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The Factors Effect on Weaning Weight of Hair Goats in West Anatolia

Batı Anadolu' daki Kıl Keçilerinin Sütten Kesim Ağırlığını Etkileyen Faktörler

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Key Words:

Hair Goat, Herd, Birth Type, Canonic correlation, Weaning weight

ABSTRACT

Objective: In this study the relationships of herd, year of birth, sex, birth type, effects of Turkish Hair Goats were investigated by canonical correlation analysis to highlight more effective factors on the weight of hair goat kids.

Material and Methods: The data were utilized from 1020 male and 1011 female Hair goat kids which were born in the period 2013 to 2016. The herd, year of birth, birth type and sex are analyzed as the first set of variables (X); weight at birth, weight at thirty day of age and weight at weaning age effects are analyzed as the second set of variables (Y). By performing canonical correlation analysis, canonical correlations between the first, second and third pair of canonical variates were estimated and three canonical correlations were found significant ($P < 0.01$).

Results: The biggest correlations between year of birth, sex, birth type variables and v1, v2 and v3 canonical variates were found -0.77, 0.87 and -0.82, respectively. The biggest correlations between weight at birth, weight at thirty day of age and weight at weaning age and w1, w2 and w3 canonical variates were found 0.84, -0.97 and -0.78, respectively. As a result it has been determined that sex and birth type play an important role in the formation of the goat kid's body weights.

Conclusion: Hair goats reared in West Anatolia are slaughtered mostly at the end of the weaning. Because of this, assessment the factors effect on weaning weight are important. Canonical correlation analysis therefore is used to analyze all factors at the same time to define relationships between each other of weaning traits for hair goats.

Anahtar Kelimeler:

Kıl Keçisi, Sürü, Doğum Tipi, Kanonik Korelasyon, Sütten Kesim Ağırlığı

ÖZ

Amaç: Bu çalışmada; Türk Kıl keçileri üzerine etkili çeşitli özellikler arası ilişkiler, kanonik korelasyon analizi ile araştırılmıştır.

Materyal ve Metot: Çalışmanın verileri 2013-2016 yılları arasında doğan 1020 erkek ve 1011 dişi Kıl keçisi ırkı oğlaklardan elde edilmiştir. Sürü, doğum yılı, doğum tipi ve cinsiyeti birinci değişken seti (X) olarak analiz edilmiştir; doğum ağırlığı, otuz günlük ağırlık ve sütten kesimdeki ağırlıklar ise ikinci değişken seti (Y) olarak değerlendirilmiştir. Kanonik korelasyon analizi ile birinci, ikinci ve üçüncü kanonik değişken çiftleri arasındaki kanonik korelasyonlar tahmin edilmiş ve üç kanonik korelasyon da istatistiksel olarak anlamlı bulunmuştur ($P <0.01$).

Bulgular: Doğum yılı, cinsiyet, doğum tipi değişkenleri ile v1, v2 ve v3 kanonik değişkenleri arasındaki korelasyonlar sırasıyla -0.77, 0.87 ve -0.82 bulunmuştur. Diğer yandan, doğum ağırlığı, otuz günlük ve sütten kesim ağırlığı ile w2, w2 ve w3 kanonik değişkenleri arasındaki korelasyonlar sırasıyla 0.84, -0.97 ve -0.78 bulunmuştur.

Sonuç: Oğlakların canlı ağırlığının oluşumunda cinsiyet ve doğum tipi faktörlerinin belirleyici bir rol oynadığı belirlenmiştir.

INTROCUTION

Turkey is taking a very important position with geographic location and livestock production of Europe. In the last 15 years, goat is one of the two species that has significantly increased in population of the World. This increase could be due to the scarce conditions created by global warming or the better understanding of the importance of goat products. In terms of goat population, Turkey is ranked 23th in the world and 7th in Europe. Also Turkey 9.2 million goats which is represent 63% of the European Union goat population. 23.3% of the small ruminants in Turkey are goats and 98% of this consists of Hair goats (TUIK, 2013; Atac and Burcu, 2014). The Hair kids' weaning time is generally 3-3.5 month's age in West Anatolia. Lactation period varies between 3-6 months, but in dairy types this period is longer (Koyuncu et al., 2006; Kaymakçı and Engindeniz, 2012; Atac and Burcu, 2014).

