MEDWELL PUBLISHING
Journal of Animal and Veterinary Advances 8 (3): 464-468, 2009
ISSN: 1680-5593

Investigation of Relationship Amongst Milk and Wool Yield Traits of Awassi Sheep by Using Canonical Correlation Analysis

Ismail Keskin and Birol Dag
Department of Animal Science, Faculty of Agriculture,
University of Selcuk, 42250, Konya, Turkey

Abstract: This study was carried out to investigate the relationship between milk and wool yield traits of Awassi sheep by using canonical correlation analysis. Data were collected from 108 Awassi sheep maintained at the state farm of Gozlu in Konya Province. The 2 data sets were formed for the analysis. One of the set (X set) was consisted of wool traits that were Fleece Weight (FW), Staple Length (SL), Fibre Length (FL), average number of crimps over a length of 5 cm (ANC) and Wool Fineness (WF) and the other set (Y set) was constituted of Milk Yield (MY), Lactation Period (LP), Milking Period (MP), Average Daily Milk Yield (ADMY) and Maximum Daily Milk Yield (MDMY). The first canonical correlation coefficient between the 2 sets was 0.4473 ($p>0.05$) and the 2nd was 0.3203 ($p>0.05$).

Key words: Sheep, awassi, canonical correlation analysis, milk yield traits, wool yield traits

INTRODUCTION

The characters dealt with in animal breeding and their criteria should be determined easily and cheaply. On condition that the characters and their criteria could be determined by difficult and expensive methods, indirect criteria are used generally instead of them. Economic compulsions necessitate using indirect ways to estimate milk production. Furthermore, there are some difficulties in practice relevant to determination of milk yield. If the determination of a character or its criterion is difficult and expensive and its appearance is depended on a long time and its hereditary is low, other characters have positive and powerful relationship with actual character are used as a selection criterion. Such enterprises are known as indirect selection and used commonly in animal breeding (Duzgunes *et al*., 1987).

On the other hand, productivity of selection is bound to generation interval. Therefore, expected genetic progress increases when the generation interval is shorter. In animal breeding practice, the studs must be used in earlier ages to shorten the generation interval (Dyrmudsson, 1976; Sonmez and Demiroren, 1977).

Canonical correlation analysis were used in different studies (testicular and body measurements of Awassi Ram Lambs (Emsen and Davis, 2004), reproductive traits and milk yield traits of Brown Swiss (Keskin *et al*., 2004), some characters of Akkeci kids, which were measured pre-slaughtering and post-slaughtering (Keskin *et al*., 2005), some body measurements at the birth and 6 month periods in Holstein Friesian Calves (Cankaya *et al*., 2008), body measurements, growth performance and carcass traits of Red Karaman Lambs (Yaprak *et al*., 2008).

Various characteristics are used for determining the breeding value in respect of milk yield in sheep. Some of these are registrations of partial lactation, udder measurements, some of the body measurements and blood parameters.

Wool yield and its properties can be determined easily and earlier in comparison to milk yield. Also, heritabilities of wool characteristics are high. Therefore, this study was carried out to determine whether wool yield traits can be used as indirect selection criteria for milk yield or not. Phenotypic relationships between wool and milk yield properties of Awassi sheep were determined by using canonical correlation analysis for this aim.

Canonical correlation analysis enables the researchers to explain the relationships between 2 variables sets assumed as X and Y. Also, each of this sets must consist of at least 2 variables. In the study, the X set (independent set) included wool traits as fallows Fleece Weight (FW), Staple Length (SL), Average Number of Crimps over a length of 5 cm (ANC) and Wool Fineness

Corresponding Author: Ismail Keskin, Department of Animal Science, Faculty of Agriculture, University of Selcuk, 42250, Konya, Turkey

(WF) and the Y set (dependent set) consisted of milk yield properties those are Milk Yield (MY), Lactation Period (LP), Milking Period (MP), Average Daily Milk Yield (ADMY) and Maximum Daily Milk Yield (MDMY).

MATERIALS AND METHODS

The Awassi is the most numerous and widespread type of sheep in southwest Asia. It is the typical sheep breed of Syria, Lebanon, Jordan and Israel. The Awassi is also distributed throughout southeast Turkey. It is very hardy and strives well under poor feeding and extreme climatic conditions. The husbandry is typically extensive, with animals kept in simple sheep-sheds during winter, when they are fed on straw. In some flocks, animals receive some hay and limited amount of concentrates for a short period before and after lambing. The lactation period is 6-7 months. Average total milk yield is about 100-150 kg for unimproved Awassi ewes. However, the total milk yield of improved Awassi ewes is approximately, 250-300 kg. Body weights for ewes and rams are 45-50 kg and 60-70 kg, respectively. Average greasy fleece weight is about 1.5-2.0 kg. Staple length and wool fineness are 11-16 cm and 32-35 μ, respectively (Kaymakci, 2004). The Awassi has a brown face and legs with the fleece varying in color from brown to white. The unimproved Awassi sheep has a big fat tail.

