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Effects of Weaning Ages on the Growth, Feed Conversion Efficiency and Some Behavioral Traits of Brown Swiss x Eastern Anatolian Red F₁ Calves

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ABSTRACT

The purpose of this research was to investigate the possibility of the reducing weaning age of Brown Swiss x Eastern Anatolian Red F₁ crossbred calves reared in North East Region of Anatolia. A total of 26 calves were housed in individual hutches and weaned at 2 (early weaning) or 3 (late weaning) months of age. While weaning weight of the calves in different weaning age treatment groups was significantly ($P<0.01$) different in favor of calves weaned later, 6 months weight was not significantly affected by ages of weaning. Average 6 months weight of the male calves was significantly ($P<0.05$) higher than that of female calves. The effects of weaning ages on the weight gain in both post-weaning and overall periods of the trial were not significant. Total milk dry matter intake (DMI) of the late weaned calves were significantly ($P<0.01$) greater than that of early weaned calves. However, starter DMI of the calves weaned 2 months of age was higher ($P<0.05$) than that of late weaned calves, but dry hay and total feed DMI were not affected by the weaning ages. Sex of the calves also did not result in significant effects on the milk, dry hay, starters and total feed DMI. Feed conversion efficiency in a period between birth and 6 months of age were not significantly affected by weaning ages. The weaning age and sex of calves did not significantly affect the gains in body measurements. Percentage of time spent for lying, standing, eating and drinking water behaviors were not also significantly affected by both weaning ages and sex of calves. The results of this study suggested that the crossbred calves could be weaned successfully at 2 months of age without having adverse effect on their growth, feed conversion efficiency and behavioral traits.

Keywords: Early weaning; Feed intake; Growth performance; Behavior; Feed conversion efficiency

Sütten Kesim Yaşlarının Esmer x Doğu Anadolu Kırmızısı F₁ Buzağlarında Büyüme, Yemden Yararlanma Oranı ve Bazı Davranış Özellikleri Üzerine Etkileri

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ÖZET

Bu çalışmanın amacı, Kuzey Doğu Anadolu Bölgesi'nde yetiştirilen Esmer x Doğu Anadolu Kırmızısı F₁ melezi buzağuların süttan kesim yaşının düşürülme imkânlarını araştırmaktır. Toplam 26 buzağı bireysel bölmelerde barındırılarak 2 (erken süttan kesim) veya 3 (geç süttan kesim) aylık yaşlarda süttan kesilmişlerdir. Süttan kesim ağırlığı geç süttan kesilen buzağular lehine önemli (P<0.01) derecede farklı iken, 6 ay ağırlığı süttan kesim yaşından önemli derecede etkilenmemiştir. Erkek buzağuların 6 ay ağırlıkları önemli derecede (P<0.05) dişi buzağulardan daha yüksek bulunmuştur. Süttan kesim yaşının süttan kesim sonrası ve tüm deneme süresince canlı ağırlık artışı üzerine etkisi önemli olmamıştır. Toplam süt kuru madde tüketimi, geç süttan kesilen buzağularda erken süttan kesilenlere göre önemli derecede (P<0.01) daha yüksek bulunmuştur. Ancak, 2 aylık yaşta süttan kesilen buzağuların kesif yem kuru madde alımı geç süttan kesilenlerden daha yüksek iken (P<0.05), kuru ot ve toplam yem kuru madde tüketimleri süttan kesim yaşlarından etkilenmemiştir. Süt, kuru ot, kesif ve toplam yem kuru madde tüketimi üzerine buzağı cinsiyeti de önemli derecede etki yapmamıştır. Doğum 6 ay arası dönemde, yemden yararlanma oranı süttan kesim yaşlarından önemli derecede etkilenmemiştir. Süttan kesim yaşları ile buzağı cinsiyetinin, vücut ölçülerinde saptanan artışlar bakımından önemli etkileri olmamıştır. Yatma, ayakta durma, yem yeme ve su içme davranışları için harcanan zamanların oranları da, buzağuların süttan kesim yaşı ve cinsiyetlerinden önemli derecede etkilenmemiştir. Araştırma sonuçları, melez buzağuların büyüme, yemden yararlanma ve davranış özellikleri bakımından herhangi bir olumsuz durum oluşmaksızın başarılı bir şekilde 2 aylık yaşta süttan kesilebileceğini göstermiştir.