In goat breeding, generally the descriptive statistics were given and relationships of traits were calculated with correlation coefficients. In some studies, when the number of independent traits is more than one, multiple correlation coefficients are calculated. Whereas, in the case of multiple dependent and independent traits existence, the relationship is explained by canonical correlation coefficients.

Canonical correlation analysis is a multivariate technique that generalization of multiple regression analysis. This analysis describes the relationship between two variable sets by calculating the linear combinations which are maximally correlated (Tabachnick and Fidel, 2001). It was used to identify the combination of variables that best separate the two genetic groups. This technique has gained acceptance in various scientific fields such as psychology, social science, animal science, ecology, education etc. In goat breeding however, there are few studies (Keskin et al., 2005; Çankaya and Kayaalp, 2007) that canonical correlation analysis was applied.

Keskin et al. (2005) were studied the relationships between some traits of Akkeçi kids. They investigated the pre-slaughtering and post-slaughtering traits by using canonical correlation analysis. Seven pre-slaughtering traits (slaughter weight, body length, wither height, heart girth depth, heart girth width, heart girth circumference, leg circumference) constituted the X variable set while eight post-slaughtering traits (head weight, feet weight, skin weight, omental and mesenteric fat weight, weights of heart-lung-liver, spleen weight, hot carcass weight, cold carcass weight) constituted the Y variable set. The correlation between the first canonical variable pair was found as 0.962.

Çankaya and Kayaalp (2007) were applied to canonical correlation analysis to estimate the relationship between eight different morphologic traits (X set–height at withers, body length, chest width, chest girth, chest depth, front, middle and hind rump width and the live weights at three different periods (Y set – birth weight, weaning weight and weight at sixth month) from 86 kids of German Fawn x Hair Crossbred at Çukurova University. They estimated significant canonical correlation coefficient as 0.931 between the first pair of canonical variables.

In this study, relationships among the herd, year of birth, birth type, sex, weight at birth, weight at thirty day of age and weight at weaning age effects of Turkish Hair Goats were investigated by canonical correlation analysis. For this purpose, the data obtained from the farms cultivated under the few semi-intensive and most extensive conditions, without intervention in growing conditions, were evaluated by canonical correlation analysis.

MATERIAL and METHODS

Material

The material of this study consist of 1020 male and 1011 female Hair goat kids which were born in the period 2013 until 2016 from 12 different herds in Aegean region of Turkey, Izmir. The herd, year of birth, birth type and sex are analyzed as the first set of variables (X); weight at birth, weight at thirty day of age and weight at weaning age effects are analyzed as the second set of variables (Y) which are illustrated as shown: Y1 is weight at birth, Y2 is weight at thirty day of age, Y3 is weight at weaning age, X1 is herd, X2 is year of birth, X3 is birth type and X4 is sex. The 12 herds were grouped in to four categories in terms of management, number of goats, feeding system and altitude.

Method

Correlation analysis examines the relationship between two or more variables, and regression analysis examines how one variable changes one unit and how the other variable changes. The canonical correlation analysis is a multivariate statistical method and it is the analysis which investigates the largest relationship between sets of variables. This method describe the linear combinations of the variables. Therefore, useful for predictive or comparative purposes the canonical variates representing the optimal linear combinations of dependent and independent variables and the canonical correlation showing the relationship between them are the results of interest (Hair et al., 1998; Keskin

and Özsoy, 2004). Wm and Vm are canonical variates are defined as below:

The canonical correlation (Cm) is the correlation between Wm and Vm. Canonical roots or eigenvalues represents the amount of variance in one canonical variate accounted for by the other canonical variate (Hair et al., 1998). When the canonical correlation is maximum the canonical coefficients (am1, am2,.....amp and bm1, bm2,.....bmq) were estimated. The maximization technique as follows: Let the first group of p variables is represented by the random vector, X(px1), and the second group of q variables is represented by the random vector, Y(qx1). For testing the statistical significance of the canonical correlations used the Wilks' lambda test statistic is used.

Large canonical correlation always does not mean that there is a powerful relationship between the two sets of the traits. Because canonical correlation maximizes the correlation between linear combination of variables in two groups and not maximizes the amount of variances accounted for in one set of variables by the other set of variables. The canonical correlation analysis was performed by means of PROC CANCORR procedure of SAS 9.0 software (2002).