Data for the analysis were obtained from 108 Awassi sheep raised at the state farm of Gozlu in Konya Province (38°27'N, 32°22'E and 930 m above sea level). Sheep were milked twice in a day by hand. Milking and milk yield controls were started at the 45th day of lactation. Milk yield controls were made every fortnight and lasted at the end of lactation period. Milk yields were measured by milking cups with an accuracy of 25 mL. Holland method were used for estimating milk yield.

Sheep were shorn once in a year at the beginning of summer. Fleece weights were measured by hand scales sensible to 50 g and recorded after shearing. Wool samples were taken from shoulder, side and rump sections of each animal. After that wool properties were determined (Doehner and Reumuth, 1964; Ozcan, 1990; Ertugrul, 1991).

Least squares means of all traits were calculated by using Harvey's pocked program (Harvey, 1987). Also, the effects of environmental factors (year, age) one traits were determined. Data for all traits were standardized according to the standard factors before the canonical correlation analysis.

Canonical correlation analysis was derivated from the multiple regression analysis. In multiple regression analysis, X variable group contains q variables and Y variable group has p = 1 variable. Multiple regression analysis is used for investigating the a'x linear combination, which is highly related with Y. However, in the canonical correlation analysis, Y variable group contains $p \geq 1$ variables. Correlation coefficient between the linear combinations of the variables of X and Y groups is researched in this analysis. Firstly the linear combination couple that gives the maximum correlation coefficient is constituted. After that the other linear combination couple, which is independent from the 1st linear combination couple, is formed. Also these couples are independent from each other and the correlation between them is maximum. The linear combination couples are called canonical variable and the correlation coefficient between these couples is named canonical correlation (Gurbuz, 1989; Tatlidil, 1996; Kocabas *et al*., 1998). When the linear combination couples are constituted, a and b canonical coefficient vectors, which maximizes the correlation coefficient between a'x and b'y are investigated. If X is interpreted as the cause of Y, a'x is called best predictor and b'y is called best predicted criterion in this situation (Gurbuz, 1989; Kocabas *et al*., 1998).

Relationships between milk and wool traits of Awassi sheep were investigated by using canonical correlation analysis. This analysis provides to explain the relationships between 2 variable sets.

It is supposed that the 1st team contains p variables; the second team contains q variables and also $p \leq q$. In this situation, it is possible that a correlation coefficient between the each linear combination of the variables of the 1st and 2nd team can be calculated. Just like this a lot of combination couples can be taught. However, one of the correlation coefficients calculated from these combination couples is maximum. This correlation coefficient is called the first canonical correlation and the linear combination of the variable teams used for this correlation is also, called the 1st canonical variables (Gurbuz, 1989).

Explained variance determines how much variance of observed variables is expressed by canonical variables for each sets. The level of this proportion can obtain us to express whether the eigen values of analysis matrix used to calculate canonical correlations between variable sets is enough or not to interpret the correlation, which really observed between the 2 sets. Statistica computer pocked program is used for the canonical correlation analysis (Statistica, 1995).

RESULTS AND DISCUSSION

Some definitional values of milk and wool yield traits are given in Table 1. Effects of environmental factors on the traits in Table 1 were investigated by least square analysis (Harvey, 1987). Effects of year on LP ($p<0.01$), MDMY ($p<0.05$), FL ($p<0.01$) and SL ($p<0.01$) were statistically significant. Age only had a significant effect on FW ($p<0.01$).

The simple correlation coefficients among the all traits are also given in Table 2. The higher correlation coefficients were found between MY and ADMY (0.872); ADMY and MDMY (0.806); LP and MP (0.601); SL and FL (0.566). Especially the correlation coefficients between milk and wool traits were lower.

The first canonical correlation coefficient between milk and wool traits was found, as 0.4473 ($p>0.05$). This calculated value is higher than the correlation coefficient between milk and wool traits in Table 2 (for LP and FL 0.126; for MP and FL 0.103).

The 2nd, 3rd and 4th canonical correlation coefficient between milk and wool traits were found as 0.3203, 0.0964 and 0.0316, respectively ($p>0.05$).

Linear combination of variables, which obtains the highest canonical correlation was determined as follows; V_1 = -0.0286, FW -0.3722, SL + 0.3083 FL -0.921 IANC -0.1693 WF and W_1 = 0.0683MY + 1.0542 LP-0.4554 MP+0. 7249 ADMY -0.8928 MDMY.

The first canonical correlation value (0.4473) is equal to the correlation coefficient between V^1 and W_1 values those are calculated far each animal. Although the canonical variables are artificial, calculating the correlation coefficients between indexes of V_1 and W_1 and original variables interpret them. Because these correlation coefficients indicate the contribution amount of whichever one original variable to the canonical variable.