Anahtar Kelimeler: Erken süttan kesim; Yem tüketimi; Büyüme performansı; Davranış; Yemden yararlanma oranı

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1. Introduction

North East Region of Turkey is very suitable for cattle production due to widespread pastures and geographical conditions. Since milk and meat yields of Eastern Anatolian Red (EAR) cattle which is predominant native cattle breed do not satisfy for cattle producers, most of EAR cows reared in this area have been crossed with Brown Swiss (BS), Holstein Friesian or Simmental sires in order to improve milk and beef production. Therefore, nowadays, 59.2% of the total cattle population in this part of Turkey is consisted of crosses of EAR with the European cattle breeds, and a large proportion of the crossbreds is formed by the crosses of EAR cows with BS sires.

One of the significant factors affecting profitability of the dairy enterprise is efficient growth of dairy calves (Quigley et al 2006). Calf feeding programs have also significant influence on the efficiency of the growth rate of the young animals. Early weaning of the calves is cost effective practice at moderate environmental conditions since it gets calves started on cheaper dry feeds sooner. Therefore, raising cost of the calves is reduced by

transition from feeding of milk to feeding of dry feeds. Weaning ages of the calves reared in Turkey is highly variable and it varies from 70 to 180 days of age (Erez 2011).

Over the years, many studies (Ulutaş et al 1996; Koçak & Güneş 2005; Kehoe et al 2007; Hill et al 2009) carried out on different cattle breeds showed no significant differences in body weights and weight gains of the calves weaned early or late in different phases of the growth. Uğur & Yanar (1998), Uğur et al (2004) and Hill et al (2009) also reported that the weaning ages did not have significant influence on the feed conversion efficiency, while Bojarpour et al (2010) and Özkaya & Toker (2012) indicated that early weaning tended to increase feed consumption of dairy calves.

Up to now, any experimental data on the effect of different weaning ages on the growth performance, feed intake, feed conversion efficiency and some behavioral traits of the F₁ crossbred calves of Eastern Anatolian Red (EAR) cows with Brown Swiss (BS) sires reared in North East Region of Turkey has not been reported. Therefore, the study was carried out to compare growth performance,

feed conversion efficiency, feed intake, gains in the body measurements, cost of weight gain as well as some behavioral traits of the calves weaned at 2 or 3 months of ages.

2. Material and Methods

The experiment was conducted at Research Farm of College of Agriculture (1821 m altitude, 39° 55' 15.49" N latitude, 41° 17' 12.90" E longitude) at Ataturk University, Erzurum, Turkey. Twenty six (14 female, 12 male) newborn F₁ crossbred calves (BS♂ X EAR♀) were used in this study. The calves were born in late winter and early spring seasons. The calves were allowed to stay with their dam to receive colostrum for the first three days of their lives. Then, they were allocated randomly to two ages of weaning groups as early (weaning at 2 months of age) and late (weaning at 3 months of age) according to their sex. They were housed in a calf barn containing individual pens furnished by feeders and a plastic bucket during the study. The calves were fed with whole milk by using plastic bottles fitted with soft rubber nipples. The amount of milk fed calves was kept constant at 10% of their birth weight as suggested by Ulutaş et al (1996). The whole milk was fed to calves twice a day. All calves were weaned at either 2 months (n= 14 animals) or 3 months (n= 12 animals) of age. Two different calf starters (starter I and II) and high quality dry hay were used during the experiment. Chemical composition of the feeds used in the study is presented in Table 1. While starter I was fed to calves between birth and 4 months of age, starter II was offered to the young animals between 4 and 6 months of ages. While the maximum quantity of the calf starters was 2 kg per day, the calves had ad libitum access to dry hay. The young animals were fed individually the calf starters and dry hay during the research period. Starter I and II remained in feeders were weighed daily and the amount of feed consumed was determined and recorded. Every morning, dry hay remained in the feeder was also collected and then weighed. Before fresh dry hay was put in the feeder, the amount of the fresh dry hay was also determined and recorded. The quantity of the fresh dry hay was higher than

amount of dry hay which might be consumed daily by a calf. Therefore, the calf consumed dry hay as much as it desired (*ad libitum* feeding). Water was also supplied by a water bucket in the calf pens during the trial.

