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CONTENTS

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Use of "maguey" (*Agave salmiana* Otto ex. Salm-Dick) as forage for ewes
J.M. Pinos-Rodríguez, J.R. Aguirre-Rivera, J.C. García-López, M.T. Rivera-Miranda, S. González-Muñoz, S. López-Aguirre and D. Chávez-Villalobos (Mexico) 101

Seroprevalence of Leptospiral infection in rodents of dairy cattle herds complexes in suburb of Mashhad-Iran
M. Talebkhan Garoussi, J. Vand-e-Useefee and J. Mehrzad (Iran) 109

Genetic polymorphism of some blood proteins in Saanen goats
Cengiz Elmaci, Yasemin Oner, Ozhan Turkyilmaz and Meltem Cetin (Turkey) 113

Gallbladder mucocele in two dogs with pituitary-dependent hyperadrenocorticism: a case report
C. Melián, M. Morales, M.D. Perez-Alenza, J.A. Corbera and N. Diez Bru (Spain) 117

Development of dot-ELISA for diagnosis of *Peste des petits ruminants* (PPR) in small ruminants
P. Saravanan, V. Balamurugan, A. Sen, B. Sahay and R.K. Singh (India) 121

Determining economically optimum weaning age: A case study in Erzurum, Turkey
H. Bayram Isik, Murat Kulekci and Avni Birinci (Turkey) 125

Electrocardiogram of homing pigeon
A.A. Papahn, H. Naddaf, A. Rezakhani and M. Mayahi (Iran) 129

Effects of *Bacillus licheniformis* amylase on starch digestibility and sheep performance
M.M. Crosby, G.D. Mendoza, L.M. Melgoza, R. Bárcena, F.X. Plata and E.M. Aranda (Mexico) 133

Effect of pinealectomy and melatonin administration on jejunal mucosal enzymes and performance of young broiler chickens
R. Thakur, J.S. Tyagi, J. Mohan and K.V.H. Sastry (India) 137

Effect of frequent ejaculation on live weight and sperm characteristics in Norduz lambs
M. Bingöl, A. Yilmaz, F. Cengiz and D. Kum (Turkey) 141

Histochemical studies on structural changes of large conducting arteries in male diabetic rats
M.R. Arab, G.R. Komeili, A. Touhidi, Aval F. Sargolzaie and M.R. Shahraki (Iran) 145

Gentic variability in Integrin Beta-1 (ITGB1) gene of buffaloes
Bejoy John, Subodh Kumar, S.M. Deb, Abhijit Mitra, S.K. Niranjan, Soumen Naskar and Arjava Sharma (India) 149

Estimation of inorganic and biochemical constituents of *Parascaris equorum* from horse
N. Moghaddar, B. Tabai and M. Mahjoob (Iran) 153

Evaluation of the effect of rennet type on the texture and colour of goat cheese
M.R. Fresno, S. Álvarez, V. Rodríguez, N. Castro and A. Argüello (Spain) 157

Quality of silages from sunflower harvested at different vegetational stages
Murat Demirel, Duran Bolat, Sibel Çelik, Yunus Bakici and Savaş Çelik (Turkey) 161

Effect of oral administration of Clomiphene citrate on sperm viability and fertility of boar semen
D.O. Umesiobi (South Africa) 167

Continued overleaf

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Determining Economically Optimum Weaning Age: A Case Study in Erzurum, Turkey

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Abstract

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This study aims to find out optimum weaning age for calves in order to minimize the feeding cost of a farm. Two breeds of calves, i.e. Brown Swiss and Holstein Friesian, were weaned on three different weaning ages, i.e. 30, 45 and 60 days. The calves have been observed from birth to six months. The significant variables on weight gain have been estimated using logarithmic production model. It has been found out that the feeding cost of one kg weight gain for earliest weaning age is about 16% less than for the latest weaning age. It is concluded that shortening weaning age period will reduce the feeding cost and increase the farm income.

Key words: Calf, optimum weaning age, weight gain, feeding cost.

Introduction

In Erzurum Province, located in Eastern Anatolia, 60% of farmers' income come from livestock production (Peker, 1997). Thus, livestock production is more important than crop production in this region. The abundance of meadows and pastures in the area also motivate livestock producers to let the animal graze instead of feeding them at the barn.

Determining optimum weaning age for calves can help farmers to utilize inputs more efficiently, i.e., reduce the feeding cost and increase the profit margin of a farm. The feeding expenses have the largest share in cattle farming in Turkey (Peker, 1997). The researches on livestock have claimed that it is possible to have earlier weaning than the age currently practised in farms without hindering animal growth.