The correlation coefficients between wool yield traits and their own canonical variables were given in Table 3. As shown in Table 3 that FW has the most effect on the formation of V_1, V_2, V_3, V_4 and V_5 canonical variables. Effects of the other wool traits on these canonical variables were low.

The correlation coefficients between milk yield traits and their own canonical variables were given in Table 4. MY, ADMY and MDMY have more effect on the formation of W_1, W_2, W_3, W_4 and W_5 canonical variables and the contributions of LP and MP to these canonical variables were low.

There are several studies about canonical correlation analysis in sheep breeding. Some of these studies were abstracted for the benefits of the researchers. The findings of this study couldn't be compared with any findings, because there weren't any study on similar topics before. Cottle (1988) determined the relationships between blood metabolites and fleece weight by using canonical correlation analysis. There was a significant correlation between total protein and fleece weight in the study.

Tatar (1999) investigated the relationship between suckling period traits (X set) and fattening period traits (Y set) of Ile de France × Akkaraman (B_1) crossbred male lambs by using canonical correlation analysis. There was a high canonical correlation coefficient (0.730) between these 2 sets. Also, high canonical correlation coefficients (0.730-0.850) between the set of weaning weight and suckling period traits and the set of fattening traits were determined.

Ozturk (2000) searched the relations between characteristics of preweaning periods and carcass traits of Ile de France × Akkaraman (B_1) crossbred male lambs by using canonical correlation method. It is reported that the best set of preweaning period includes birth type, ewe's

Table 1: Some definitional values of milk and wool yield traits of Awassi sheep

Traits	$\bar{X} \pm S_{\bar{x}}$
Fleece weight (g)	2810.6±55.20
Staple length (cm)	12.185±0.212
Fibre length (cm)	14.796±0.265
Average number of crimps	9.824±0.188
Wool fineness (μ)	33.546±0.443
Milk yield (mL)	104667±3415
Lactation period (day)	184.49±1.070
Milking period (day)	147.58±0.890
Average daily milk yield (mL)	711.7±20.90
Maximum daily milk yield (mL)	1090.8±35.3

Table 2: The correlation coefficient between milk and wool traits

Traits	MY	LP	MP	ADMY	MDMY	FW	SL	FL	ANC	WF
MY		0.278**	0.391**	0.872**	0.700**	-0.026	0.020	0.059	-0.057	-0.129
LP	0.278**		0.601**	0.202*	0.195*	0.045	0.001	0.126	-0.336**	0.009
MP	0.391**	0.601**		0.286**	0.250**	0.044	0.033	0.103	-0.048	-0.131
ADMY	0.872**	0.202*	0.286**		0.806**	-0.025	-0.007	-0.001	-0.060	-0.048
MDMY	0.700**	0.195*	0.250**	0.806**		0.020	0.025	-0.072	0.038	0.052
FW	-0.026	0.045	0.044	-0.025	0.020		0.291**	0.046	-0.106	-0.009
SL	0.020	0.001	0.033	-0.007	0.025	0.291**		0.566**	-0.140	0.078
FL	0.059	0.126	0.103	-0.001	-0.072	0.046	0.566**		-0.275**	0.042
ANC	-0.057	-0.336**	-0.048	-0.060	0.038	-0.106	-0.140	-0.275**		-0.151
WF	-0.129	0.009	-0.131	-0.048	0.052	-0.009	0.078	0.042	-0.151	

$^{*}p<0.05$ and $^{**}p<0.01$; statistically significant

Table 3: The correlation coefficients between wool yield traits and their own canonical variables

Traits	V_1	V_2	V_3	V_4	V_5
FW	-0.992	0.997	1.000	1.000	-0.999
SL	-0.297	0.284	0.292	0.285	-0.283
FL	0.005	0.023	0.049	0.040	-0.050
ANC	-0.003	-0.120	-0.106	-0.105	0.105
WF	-0.024	0.069	-0.008	-0.016	0.002

Table 4: The correlation coefficients between milk yield traits and their own canonical variables

Traits	W_1	W_2	W_3	W_4	W_5
MY	-0.996	1.000	0.976	-1.000	0.999
LP	-0.278	0.281	0.378	-0.274	0.284
MP	-0.390	0.395	0.555	-0.383	0.400
ADMY	-0.858	0.870	0.33	-0.873	0.870
MDMY	-0.639	0.696	0.735	-0.703	0.698

age, ewe's weight and birth weight and a significant canonical correlation coefficient (0.733) was calculated between this set and the carcass characteristics set. In this study, the first canonical correlation between milk yield and wool yield traits was found as 0.4473. This value is higher than the simple correlations between these traits. The relationships between milk yield and wool yield traits can be explained by the first canonical correlation (r = 0.4473) and canonical variable:

$$V_1 = -0.0286FW - 0.3722SL + 0.3083FL - 0.9211ANC - 0.1693WF$$

$$W_1 = 0.0683MY + 1.0542LP - 0.4554MP + 0.7249ADMY - 0.8928MDMY$$

The calculations showed that 49.77% of the variance of the standardized traits of Y set (MY, LP, MP, ADMY and MDMY) can be explained by the first canonical variable of Y set traits also, 21. 81% of total variance of the standardized traits of X set (FW, SL, FL, ANC and WF) can be explained by the first canonical variable of X set traits.

