KSÜ Tarım ve Doğa Derg 25 (Ek Sayı 1): 300-306, 2022
KSU J. Agric Nat 25 (Suppl 1): 300-306, 2022
DOI:10.18016/ksutarimdoga.vi.1013499

Dry Period Length in Dairy Cattle: II. Influence on Calf Survival and Growth Performance

Jale METIN KIYICI[1✉], Özlem KÖKNUR[2] , Mahmut KALIBER[3]
[1,3]Department of Animal Science, Faculty of Agriculture, Erciyes University, 38039 Kayseri, [2]Saray Farm Dairy Operation Corporation, Develi, Kayseri
[1]https://orcid.org/0000-0002-5030-5748, [2]https://orcid.org/0000-0002-6905-984X, [3]https://orcid.org/0000-0001-5572-6384
✉: jalemetin@erciyes.edu.tr

ABSTRACT
This study was conducted to investigate the effects of dry period length (DPL) on survival rate, gender, growth performance, mortality of Holstein calves. Data belonged to 800 Holstein cows in different parities (2nd, 3rd and ≥4th) and 800 calves delivered by these cows. DPL were classified in 5 categories (≤40, 41-50, 51-60, 61-70, ≥71 days). Calves were weighed and body dimensions (body length, wither height, hearth girth) at birth and 6th months of age. There were significant relationships between DPL and calf gender (P<0.01). The cows with DPL of 51-60 days had greater female calf ratios and the cows with DPL of 61-70 days had greater male calf ratios. In the study, the relationship between calves' body weights (birth and 6th month) and DPL was found to be significant at P<0.01 level, and the relationship between body measurements (6th month body length 6th month wither height) and DPL was significant at P<0.05 level. These values the highest were observed in the calves of the cows with DPL 61-70 days. The relationship between calves survivability, mortality values and DPL was not significant (P>0.05). The results obtained from the study showed that the dry period length of the cows can be planned between 61-70 days, considering the body weight and growth performance of the calves.

Animal Breeding

Research Article

Article History
Received : 22.10.2021
Accepted : 20.12.2021

Keywords
Dry period length
Calf performance
Mortality
Gender
Holstein

Süt Sığırlarında Kuru Dönem Uzunluğu: II. Buzağılarda Yaşama Gücü ve Büyüme Performansı Üzerinde Etkisi

ÖZET
Bu çalışma Holstein ırkı ineklerde kuru dönem uzunluğunun (KDU) buzağılarda yaşama gücü, cinsiyet, büyüme performansı, mortalite üzerindeki etkisini araştırmak amacıyla yapılmıştır. Çalışmada Holstein ırkı 800 baş inek (laktasyon sırası: 2, 3 ve ≥4) ve bu ineklerin yeni doğan buzağıları kullanılmıştır. İnekler KDU' ya göre beş kategoride KDU≤40 gün, 41-50, 51-60, 61-70, KDU≥71 gün sınıflandırılmıştır. Buzağıların doğumda ve 6 aylık yaşta canlı ağırlıkları ve bazı vücut ölçüleri alınmıştır. Çalışma sonucunda ineklerde KDU ile buzağı cinsiyeti arasındaki ilişki anlamlı (P<0.01) olmuştur. Kuru dönem uzunluğu 51-60 gün olan ineklerde dişi buzağı sayısı, 61-70 gün olan ineklerde ise erkek buzağı sayısı daha fazla olmuştur. Çalışmada buzağıların doğum ve 6. ay canlı ağırlıkları ile KDU arasındaki ilişki P<0.01 düzeyinde ve 6. ay vücut uzunluğu ve cidago yüksekliği ile KDU arasındaki ilişki P<0.05 düzeyinde anlamlı bulunmuştur. Bu değerler en yüksek 61-70 gün kuruda kalan ineklerin buzağılarında görülmüştür. Buzağıların mortalite değerleri ile KDU arasındaki ilişki anlamlı olmamıştır (P>0.05). Çalışmadan elde edilen sonuçlar, buzağıların canlı ağırlık ve büyüme performansı dikkate alındığında ineklerde kuruda kalma süresinin 61-70 gün arasında planlanabileceğini göstermiştir.