Yanar *et al.* (1994 and 1997) have indicated that weaning calves at five weeks can be possible without hindering animal growth. The recent research by Akbulut and Bayram (2000) showed that Brown Swiss and Holstein Friesian calves reached 500 g/day concentrate feed consumption in 36 and 38 days of age, respectively. They concluded that weaning calves at this age could be the "physical optimum weaning age", since this was more efficient in terms of input usage and did not have any adverse effect on animal growth. Besides the physical optimum weaning age, knowing the economic optimum

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weaning age may help to increase the gross profit of the livestock farms.

Thus the objective of this research was to determine the optimum economic weaning age for Brown Swiss and Holstein Friesian calves.

Materials and Methods

The data of this study include four year time period from 1996 to 2000 for the total of 90 Brown Swiss and Holstein Friesian calves in six groups (two breeds and three weaning ages: 30, 45 and 60 days). Fifteen calves were selected for each group, but some of them died during the study period and in total 74 calves were left. At the end, the number of calves in each weaning age group was 12, 10 and 11 for Holstein Friesian and 12, 15 and 14 for Brown Swiss, respectively.

After the calves were born, they were allowed to suckle their mothers and received colostrum for the first 3 days. Then, they were fed with whole milk (7% of birth weight) by using buckets every morning.

Calves were fed with "starter 1" (19% CP, 8% cellulose) from birth to 4 months of age, and with starter 2 (18.2% CP, 10% cellulose) from 4 months of age to the end of feeding period, i.e., 6 months. Dried hay (4.8% CP, 28.4% cellulose) in medium quality was offered to the calves *ad libitum* in this study. The quantity of the starters and hay actually consumed was recorded daily.

To determine economic optimum weaning age, the first stage was to estimate the relationship between dependent variable (total live weight) and independent variables: breed, gender, weaning ages, birth weight, weaning weight and dry feed intake. Among several functional forms, logarithmic-linear function has been chosen in this research using Eviews 5.0 program.

The functional form can be written as follows:

$$\text{Log}(TLW) = C + \beta_1 B + \beta_2 G + \beta_3 WA_2 + \beta_4 WA_3 + \beta_5 \text{Log}(BW) + \beta_6 \text{Log}(WW) + \beta_7 \text{Log}(F)$$

Where, C is an intercept/constant term, and βs are coefficients. The dependent variable *TLW* refers to total live weight (kg) at the end of six months; *B, G,* WA_2 and WA_3 are dummy variables for breed, gender and weaning ages, respectively. Subscripts on WAs refer to second and third groups, i.e., the groups weaned at 45d and 60d, respectively. *BW*, *WW* and *F* denote birth weight (kg), weaning weight (kg) and dry feed intake (g), respectively.

Notice that dummy variables do not have logarithms in the equation since they possess zero values by their nature (having zero values makes logarithm indefinite). In addition, to avoid dummy variable trap and perfect multicollinearity among independent variables, one category/group from each dummy variable has been excluded. For example, out of three weaning age groups, two groups have been included into the equation and the first group, weaned at 30d, has been excluded from the equation. Hence, this first group will be our reference group and the other two groups in the model will be compared based on this group.

Results and Discussion

Given 1 for male and 0 for female, we can see that overall the number of male calves is more than the number of female calves in both breeds. However, HF breed has more male calves than BS breed with the ratios of 0.55 and 0.51, respectively. Both average birth weights (33.58 for HF and 34.17 for BS) and average weaning weights (45.09 for HF and 45.59 for BS) are slightly higher in Brown Swiss breeds. Brown Swiss calves consumed more dry feeds (2.04 kg/day) than Holstein-Friesian calves (1.75 kg/day). Finally, total live weights (TLW) at the end of six months were quite similar for both breeds. A HF calf weighs 128.7 kg on average while a BS calf weighs 129.61. Given these values, it can be concluded that both breeds have quite similar qualities and characteristics.

The R-squared found in our model (Table 1) is quite reasonable because it is very common to have lower R-squared values in cross-sectional models. Given the F-statistic (5.85 with probability zero) we reject the null hypothesis that all slope coefficients are equal to zero.

Durbin-Watson d statistic has been used to detect the existence of auto-correlation. Since the computed d value (2.04) lies between d_u (1.834) and (4-d_u=2.166), there is no evidence of positive first-order serial correlation (i.e., auto-correlation).