Table 1- Chemical composition of starters and dry hay used in the study

Çizelge 1- Çalışmada kullanılan kesif yemler ile kuru otun kimyasal kompozisyonu

Nutrients	Starter I (%)	Starter II (%)	Dry hay (%)
Dry matter	87.5	88.2	87.8
Crude protein	18.3	17.4	7.1
Ether extract	4.5	4.3	3.8
Crude ash	8.7	9.3	8.4
Crude cellulose	12.3	12.9	28.4

The weights and body measurements such as body length, chest depth, heart girth, height at withers and fore-shank circumference were measured and recorded at birth, weaning and 6 months of age. Behavioral data were collected by instantaneous sampling method as explained by Martin & Bateson (1993). In this method, behavior of an animal was determined and recorded once a week during 6 months by walking through the calf barn, at a distance from the calf pen at least 2.0 m, every 15 min from 9.00 until 12.00 AM. Calves did not appear to be interested in or disturbed by the presence of the observer. The behavior was observed and recorded for each of the following activities by a method utilized by Kartal & 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). First of all, number of observations belonging to each behavioral trait was found out. Then, percentage of time spent for each activity was calculated by dividing the number of observation for each trait to total quantities of the all observations. The result was expressed as a percentage by multiplying with 100. Percentage time spent for each activity was calculated for a period between birth and 6 months of age.

A 2 x 2 completely randomized factorial experimental design was used for statistical analysis of the data. The analysis of variance (ANOVA) was carried out by using SPSS (2004) statistics program. The interaction between weaning age and sex was excluded from the statistical model, since they were not significant in the preliminary statistical analysis. Behavioral data were also subjected to ANOVA, since they had normal statistical distribution. The statistical model used in the analysis is presented in Equation 1.

$$Y_{ijk} = \mu + a_i + b_j + e_{ijk} \quad (1)$$

where; Y_{ijk} , the measurement of a particular trait; μ , the population mean; a_i , effects of weaning age [$i = 1$ (2 months), 2 (3 months)]; b_j , effects of sex [$j = 1$ (male), 2 (female)]; e_{ijk} , normally distributed random error with a mean of zero and variance σ_e^2 .

3. Results and Discussion

Least square means with standard errors for weights obtained at birth, weaning and 6 months of age are presented in Table 2. The average weight of the calves weaned at 3 months of age was 21.09 kg heavier than that of calves weaned at 2 months of age ($P < 0.01$). This result was in accordance with the

findings of Uğur & Yanar (1998), Koçak & Güneş (2005) and Bajarpour et al (2010). The weight difference in favor of calves weaned at 3 months of age disappeared at 6 months of age. The weights obtained at 6 months of age were not affected significantly by the weaning age treatment. The result could be ascribed to the compensatory growth of the early weaned crossbred calves. Similarly, Bjorklund et al (2013) observed that 4-months weight of the calves weaned early (at 47 days) group did not differ from weights of calves in the mid (64 days) and late (90 days) groups.

Sex of the calves did not have significant effect on the weights obtained at birth and weaning. However, insignificant weight differences in favor of male calves at birth, weaning became significant ($P < 0.05$) in 6 months of age. The average 6 months weight of male calves was 11.47 kg higher than that of female calves (Table 2). The result is in accordance with the finding of Uğur & Yanar (1998).

The weaning age resulted in a significant ($P < 0.01$) effect on the daily weight gain in the pre-weaning period in favor of late weaned calves (Table 3). Similarly, Laswai et al (2007) and Kisac et al (2011) reported that the calves fed milk longer time had the highest ($P < 0.01$) average daily weight gain

Table 2- Least squares means and standard errors of weights (kg) obtained from the crossbred calves at different ages

Çizelge 2- Melez buzağuların farklı yaşlarda belirlenen ağırlıklarına (kg) ait en küçük kareler ortalamaları ve standart hataları

	N	Birth weight	Weaning weight	6 months weight
		$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$
Overall mean	26	28.69±0.74	63.79±1.69	141.18±2.48
Weaning age				
2 months	14	29.04±1.01	53.24±2.31	140.53±3.38
3 months	12	28.33±1.08	74.33±2.48	141.83±3.63
Level of significance		ns	**	ns
Sex				
Female	14	27.88±1.01	62.08±2.31	135.45±3.38
Male	12	29.50±1.08	65.50±2.48	146.92±3.63
Level of significance		ns	ns	*

** $P < 0.01$; * $P < 0.05$; ns, not significant

in the pre-weaning period. In the present study, the weaning age effect on the weight gain disappeared in the post-weaning period. Overall daily weight gains in the period between birth and 6 months of age were not significantly different. All calves had a lower daily weight gain in the pre-weaning period of the growth, then, rate of weight gain increased with time as already reported by Ulutaş et al (1996) and Uğur et al (2004). Daily weight gains of the male calves in the post-weaning and overall periods in the present study were significantly ($P<0.01$) higher than those of the female calves. On the other hand, daily weight gains of the male and female calves in pre-weaning period did not differ significantly. Similar results were already reported by Yanar et al (2006) and Metin et al (2006).