Zootekni

Araştırma Makalesi

Makale Tarihçesi
Geliş Tarihi : 22.10.2021
Kabul Tarihi : 20.12.2021

Anahtar Kelimeler
Kuru dönem uzunluğu
Buzağı performansı,
Mortalite
Cinsiyet
Holstein

To Cite Metin-Kıyıcı J, Köknur Ö, Kaliber M 2022. Dry Period Length in Dairy Cattle: II. Influence on Calf Survival and Growth Performance. KSU J. Agric Nat 25 (Suppl 1): 300-306, DOI:10.18016/ksutarimdoga.vi.1013499.

Atıf Şekli: Metin-Kıyıcı J, Köknur Ö, Kaliber M 2022. Süt Sığırlarında Kuru Dönem Uzunluğu: II. Buzağılarda Yaşama Gücü ve Büyüme Performansı Üzerinde Etkisi. KSÜ Tarım ve Doğa Derg 25 (Ek Sayı 1): 300-306. DOI:10.18016/ksutarimdoga.vi.1013499

INTRODUCTION

Dairy cows are subjected to a dry period for certain duration between two lactations to have regular milk yield in subsequent lactation (Collier et al., 2012). Optimum dry period length (DPL) is determined by taking herd size, parity and milk yield levels into consideration. Traditionally, such periods are applied as 305 days for lactation and 51-60 days for DPL (Bachman and Schairer, 2003; Grummer and Rastani, 2004). DPL are related to milk yield, milk composition, reproduction performance of the dairy cows as well as birth weight, survival rate and growth performance of the calves of these cows (Coppock et al., 1974; Kuhn et al., 2006; Pezeshki et al., 2008; Atashi et al., 2013; Hossein-Zadeh and Mohit, 2013; Rahbar et al., 2016; Metin Kıyıcı et al., 2020). Healthy calves are significant indicator of animal welfare and economic livestock farming (Lorenz et al., 2011a; McGuirk, 2008; Santman-Berends et al., 2014). Size of delivered calf is an important characteristic for ease of delivery and survival of neonatal calf (Johanson and Berger, 2003). On the other hand, epidemiological evidence suggests that small size at birth is associated with increased predisposition to metabolic diseases during adult life (Symonds et al., 2010; Vuguin, 2007). Birth weight of the calves, growth performance and survival rates are largely influenced by the animal breed, gender, age of mother, maternal ability, number of calves at birth, several genetic and environmental factors (Akbulut et al., 2001). Additionally, Atashi et al., (2013) indicated that DPL had also significant effects on calf birth weight and growth performance.

Therefore, in this study was designed to investigate the relationships between dry period length with gender, birth and 6th month growth performance and survival rates (or mortality) of Holstein calves.

MATERIALS and METHODS

Data obtained from a commercial dairy farm were used in the study. Thus, measurement of phenotypic characteristics was performed under the routine management and breeding procedure for calves at farm, no animal experiment and additional handling was involved in the study. Therefore, no ethics approval was necessary.

In the study, data obtained from cows raised in an intensive commercial dairy breeding operation (Saray Farm Dairy Operation Co.) located in Central Anatolia region of Turkey (Latitude:38°.34'66.79, Longitude: 35°.47'84.66) were used. Data belonged to 800 heads Holstein cows in different parities (2nd, 3rd and ≥4th) and 800 heads calves delivered by these cows between November 2014 and December 2015. Parities and calving body weights (kg) of multiparous cattle used in this study are provided based on DPL in Table 1.

Table 1- Parities and calving body weights (kg) of multiparous cattle based on DPL
Çizelge 1- KDU' na göre ineklerin sayısal dağılımı (baş) ve buzağılamadaki canlı ağırlık ortalamaları (kg)

Lactation Numbers *Laktasyon Sayısı*	Dry Period Length (day) *Kuru Dönem Uzunluğu (gün)*											
	≤40 (days)		41-50 (days)		51-60 (days)		61-70 (days)		≥71 (days)		General	
	n	BW (kg)	n	BW (kg)	n	BW (kg)	n	BW (kg)	n	BW (kg)	n	BW (kg)
2	30	613	47	610	106	597	33	579	15	614	231	603
3	34	609	58	627	156	613	84	623	72	609	404	616
≥4	19	617	23	616	65	600	29	604	29	617	165	611
General	83	613	128	618	327	603	146	602	116	613	800	610

