

## Estimates of Genetic and Phenotypic Parameters for the Birth Weight of Calves of Holstein Friesian Cattle Reared Organically

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**Abstract:** The aim of this study, was to estimate genetic and phenotypic parameters for birth weight and to determine the survival rate of calves of Holstein Friesian cattle reared organically. Aborting rate, still born rate and the calving difficulty rate were 4.6, 3.9 and 9.1%, respectively. The average birth weight was  $42.76 \pm 0.229$  kg in present study. This value was quite higher than the birth weight in Holstein Friesian calves that breed conventionally in Turkey's conditions. The effect of calving season ( $p < 0.01$ ) and farming system ( $p < 0.05$ ) on birth weight were significant. Male calves had 2.69 kg higher birth weight than females and this difference was found significant ( $p < 0.01$ ). The mean birth weight of single calves was 6.26 kg (17%) higher than that of twin calves. The effect of the years on birth weight was not significant, because caring, feeding and the other breeding methods were made according to the conditions of the regulations. As the birth parity was increased, the birth weight decreased ( $p < 0.05$ ). Heritability and repeatability estimates belong to birth weight were found as  $0.232 \pm 0.110$  and  $0.206 \pm 0.073$ , respectively.

**Key words:** Holstein Friesian, calf, birth weight, organic dairy, survival rate

### INTRODUCTION

Organic dairy production is drawing increasing attention because of public concerns about food safety, animal welfare and environmental impacts of intensive livestock systems (Sato *et al.*, 2005). Organic livestock production is a means of food production with a large number of rules directed towards a high status of animal welfare, care for environment, restricted use of medical drugs and the production of a healthy product without residues (pesticide and medical drugs) (Kijlstra and Eijck, 2006). Organic livestock productions have some rules. These rules relate to foodstuffs, disease, prevention and veterinary treatment, animal welfare, husbandry practices and management of manure (Von Borell and Sorensen, 2004).

There are many comprehensive studies on organic bred cattle in different countries especially, in Europe (Reksen *et al.*, 1999; Hardeng and Edge, 2001; Bennedsgaard *et al.*, 2003; Nauta *et al.*, 2006). These studies are mostly related to milk traits, reproductive performance and animal health. However, there is little information about the survival rate and the birth weight of calves on organic husbandry.

The rate of the aborting, stillborn and calving difficulty incidence is very important for the yield of herd

and management in cattle farms. Also, the birth weight is an important breed characteristic in cattle. The birth weight is not only the easiest and the most reliable measurement of the prenatal period, but also a substantial factor that affects post-natal growth and development (Akbulut *et al.*, 2001). A substantial and positive relationship was determined between the birth weight and the first calving age (Kaygisiz *et al.*, 1995; Bakir *et al.*, 2004; Heinrichs *et al.*, 2005). This relationship can be interpreted as Heifers that have a higher birth weight on calving at an earlier age (Pietersma *et al.*, 2007). Additionally, calving difficulties and death risk are closely related to the birth weight in cattle farming. The rate of death and calving difficulty has increased in both calves that have a very low and high birth weight (Johanson and Berger, 2003).

The aim of this study, was to estimate genetic and phenotypic parameters for birth weight and to determine the survival rate of calves of Holstein Friesian cattle reared organically.

### MATERIALS AND METHODS

The birth records of calves bred in private organic dairy farm, which is the first organic dairy farm in Turkey was established in Kelkit county of Gumushane province

located in Eastern Black Sea region of the country in 2003, forms the material of this study. The town has a harsh climate and altitude from sea level ranges about 1450 m, the yearly average temperature is 6.9°C, the coldest month average is -6.9°C (January) and the hottest month average is 18.7°C (August), the average annual rainfall is around 355 mm (Karakuzulu, 2006).

At the beginning, pregnant heifers from conventional dairy farm in Wisconsin, USA were brought to the farm and they were reared in the farm under pre-organic dairy conditions for 2 years. Later, the farm was converted to organic production in 2005. Data collected between 2003 and 2004 were named as pre-organic data and records obtained after 2005 were named as organic data.

Caring, feeding, sheltering and veterinary treatment of the cattle in this organic dairy farm are applied according to the regulations of the organic agriculture and application procedures which have been published by the Ministry of Agriculture in June, 2005 (Anonymous, 2005).

In Turkey, according to present organic agriculture regulations, it was permitted that organic dairy husbandry 60% of daily formulated feed must be composed of roughage and the other 40% must be composed of concentrate. In addition to this with the permission of the control committee, the amount of concentrate can be increased to 50% for a maximum of three months for the animals that are in lactation and have calved recently. When, the organic feed production is inadequate, 10% of yearly total feed need can be provided with conventional feeds. This percentage was dropped to 5% in 2008 (Anonymous, 2005). Alfalfa, sainfoin, common vetch corn and barley are produced organically in this farm without using chemical fertilizer. Corn, common vetch are utilized for production of silage. The silage, organic dry meadow hay and organic dry alfalfa are used in the diet of the animals as sources of roughage.