Amounts of milk ($P<0.01$) and starters ($P<0.05$) DMI of the calves weaned at 2 months of age throughout the study was significantly different from those of calves weaned at 3 months of age (Table 4). The late weaned crossbred calves consumed 9.68 kg more milk dry matter (equal to 80.6 kg whole milk) than calves weaned at 2 months of age. On the other hand, late weaned calves consumed 23.21 kg less starter ($P<0.05$) than young animals weaned earlier. The result is in harmony with the findings

of Khan et al (2007), Bojarpour et al (2010), Özkaya & Toker (2012) and Rashid et al (2013). The reduction in calf starter intake of the young animals in the late weaning group could be due to prolonged milk feeding. Jasper & Weary (2002) reported that increased intake of nutrients in liquid form generally causes less starter and forage intake in the dairy calves.

Least square means with standard error for feed conversion efficiencies in different phases of the growth of the crossbred calves are presented in Table 5. Feed conversion efficiency was in favor of late weaned calves ($P<0.05$) in the pre-weaning period. However, the same value was better for early weaned calves ($P<0.01$) in the post-weaning period. On the other hand, the difference between weaning age groups regarding feed conversion efficiency values obtained in the period between birth and 6 months of age was not statistically significant. Similar observation has already been reported by Kehoe et al (2007). The feed conversion efficiency values of male and female calves in pre- and post-weaning periods did not differ significantly. The result is in harmony with the finding of Uğur & Yanar (1998).

Table 3- Least squares means and standard errors of weight gains (kg) at various periods of the growth of crossbred calves

Çizelge 3- Melez buzağların farklı büyüme dönemlerinde ağırlık artışlarına ait en küçük kareler ortalamaları ve standart hataları

	<i>Weight gains</i>			
	<i>In pre-weaning period</i>	<i>In post-weaning period</i>	<i>Between birth and 6 months of age</i>	
	<i>N</i>	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$
Overall mean	26	0.46±0.02	0.72±0.02	0.62±0.01
Weaning age				
2 months	14	0.40±0.02	0.73±0.03	0.62±0.02
3 months	12	0.51±0.03	0.72±0.03	0.63±0.02
Level of significance		**	ns	ns
Sex				
Female	14	0.45±0.02	0.68±0.03	0.60±0.02
Male	12	0.47±0.03	0.76±0.03	0.65±0.02
Level of Significance		ns	*	*

** $P<0.01$; * $P<0.05$; ns, not significant

Table 4- Least square means and standard errors of milk, dry hay, starters and total feed dry matter intake of the calves between birth and 6 months of age

Çizelge 4- Doğum ile 6 aylık yaş arasında buzağuların süt, kuru ot, kesif yem ve toplam yem kuru madde alımına ait en küçük kareler ortalamaları ve standart hataları

	N	Total feed dry matter intake (kg) between birth and 6 months of age for			
		Milk	Dry hay	Starters	Total feed
		$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$
Overall mean	26	25.76±0.70	76.99±1.95	260.89±4.65	363.64±6.06
Weaning age					
2 months	14	20.92±0.95	78.37±2.66	272.50±6.34	371.79±8.26
3 months	12	30.60±1.02	75.60±2.86	249.29±6.81	355.49±8.87
Level of significance		**	ns	*	ns
Sex					
Female	14	25.09±0.95	77.53±2.66	258.28±6.34	360.90±8.26
Male	12	26.43±1.02	76.44±2.86	263.51±6.81	366.38±8.87
Level of significance		ns	ns	ns	ns

***P*<0.01; **P*<0.05; ns, not significant

Table 5- Least square means and standard errors of feed conversion efficiencies of the calves at different periods of the growth

Çizelge 5- Büyümenin farklı dönemlerinde buzağuların yemden yararlanma değerlerine ait en küçük kareler ortalamaları ve standart hataları