BW; Body Weight (kg)

The procedure for drying off the cows was carried out by reducing the number of daily milking frequency of 3 gradually to 2 and 1 when the daily milk yield of the cattle decreased to 10 liters or below. The time between full termination of milking and parturition was monitored as dry period length. The cows with signs of parturition were taken to the individual calving pen and calves were born in these pens. Neonatal calves stayed with their mothers after the birth and consumed colostrum *ad-libitum* for three days. At the end of three days, calves were relocated into the individual pens and fed with milk until weaning (30 days) with a daily amount of 10% of their body weight. From the 7th day to weaning the calves were supplied with a concentrate mixture and alfalfa hay *ad libitum*. After weaning, animals were kept in group housing pens and received milk replacer for 40 days and fed with forage and commercial concentrate mixture *ad libitum* until the 180th day. Clean drinking water was supplied *ad libitum* at all the time. Chemical composition of the feeds used in the study (fresh milk, milk replacer, calf starter, calf grower feeds and alfalfa hay) is presented in Table 2.

To follow up growth performance of calves, body

weight and body size (body length, wither height, hearth girth) were measured right after the birth (within the first 24 hours) and at the age of 6 months. The animals were weighed to the nearest kilogram using an electronic scale (EziWeigh 5i, Tru-Test, New Zealand) placed on a concrete platform. Body measurements were taken by two person using an ordinary measuring tape and recorded in centimeters. Body length was measured as the distance from Tuber a*triculus humeri* to *Tuber ichii*; wither height was measured as the distance from the ground to the highest point of wither. Hearth girth was measured behind the front shoulder at the fourth ribs, posterior to the front leg.

Table 2. Nutritive values of fresh milk, milk replacer, concentrate mixtures and alfalfa hay used in the study
Çizelge 2. Çalışmada kullanılan taze süt, süt ikame yemi, konsantre yem ve yonca kuru otu besin değerleri

Nutrients *Besin Elementleri*	Fresh milk *Taze süt*	Milk replacer *Mama*	Calf starter feed *Buzağı başlangıç yemi*	Calf grower feed *Buzağı büyütme yemi*	Alfalfa hay *Yonca kuru otu*
Dry matter (%)	12.2	96.2	88.0	88.0	91.7
Crude protein (% of DM)	3.4	31.2	18.0	17.0	18.1
Crude fat (% of DM)	3.3	20.1	4.6	4.6	2.5
Crude ash (% of DM)	0.7	6.1	8.2	10.0	9.8
Crude cellulose (% of DM)	-	-	12.0	12.0	29.4

Statistical Analysis

Statistical analyses were performed with IBM SPSS Statistics 22.0 software (SPSS 2013). In present model, bulls effect was taken as random effect and parity (2^{nd}, 3^{rd} and $\geq 4^{th}$), calving year (2014, 2015), calving season (winter: December to February, spring: March to May, summer: June to August: and autumn: September to November) were taken as fixed effect. The relationships between DPL variable and categorical data (calf gender, survival rates (or mortality)) were tested with the use of Pearson Chi-Square Test and results were expressed in percentage (%). Mortality is the proportion of animals that die per hundred animals in an animal group (Tüzemen 2002). Mortality is calculated by the formula below;

Mortality (%) = (Number of Animals Died / Total Number of Animals) x 100

Since body length trait did not exhibit normal distribution, relevant data were subjected to non-parametric independent samples Kruskal Wallis Test and results were expressed in median (25-75 percentiles). The body weight (kg), height at withers (cm) and hearth girth (cm) traits exhibited normal distribution, so One-Way Anova Test was applied to relevant data. Significant means were compared with the use of Tukey's multiple range test.

RESULTS and DISCUSSION

Results on the effect of the different DPL on some investigated traits of calves are provided in Table 3.