Table 1
Estimation results

Dependent variable: LOG(TLW)
Method: Least squares
White heteroskedasticity-consistent standard errors and covariance

Variable	Coefficient	Std. error	t-Statistic	Probability
C*	3.475	0.207	16.714	0.00
B	0.001	0.020	0.061	0.95
G	0.047	0.017	2.810	0.01
WA2	0.001	0.026	0.051	0.96
WA3	-0.022	0.027	-0.826	0.41
LOG(BW)	0.197	0.098	2.004	0.05
LOG(WW)	0.174	0.098	1.776	0.08
LOG(F)	0.013	0.036	0.377	0.71
R-squared	0.42	Durbin-Watson stat		2.04
F-statistic	5.85	Prob(F-statistic)		0.00
Chi-square	4.68	Prob(Chi-Square)		0.91

*C denotes constant term. B-Breed, G-Gender, WA2, WA3-Weaning at 45 and 60d, BW-Birth weight, WW-Weaning weight, F-Dry feed intake.

Table 2
Feeding costs for three weaning age groups

		Weaning at (days)			Prices[3]
		30	45	60	($/kg)
Total milk intake (kg)		46.92	80.37	119.16	0.40
Total feed intake (kg)	Commercial concentrate	368.50	360.50	354.50	0.30
	Roughage[1]	195.10	188.80	180.40	0.08
Total feeding cost ($)		144.93	155.40	168.45	
Weight gain (kg)		95	96	95	
Cost of weight gain ($/kg)[2]		**1.53**	**1.62**	**1.77**	

1. Roughage included Alfalfa hays and other dry feed intakes.
2. Calculated by total feeding cost divided by weight gain.
3. Prices given in the table are based on the year 2000.
4. All the figures in the table are the average values for each group from birth to the end of the sixth month.

White test has been used to detect the presence of heteroscedasticity problem. Since the computed chi-square value is 4.68 with 91% probability, there is no evidence of heteroscedasticity in this model.

The estimation results show that gender (G), birth weight (BW) and weaning weight (WW) are highly correlated with and significantly affect the total live weight (TLW). On the other hand, the other variables (Breed, weaning age and dry feed intake) have been found to be statistically not significant. One of the most important findings in this study is that weaning age (WA) has been found to be not significant. That means, compared to our reference group (i.e., WD1 = 30d), weaning calves in 45d (WD2) or 60d (WD3) do not make any significant difference on total live weight. Therefore, given other variables constant, extending the weaning period do not provide any advantage over weight gain. Considering the previous studies (Yanar *et al.*, 1997; Akbulut and Bayram, 2000) and the results of this study, economically optimum weaning age is the earliest weaning age (30d).

The average price of milk in year 2000 was 0.40 $/kg, while the average prices of roughage and commercial concentrate during the same time period were 0.08 and 0.30 $/kg, respectively. As can be seen in Table 2, while average weight gains in six months in three groups were almost the same, the cost of one kg weight gain was the lowest ($1.53) in 30d weaning group. The main factor causing these different costs amongst the groups was the milk consumption. Since the milk price was the highest amongst other feeding substances and WD1 consumed the least milk, this group had the lowest feeding cost. The cost of per kg weight gain was approximately 16% higher in WD3 than in WD1. It is concluded that a farmer can reduce his/her feeding cost (or increase his/her profit) by 16% just by shortening the weaning period from 60d to 30d.

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एच.बयराम आइसिक, मुरत कुलेक्सी, अवनी बिरिन्सी। आर्थिकतः अभीष्ट बिलगावन आयु ज्ञात करनाः टर्की के एर्जुरम में एक अध्ययन।

फार्म के प्राशन व्यय को घटाने के लिए गोवत्सों के बिलगावन हेतु अभीष्ट आयु ज्ञात करना इस अध्ययन का उद्देश्य है। ब्राउन स्वीस और होल्स्टीन फ्रीजियन नस्ल के वत्सों को क्रमशः 30, 45 और 60 दिनों की तीन भिन्न आयु पर बिलगावित किया गया। यह अध्ययन जन्म से लेकर छः माह की आयु तक किया गया। लॉगीय उत्पादन माडल से भार वृद्धि की सार्थकता का अध्ययन किया गया। इससे यह पाया गया की न्यूनतम आयु पर बिलगावित वत्सों की प्रति किग्रा शरीर भार वृद्धि का व्यय अधिकतम आयु के वत्सों से 16% कम था। इससे यह निष्कर्ष निकला कि बिलगावन आयु को घटा कर प्राशन व्यय घटाकर फार्म की आय बढ़ायी जा सकती है।