	N	Feed conversion efficiency ¹		
		In pre-weaning period	In post-weaning period	Between birth and 6 months of age
		$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$
Overall mean	26	1.40±0.08	4.22±0.11	3.26±0.06
Weaning age				
2 months	14	1.63±0.12	3.84±0.15	3.35±0.09
3 months	12	1.17±0.12	4.60±0.16	3.17±0.09
Level of significance		*	**	ns
Sex				
Female	14	1.46±0.12	4.42±0.15	3.38±0.09
Male	12	1.34±0.12	4.02±0.16	3.14±0.09
Level of significance		ns	ns	ns

***P*<0.01; **P*<0.05; ns, not significant, ¹Feed conversion efficiency= dry matter consumed (kg) / weight gain (kg)

Gains in body measurements such as body length, hearth girth, height at withers, chest depth and fore-shank circumference were not significantly influenced by both the weaning age and sex of calves (Table 6). The results of body measurements are in agreement with the findings of the previous studies on calves weaned at different ages (Kehoe et al 2007; Rashid et al 2013).

In Table 7, least square means with standard errors for behavioral traits observed throughout the experiment are presented. Weaning age and sex did not result in significant differences in the average percentage of time spent for lying, standing, eating and drinking water behaviors during the entire research period. The data on the behavioral traits demonstrated that the weaning age did not affect

Table 6- Least square means and standard errors of gains in body measurements of the crossbred calves (cm) between birth and 6 months of age

Çizelge 6- Doğum ile 6 aylık yaş arasında melez buzağların vücut ölçülerindeki artışlara ait en küçük kareler ortalamaları ve standart hataları

	N	Height at withers	Body length	Chest depth	Heart girth	Fore-shank circumference
		$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$
Overall mean	26	29.83±0.93	34.56±1.09	18.33±0.55	48.88±0.82	3.63±0.18
Weaning age						
2 months	14	30.49±1.27	33.49±1.49	18.03±0.75	47.92±1.11	3.80±0.24
3 months	12	29.17±1.36	35.63±1.60	18.63±0.81	49.83±1.20	3.46±0.26
Level of significance		ns	ns	ns	ns	ns
Sex						
Female	14	28.41±1.27	34.65±1.49	17.40±0.75	48.17±1.11	3.30±0.24
Male	12	31.25±1.36	34.46±1.60	19.25±0.81	49.58±1.20	3.96±0.26
Level of significance		ns	ns	ns	ns	ns

** , P<0.01; * , P<0.05; ns, not significant

Table 7- Least square means and standard errors of percentage of time spent on different activities of crossbred calves as affected by different weaning ages in a period between birth and 6 months of age

Çizelge 7- Doğum ve 6 aylık yaş arası periyotta farklı sütten kesim yaşları uygulanan melez buzağların farklı aktiviteleri için harcanan zamanların oranlarına ait en küçük kareler ortalamaları ve standart hataları

	N	Behavioral traits			
		Standing (%)	Lying (%)	Eating (%)	Drinking (%)
		$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$
Overall mean	26	25.52±0.74	35.89±0.93	37.54±0.85	1.05±0.14
Weaning age					
2 months	14	25.81±1.01	35.45±1.26	37.69±1.16	1.06±0.19
3 months	12	25.24±1.08	36.33±1.36	37.39±1.25	1.04±0.20
Level of significance		ns	ns	ns	ns
Sex					
Female	14	25.49±1.01	35.73±1.26	37.82±1.16	0.97±0.19
Male	12	25.56±1.08	36.05±1.36	37.26±1.25	1.13±0.20
Level of significance		ns	ns	ns	ns

ns, not significant

the behavioral pattern of the calves. Weaning the calves at 2 months of age did not cause detrimental influence on the behavioral pattern of the calves.

Weaning ages had significant (P<0.01) effect on the cost of weight gain. Average feeding cost per kg weight gain of the calves weaned at 2 and 3 months of ages were \$ 2.18 and \$ 2.41 (4.28 and 4.71 Turkish Liras) respectively. The increased cost of calves weaned at 3 months of age was due to the

extra amount of milk (average 80.6 kg per calves) offered to the young animals. Similarly, Bjorklund et al (2013) reported that total cost per kg of gain for the first 90 days of age was lowest for early weaned calves (\$ 3.02) and highest for late weaned animals (\$ 4.13). On the other hand, Laswai et al (2007) reported insignificant effects of the weaning age on the cost of weight gain of the calves reared in Tanzania.

4. Conclusions

The results of this research suggest that it is possible to wean calves reared under the conditions of North East Turkey at 2 months of age without causing any detrimental effect on their growth performance. Further studies on the on weaning age earlier than 2 months should be conducted under these conditions.

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