In the study, the differences in survival rate were not significant (P>0.05) between the groups. The greatest survival rate (88.0%) was obtained from the calves of cows with ≤40-day dry period (mortality is %12) and the lowest survival rate (81.0%) was obtained from the calves of cows with ≥71-day dry period (mortality is %19). The annual average of the calves survival rate of the farm where the study was conducted is 94%. Calf survival characteristics; calf birth weight, gender, age of the mother, body weight of the mother, farm, calving season, calving year etc. is affected by many factors (Bilgiç ve Alıç, 2004; Koçak ve Güneş, 2005; Bayrıl ve Yılmaz, 2010). Additionalıy, Uzmay et al (2010) reported that the risk of dystocia was 1.96, 4.53 and 5.29 times higher in calves with birth weight classes 35.1-40.0, 40.1-45.0 and ≥45.1 kg, respectively. The overall mean of survival rate value reported by Karakaş (2002) as 83.7 %, Özçakır and Bakır (2003) as 96.22 %, Bayrıl ve Yılmaz (2010) as 92.1 %, Yüceer and Özbeyaz (2010) as 88.90 %, Ayaşan et al., (2016) as 83.0 % and Hızlı et al., (2017) reported as 97.12 %.

There were significant relationships between DPL and calf gender (P<0.01). The greatest number of female calves (178 – 54.4%) was obtained from the cows with DPL of 51-60 days and the lowest number of female cows (53 – 36.3%) was obtained from the cows with DPL of 61-70 days (Table 3). In the dairy cattle industries, breeders desire to have female cows to enlarge or replacement stock their herds, but beef cattle farmers desire to have male calves (Erten and Yılmaz 2012). Therefore, calf gender is an important factor in dairy cattle industries.

In this study there were significant relationships between DPL and calf birth weight (P<0.01) (Table 3). The greatest calf birth weight (42.79±4.40 kg) was obtained from the calves of cows with DPL of 61-70 days and the lowest calf birth weight (40.39±4.28 kg) was obtained from the calves of cows with DPL of ≤40 days. Atashi et al., (2013) indicated that calf birth weight did not differ for cows with DPL of 0 to 35 d, 36 to 50 d, or 51 to 60 d, but the average calf birth weight for cows with standard DPL (51 to 60 d) was less than in those with longer dry periods. Previous researchers reported no differences in calf birth weight for cows with 28-d and 49-d dry periods (Pezeshki et al., 2008), or for cows with 30-d and 60-d

Table 3- The effect of the different DPL on some investigated traits of calves
Çizelge 3- Buzağılarda incelenen bir kısım özellikler üzerinde KDU' nun etkisi

Traits* / *Özellikler*	Dry Period Length (day) / *Kuru Dönem Uzunluğu (gün)* ≤40 (n=83)	41-50 (n=128)	51-60 (n=327)	61-70 (n=146)	≥70 (n=116)	Genel	P
Rate of survival (n (%))							
Live	73 (88.0)	112 (87.5)	280 (85.6)	126 (86.3)	94 (81.0)	685 (85.6)	
Death	10 (12.0)	16 (12.5)	47 (14.4)	20 (13.7)	22 (19.0)	115 (14.4)	0.597
Total	83 (100.0)	128 (100.0)	327 (100.0)	146 (100.0)	116 (100.0)	800 (100.0)	
Gender (n (%))							
Female	42 (50.6)^{a}	61 (47.7)^{a}	178 (54.4)^{b}	53 (36.3)^{c}	55 (47.4)^{a}	389 (48.6)	
Male	41 (49.4)^{a}	67 (52.3)^{a}	149 (45.6)^{b}	93 (63.7)^{c}	61 (52.6)^{a}	411 (51.4)	0.009
Total	83 (100.0)	128 (100.0)	327 (100.0)	146(100.0)	116(100.0)	800(100.0)	
Body Weight (kg)							
Birth	40.39±4.28^{a}	40.50±4.49^{a}	40.97±3.77^{a}	42.79±4.40^{b}	41.32±3.90^{b}	41.22±4.15	0.001
6th month	184.78±20.46^{a}	188.06±31.78^{ab}	196.55±30.05^{b}	198.43±33.36^{b}	195.94±31.51^{b}	194.17±30.60	0.003
Body length (cm)							
Birth	69.0 (63.0-71.0)	70.0 (66.0-71.0)	70.0 (67.0-71.0)	70.0 (67.0-72.0)	70.0 (65.0-71.0)	---	0.067
6th month	107.0 (103.5-110.5)	108.0 (104.0-112.75)	108.0 (104.0-112.0)	109.5 (105.0-114.0)	108.0 (104.0-111.0)	---	0.047
Wither height (cm)							
Birth	71.30±6.41	72.41±5.91	72.51±5.77	73.23±5.96	72.09±6.00	72.44±5.94	0.192
6th month	106.00±4.31^{a}	105.81±5.26^{ab}	107.15±5.15^{ab}	107.20±5.65^{ab}	107.17±5.95^{b}	106.96±5.33	0.019
Hearth girth (cm)							
Birth	73.07±4.95	73.90±4.89	74.01±4.76	74.72±5.09	73.72±4.81	73.98±4.88	0.158
6th month	126.44±6.65	128.07±9.545	129.16±8.487	129.48±9.702	128.89±8.528	128.72±8.759	0.122

