports the favourable seasonal effects of spring, since the postweaning period for the winter born calves coincides with the spring. The lowest average daily gains were made by autumn born calves in the preweaning period and by summer born calves in the postweaning period, which coincide with the winter and autumn seasons, respectively. The findings are generally in agreement with the reports by Rodostits *et al.* (6) and Ertuğrul *et al.* (13).

The calves in this study had equal or higher values than the same breed of calves reared indoors at this station in terms of wither heights, body lengths and heart girths at different ages, the only exception was for the cannon bone circumference (19). Also, the mean body measurements of calves were equal to or superior to those of Simmental calves reared at Karacabey State Farm (20). When the body measurements in this study were compared with other dairy and dual purpose breeds such as Holstein and Brown Swiss (13), it seems that Simmental calves had the same or larger body frame and stronger bone formation. Spring born calves had the highest values at 1, 2 and 3 months of ages, and winter born calves did so at 6 months of age.

The important advantage of individual outdoor housing for raising calves is to provide a clean environment for the calf, which lowers the risk of disease contamination (1,7,8). Because of a high incidence of health problems in the preweaning period, the data for this period were divided into two stages, from 0 to 1 and 1 to 3 months of age. The newborn calf has virtually no immunity to infection and yet the calf must survive in a highly contaminated environment. As the calf takes its first breath, pathogenic organisms start entering the body. So, to protect the calf from developing septicaemia, colostrum should be provided as soon after birth as possible and in adequate amounts. The sooner the calf receives maternal antibodies, the better will its chances be for survival. However, even proper colostrum feeding will not give complete protection to the animal. Infectious scours are the most frequent disorder among calves, particularly in the first month (13).

The main reason for changing the calf raising practice from the indoors to the outdoors was due to the high calf mortality on the farm, which had varied from 1.2 to 6.4% in preweaning and 4.5 to 13.1% in postweaning periods (19). Alpan *et al.* (20) also reported a 10.6% mortality rate for Simmental calves at Karacabey State Farm in the first six months of life. The mortality rate for calves raised outdoors in individual hutches was 5.0 and 2.5% for Holstein and Brown Swiss breeds in the first 6 months of life at Karacabey State Farm (13). However, in another study (17), 15.7% of the Holstein calves died in the first two months.

The results indicated that Simmental calves could be reared outdoors successfully in Kazova State Farm conditions. Since one of the main objectives of changing the calf raising management system on the farm from indoors to outdoors was to reduce the high calf mortality, the results obtained also appear to justify that change.

Acknowledgements

The authors wish to thank the Scientific and Technical Research Council of Turkey for its financial support, Project No. VHAG 1174, and also we would like to thank Orhan KAYA, DVM, for his help at the Kazova State Farm.

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