Results and Discussion

In goat breeding, several studies have been conducted on relationships between phenotypic and genetic characteristics of hair goats. Generally, relationship among several traits of Hair goats was examined by traditional methods, but the methods that taking account all traits together were not common in Turkey.

Oral and Altınel (2006) investigated the phenotypic correlations between birth weight and body weights in different growth periods and between birth weight and survivability of Hair goat kids. In their study, the phenotypic correlations between birth and body weights in different growth periods of kids were positive and statistically significant ($P<0.01$).

Besides, Cemal et al. (2013) determined birth weights and growth performances of Hair goat kids at the extensive breeding conditions. The variances affect by herd, birth type and sex, except years, on birth weight of kids were found statistically significant ($P<0.01$).

Atay and Gokdal (2016) determined the production characteristics and to find out the phenotypic relationships between udder and milk production traits in Hair goats. They obtained Hair goats in extensive conditions had higher live weight gains for kids.

On the other hand, Tatar and Elçin (2002) studied relationships for live weight and body size of crossbred male lambs by canonical correlation method. Çankaya and Kayaalp (2007) investigated relationship between live weights and some body measurements in German farm x Hair crossbred by canonical correlation analysis. Two studies were found only the first coefficient significant among all estimated canonical correlation coefficients ($P<0.001$). Çankaya and Kayaalp (2007) found the highest and lowest canonical correlation coefficients as 0.93 and 0.28, respectively. Tatar and Elçin (2002) obtained the first canonical correlation coefficient as 0.73.

Şahin et al. (2011) estimated the first and second canonical correlation coefficients were found significant (0.717, 0.587) on six different morphologic traits. Also, Tahtalı et al., (2012) estimated the first canonical correlation coefficient is significant (0.668) on morphologic traits measured from 121 Karayaka lambs. Our finding was lower than the findings reported by these studies because of lower variances weaning weights.

In the present study, the descriptive statistics and frequencies of traits in the analyses were given in Table 1. Moreover, the pairs of canonical variates were shown in Table 2. The estimated canonical correlations between the pairs of canonical variates were found as 0.33, 0.27 and 0.088 and to be significant ($P<0.01$) from likelihood ratio test (Table 2). Estimated canonical correlation was the highest (0.33) for the first pair of canonical variates (W1 and V1) but the smallest (0.088) for the third pair of variates (W3 and V3). It seems that herd, year of birth, birth type and sex are correlated with weight at birth, weight at thirty day and weight at weaning age.

The coefficients of canonical variates obtained from the raw data are given in Table 3. Magnitudes of these weights represent their relative contributions to the related variate.

Because of the coefficients of canonical equations are not unique, they should be standardized that the resulting canonical variates have a mean of zero and variance of one.

Standardized canonical coefficients or canonical weights for the X and Y variables are given in Table 4. Magnitude of these weights represents their relative contribution to the related variate. There is high positive standardized canonical coefficients for thirty day weight at V3 (0.94). It follows by weaning weight (0.81) and thirty day weight at V1.

The loadings are shown in Table 5. The loadings for the birth weight, thirty day weight and weaning weight suggest that weaning weight is the most influential variable in forming V1 compared to weight at birth and

weight at thirty day. On the other hand, for the second pair of canonical variate V2, birth weight and thirty day weight are about equally negatively influential in forming V2. For the last canonical variate V3, weaning weight has negatively impact in forming V3. When the loadings for herd, year of birth, birth type and sex were examined, it seems that only herd has positively and the others have about equally influential in forming W1 (Table 5).

Conclusions

In this study, the relationships among herd, year of birth, birth type, sex, birth weight, thirty day weight and weaning weight effects were examined simultaneously. The first canonical variable set was found the biggest and therefore canonical loadings in the first linear components W1 and V1 are focused without regard to the signs of the coefficients of the canonical variable pairs. According to this, the contribution of the year of birth has the biggest contribution (-0.77) to obtain the W1 canonical variable. The sex and birth type traits were the subsequent factors effected on obtaining of W1 canonical variable, respectively. The importance of birth year may be due to good nutrition of mothers, seasonal effect, good pasture conditions, and also the improvement of management conditions. Less effect of sex and birth type can be explained by improvement in management conditions.

On the other hand, it has been determined that the weaning weight significantly contributes to the obtaining the V1 canonical variable as expected.