The birth weights of live born calves were measured in a few hours following the birth. Calves were separated from their mothers after initial colostrums. They were put into individual calf hutches. The calves stayed in individual calf hutches for 21 days and were given 4 L of milk in a day, 2 L in the morning and 2 L in the evening. After then calves were put into groups of six and were given 3 L of milk in a day. The calves were weaned after 90 days and males were sold and females were bred for the herd. In this organic dairy farming, pregnant animals were dry off period of 2 months before calving. Also, the animals whose daily milk yield decreases below 10 L were directly dry off period.

In this study, firstly, the survival rate of the calves was determined. After then, phenotypic and genetic parameters were estimated for birth weight of 577 Holstein Friesian calves born alive between 2003-2006.

Birth weights of calves were analyzed by using the following statistical model,

$$Y_{ijklmn} = \mu + a_i + b_j + c_k + d_l + f_m + g_n + e_{ijklmn}$$

where:

- $\mu$  = The populations mean
- $a_i$  = The effect of calving year
- $b_j$  = The effect of calving season
- $c_k$  = The effect of farming system (data between 2003 and 2004 named as pre-organic; after 2005 named as organic)
- $d_l$  = The effect of sex
- $f_m$  = The effect of birth type
- $g_n$  = The effect of parity
- $e_{ijklmn}$  = Error

Statistical analysis was carried out by SPSS statistics package program (SPSS, 2004). Duncan (1955) test was utilized in comparison of sub-groups means. The mother's age was not included in the model because animals brought to the farm in the establishment were in the same age group.

$S_p$  and  $h_s$  which, describe the effects of sire and dam, respectively, were included in the model for estimation of heritability and repeatability. Half sib-correlation was used for estimation of heritability birth weight. Maternal half sib correlation was used for estimation of repeatability of birth weight. Data were analyzed using Harvey's linear mixed model Least Squares and Maximum Likelihood (LSMLMW) computer program (Harvey, 1987).

## RESULTS AND DISCUSSION

Descriptive information for the birth condition, style and form of the calves born in the farm was summarized in Table 1. In this organic dairy farming, it can be said that here calves have a good performance in terms of birth status. The aborting rate was 4.6% and the stillborn rate was 3.9%, which causes important economic losses in cattle farm. A 90.9% of the calves were born without any assist. Survival rate of calves at the birth moment in the herd was 91.5%.

Least squares means with their standard errors and result of Duncan (1995) test for factors influencing birth weight are presented in Table 2. As indicated in Table 2, effect of calving season, sex, birth type ( $p < 0.01$ ), farming system and parity ( $p < 0.05$ ) on birth weight was significant. However, the effect of calving year on the birth weight was not significant.

The average birth weights of calves were determined as  $42.76 \pm 0.229$  kg (Table 2). This value was found very much higher than that declared for conventional bred

Table 1: Some descriptive rates for the birth

Variable	N	n	(%)
<b>Birth characteristics</b>			
Normal	632	578	91.5
Abort		29	4.6
Still born		25	3.9
<b>Birth type</b>			
Normal	584	531	90.9
Difficult		53	9.1
<b>Birth type</b>			
Single	580	553	95.3
Twin		27	4.7

Table 2: Least squares means and standards errors for birth weight

Factors	N	Birth weight X±S <sub>e</sub>
<b>Overall means</b>	577	42.76±0.229
<b>Calving of year</b>		
2003	20	44.68±1.36
2004	101	43.33±0.477
2005	312	42.75±0.317
2006	144	42.11±0.465
F		1.86 NS
<b>Calving of season</b>		
Winter	207	43.70±0.374 <sup>a</sup>
Spring	217	43.14±0.376 <sup>a</sup>
Summer	94	40.77±0.530 <sup>b</sup>
Autumn	59	41.24±0.678 <sup>b</sup>
F		8.273**
<b>Farming system</b>		
Pre-organic	121	43.70±0.466 <sup>a</sup>
Organic	456	42.68±0.266 <sup>b</sup>
F		5.38 <sup>a</sup>
<b>Sex of calf</b>		
Female	263	41.28±0.302 <sup>b</sup>
Male	314	43.97±0.319 <sup>a</sup>
F		36.41**
<b>Birth type</b>		
Twin	550	43.05±0.229 <sup>a</sup>
Single	27	36.79±0.889 <sup>b</sup>
F		34.77**
<b>Parity</b>		
1	108	43.78±0.483 <sup>a</sup>
2	324	42.74±0.307 <sup>b</sup>
3	145	42.03±0.472 <sup>b</sup>
F		3.159*

\*p<0.05; \*\*p<0.01; NS: Non Significant

Holstein Friesian calves in different regions of Turkey (Baspinar *et al.*, 1998; Bakir and Sogut, 1998; Akbulut *et al.*, 2001; Bakir *et al.*, 2004; Kocak *et al.*, 2007). In these studies, it was reported that the lowest birth weight for Holstein Friesian calves was 37.69 kg, the highest birth weight was 39.51 kg. The obtained birth weight is close to the rates that have been stated by Kertz *et al.* (1997) and Johanson and Berger (2003) for Holstein Friesian calves in the USA where the herd originated, the birth weights are 41.4 and 40.3 kg, respectively. According to these results, it can be said that calves bred in this organic dairy farm have good conditions in terms of birth weight and organic breeding system does not have a negative effect on the birth weight.