*Data; n (%), mean ± standard deviation or median (25-75 percentiles).
a-b: The means indicated with different superscript in the same row are significantly different

dry periods (Gulay et al., 2003). The overall mean of birth weights (41.22±4.15 kg) similar to value reported by Bush and Nicholson (1986), Başpınar et al. (1998), Johanson and Berger (2003), Uzmay et al. (2010) and greater than the values reported by Unalan (2009), Bayrıl and Yılmaz (2010) Şahiner and Demir (1998), Akbulut et al. (1993), Bardakçıoğlu (2001), Bilgiç and Alıç (2005) and Kaygısız et al. (2012). Average birth weight of Holstein-like large size breeds is commonly reported as 40-45 kg (Wattiaux 1996b). Also, in the study were determined significant ($P<0.01$) relationships between DPL with calf body weight at 6th month. The greatest calf body weight at 6th month was obtained from the calves of cows with DPL of 61-70 days (198.43±33.36 kg) and the lowest value was obtained from the calves of cows with DPL of ≤40 days (184.78±20.46 kg). These determined values were different and higher than those reported by Yanar et al (2002), Bayrıl and Yılmaz (2010), Yüceer and Özbeyaz (2010), Ayaşan et al (2016) and Aydın et al (2018).

In the study are used body length, wither height, hearth girth traits to determine growth performance of calves (Şekerden, 2010; Metin Kıyıcı and Tüzemen, 2012). The relationships between DPL and body measurements were not found to be significant ($P>0.05$). However, DPL had significant relationships with body length and wither height at 6th month ($P<0.05$). The greatest body length at 6th month was obtained from the calves of cows with DPL of 61-70 days (109.5 cm) and the lowest value was obtained from the calves of cows with DPL of ≤40 days (107.0 cm). The greatest wither height at 6th month was obtained from the calves of cows with dry period lengths of 61-70 days (107.2 cm) and the lowest value was obtained from the calves of cows with DPL of 41-50 days (106.0 cm). The 6th month body length and wither height of Holstein calves were reported as 102.53 cm and 98.31 cm by Yüceer and Özbeyaz (2010) and 134.6 cm and 94.5 cm by Doğan (2014) respectively.

CONCLUSION

Despite numerous studies about the effects of DPL on milk yield and reproduction-like traits, number of studies about the effects of DPL on growth performance and survival rate of calves is quite limited. In this study, effects of DPL on birth weight and growth performance of calves were investigated.

Calf survival characteristics; calf birth weight, gender, age of the mother, body weight of the mother, farm, calving season, calving year etc. is affected by many factors. The results obtained from the study showed that the dry period length of the cows can be planned between 61-70 days, considering the body weight and growth performance of the calves. Also in the study, it was determined that the gender of the calf was affected by the dry period length. Further research is needed for the effects of DPL on calf performance.

ACKNOWLEDGEMENTS

Authors express their sincere thanks to owners of Saray Farm Dairy Operation Co. (Kayseri/Turkey) for allowing them to perform this study in their facility. Thanks are extended to facility staff dealing with the care and growth of the cows.

Researchers Contribution Rate Declaration Summary

The authors declare that they have contributed equally to the article.

Conflicts of Interest Statement

The authors declare that they do not have any competition and any conflicts of interest.

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