This research, according to the literature reports, while the sex and birth type had a primary effect on the body weight, we observed that the management conditions were more prominent and changed this situation when the traits were evaluated simultaneously. Therefore, by going out of the classical approach, if the traits in biological studies are analyzed by canonical correlation method, the results could enable new interpretations and some features to stand out, except for prejudices.

Selection programs based on pre-estimated traits will give reliable results and rapid improvement in herds. Thus, more accurate selection results will be achieved through a pre-test with canonical correlation analysis, especially when working with traits that will be used in indirect selection.

Hair goats reared in West Anatolia are slaughtered mostly at the end of the weaning. Because of this, assessment the factors effect on weaning weight are important. The main income of Hair goats is goat kid breeding based on meat purposes. Depending on sex and birth type, Hair goats' kids can be selected and fed to get a higher body weight at the end of the weaning period. Therefore, it is possible to increase the profit rate in the meat goat breeding which constitutes the main income source of Hair goat breeders.

In conclusion, the selection of the kids according to good management conditions, sex and birth types may be increased the weaning weights of Turkish Hair goats.

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Table 1. Descriptive Statistics and frequencies of traits

Table 1. *Özelliklerin tanımlayıcı istatitikleri ve frekansları*

			N	Minimum		Maximum		Mean		Std. Dev.	
Birth Weight			**2028**	**7200**		**27400**		**12633.40**		**2476.40**	
Thirty Day Weight			**2028**	**10000**		**160900**		**17823.89**		**5415.59**	
Weaning Weight			**2028**	**1000**		**6600**		**2898.68**		**708.22**	
Herd	**Freq.**	**%**	**Birth Year**	**Freq.**	**%**	**Birth Type**	**Freq.**	**%**	**Sex**	**Freq.**	**%**
1	**470**	**23.2**	**2013**	**180**	**8.9**	**1**	**1793**	**88.4**	**1**	**1020**	**50.3**
2	**274**	**13.5**	**2014**	**560**	**27.6**	**2**	**232**	**11.4**	**2**	**1008**	**49.7**
3	**716**	**35.3**	**2015**	**713**	**35.2**						
4	**568**	**28.0**	**2016**	**575**	**28.4**						

Table 2. Canonical correlations between two sets of variables, eigen values, likelihood ratios and their probabilities
Tablo 2. *İki değişken seti arası korelasyonlar, öz değerler, olasılık oranları ve önemlilikleri*

	Canonical correlation	Squared canonical correlation	Degrees of freedom	Eigen values	Likelihood ratio	Probability Pr>F
1	0.33	0.11	12	0.12	0.82	<0.0001
2	0.27	0.07	6	0.08	0.92	<0.0001
3	0.088	0.008	2	0.008	0.99	0.0004

Table 3. Canonical coefficients of variates
Tablo 3. *Değişkenler arası kanonik katsayılar*

	W1	W2	W3		V1	V2	V3
Herd	0.418	0.384	0.409	Weight at birth	-0.00005	-0.0004	-0.00011
Year of birth	-0.949	-0.370	-0.061	Weight at thirty day	0.00009	0.00004	0.00017
Birth type	-0.794	0.478	2.564	Weight at weaning age	0.0011	0.00002	-0.0008
Sex	-0.723	1.720	-0.716				

Table 4. Standardized canonical coefficients of variates
Tablo 4. *Değişkenler arası standartlaştırılmış kanonik katsayılar*

	W_1	W_2	W_3		V_1	V_2	V_3
Herd	0.465	0.427	0.456	Weight at birth	-0.0120	-1.0641	-0.2920
Year of birth	-0.893	-0.348	-0.0580	Weight at thirty day	0.5350	0.2192	0.9426
Birth type	-0.259	0.156	0.8372	Weight at weaning age	0.8112	0.1489	-0.5700
Sex	-0.361	0.860	-0.3583				

Table 5. Correlations between the variables and related canonical variates (canonical loadings)
Tablo 5. *Değişkenler ve ilgili kanonik değişkenler arası korelasyonlar (kanonik yükler)*

	W1	W2	W3		V1	V2	V3
Herd	0.2120	0.3284	0.4475	Weight at birth	0.2398	-0.9668	0.0887
Year of birth	-0.7702	-0.2334	0.1249	Weight at thirty day	0.5876	-0.2203	0.7786
Birth type	-0.3224	0.1781	0.8216	Weight at weaning age	0.8488	0.1310	-0.5122
Sex	-0.3587	0.8722	-0.3213				

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