In this study, contrary to many conventional studies (Bakir and Sogut, 1998; Akbulut *et al.*, 2001; Bakir *et al.*, 2004; Kocak *et al.*, 2007), the effect of the year of calving on the birth weight was not significant (Table 2). Although, fetus is under protection of mother in prenatal period, environmental factors that affect the mother, also affect the birth weight of the calf either in a positive or negative way. It is expected that year after year, meadows, grasslands and climate differences cause differences in the birth weight between the years (Akbulut *et al.*, 2001). In this farming, where the birth records have been taken, because breeding, caring and feeding of the animals are done according to the specified conditions in organic agriculture regulations, the variation on the birth weight sources through the years may be low.

In this study, the effect of season of calving on the birth weight was significant (p<0.01), which was in agreement with results of the studies reported for Holstein Friesian calves (Bakir and Sogut, 1998; Akbulut *et al.*, 2001; Kocak *et al.*, 2007). The highest birth weight (43.70 kg) was obtained in the winter season (December-January-February) and the lowest birth weight (40.77) was obtained in summer. In present study, 2.93 kg difference between the 2 seasons was found significant (p<0.01). In this farm, 207 (35.8%) of the 577 live born occurred in the winter. If it is taken into account that the region of the farm has a harsh climate, it is better to have some of the winter births in the spring or other seasons.

Birth weight of pre-organic period calves were 1.24 kg heavier than organic periods calves and this difference was significant (p<0.05). This result, it maybe arise from because of pregnant heifers being brought conventional dairy farming at the beginning.

Male calves had a 2.69 kg birth weight compared to females and this difference was significant (Table 2). It was reported in a comprehensive study (Holland and Odde, 1992) for the birth weight in dairy cattle that male calves were 5-8% heavier than female calves. In agreement to this result, birth weights of male calves were 6.5% (2.26 kg) heavier than female calves. Other researchers were stated this difference between 1.3-3.6 kg in favor of male calves (Kertz *et al.*, 1997; Akbulut *et al.*, 2001; Bakir *et al.*, 2004). This difference may be attributed to longer gestation period of male calves or high androgen concentrations in male fetuses (Bakir *et al.*, 2004).

Birth weight of twin calves was 17% (6.26 kg) less than that of single calves and this difference was significant (p<0.01). This difference was reported by Bakir *et al.* (2004) and Kertz *et al.* (1997) as 11.2 and 15%, respectively.

The birth weight of the calves is related to the mother's body. The birth weight of the calves is the

**Table 3: Heritability and repeatability parameter estimation for birth weight**

-----Heritability-----		-----Repeatability-----	
$\sigma^2_s$	1.528	$\sigma^2_r$	5.404
$\sigma^2_e$	24.851	$\sigma^2_e$	20.851
$h^2$	0.232±0.110	r	0.206±0.073

lowest in the first calving because the mother can not complete its growth and development completely. As the number of the parity increases, the weight of birth increases and it is expected that the birth weight reaches its highest level in the 5th or 4th birth. But, in this study as the number of parity increased, the weight of birth decreased significant ( $p < 0.05$ ). This result may be commented as the feed formulations that are specified in organic agriculture regulations for the animals in lactation and dry off period and can not provide the nutrition needs of these animals completely in these periods. As a result of limited usage of concentrate feed because of the requirements in the regulations, the lactating cattle lose weight and because the feeding in the dry off period is inadequate, the birth weight decreases in parallel to increasing in the parity.

The heritability for the birth weight was estimated as 0.232±0.110 (Table 3). This value was considered as a medium (0.20-0.40). Heritability estimate found in the present study was higher than estimates reported by Bakir *et al.* (2004), Bakir and Sogut (1998), Kocak *et al.* (2007), 0.13, 0.011 0.115, respectively, in the same breed. Also, this value was close to the 0.24 stated by Akbulut *et al.* (2001).

In the farm, caring, breeding and feeding are done according to the conditions in the regulations, the heritability rate has been 0.232 in this farm and it shows us that environmental factors are more effective than genetic factors on the birth weight. This shows us that only after the standardization of effective environmental factors, can a selection be done for the birth weight. Repeatability was estimated as 0.206±0.073 for birth weight of Holstein Friesian calves. This value was lower than the estimates as 0.34 reported by Bakir *et al.* (2004).

**CONCLUSION**

It can be said that Holstein Friesian calves that are bred in this region, where the altitude from sea level is quite high and has a harsh climate, have good conditions in the farm in terms of the survival rate during the birth and the birth weight. It can be said that the organic breeding system has a positive effect on the birth weight or at least does not have a negative effect on it because the obtained birth weight has been quite higher than the birth weight stated for Holstein Friesian calves bred in Turkey's conditions. There is a need for extra studies to combine this good performance with the organic breeding system.

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