Consequently, it can be said that the canonical correlation coefficient between milk yield traits and wool yield traits is low, that's why wool yield traits couldn't be used as a fine approach for indirect estimation of the milk yield traits.

REFERENCES

Cankaya, S., E. Yazgan, G.T. Kayaalp, Z. Gocmez and U. Serbester, 2008. Canonical correlation analysis for estimation of relationship between some body measurements at the birth and 6 months periods in holstein friesian calves. J. Anim. Vet. Adv., 7 (8): 953-958.

Cottle, D.J., 1988. Indirect selection for adult fleece weight using canonical discriminant functions of blood metabolites. Proc. New Zealand Soc. Anim. Prod., 48: 201-205.

Duzgunes, O., A. Elicin and N. Akman, 1987. Animal Improvement, Ankara University, Faculty of Agricultural, Public. No: 1003, Ankara.

Doehner, H and H. Reumuth, 1964. Wolkunde 2, Auflage Paul Parey, Berlin und Hamburg.

Dyrmudsson, O.R., 1976. Reproductive Efficiency of Iceland Sheep I. Puberty and Early Reproductive Performance. 2nd EAPP Animal Meeting in Zurich.

Emsen, E. and M.E. Davis, 2004. Canonical Correlation Analyses of Testicular and Body Measurements of Awassi Ram Lambs. J. Anim. Vet. Adv., 3 (12): 842-845.

Ertugrul, M., 1991. Sheep and Goat Breeding Practice, Ankara Univ. Faculty of Agric. Public. No: 1211, Ankara.

Gurbuz, F., 1989. Canonical Correlation Analysis for Studying the Relationships between Variable Sets. Ankara University. Faculty of Agricultural. Public. No: 1162, Ankara.

Harvey, W.R., 1987. User's Quide for LSMLMW PC-1 Version (The Ohio State University, Department of Dairy Science, Columbus, Ohio).

Kaymakci, M., 2004. Sheep Breeding Manual. General Directorate of Agricultural Enterprises, 2004-2.

Keskin, I., U. Zulkadir and B. Dag, 2004. Canonical correlation analysis for studying the relationship between reproductive traits and milk yield traits of brown swiss herd raised at the state farm of konuklar in Konya Province. J. Anim. Vet. Adv., 3 (1): 797-799.

Keskin, S., A. Kor and E. Baspinar, 2005. The investigation of relationships between some traits measured pre-slaughtering and post-slaughtering by using of canonical correlation analysis in akkeci kids. J. Agric. Sci., 11 (2): 154-159.

Kocabas, Z., T. Kesici and A. Elicin, 1998. Investigation of Relationship amongst The Various Body Measurements by Using Canonical Correlation Analysis. II. National Animal Science Congress, Uludag Univ., Bursa, pp: 169-178.

Sonmez, R. and E. Demiroren, 1977. Early Mating Possibilities in Sheep. West Anatolian I. Dairy Livestock Breeding Symposium, MPM Publication No.: 208, Ankara.

Statistica for Windows PC 5.0, 1995. Stat Soft. Inc. 2325 East 13th Street, Tulsa, OK741 04, USA.

Tatar, A.M., 1999. Canonical correlation between body weight and measurements in suckling and fattening periods and their possibilities of using in selection in Ile de France xAkkaraman (G_1) Male Lambs. Ankara University, Graduate School of Natural and Applied Sciences (Ph.D Thesis), Ankara.

Tatlidil, H., 1996. Applied Statistical Multivariate Analysis. Department of Statistics, Faculty of Science, Hacettepe University, Ankara.

Ozturk, E., 2000. The investigation of canonical correlation between body weight and measurements in suckling and carcass characteristics in Ile de France x Akkaraman (B_1) Male Lambs. Ankara Univ. Graduate School of Natural and Applied Sciences (Ph.D Thesis), Ankara.

Ozcan, L., 1990. Sheep Breeding. Ministry of Agriculture Forestry and Rural Affairs, Vocational Publications: 343, Series: 15, Ankara.

Yaprak, M., F. Koycegiz, M. Kutluca, E. Emsen and H.W. Ockerman, 2008. Canonical correlation analysis of body measurements, growth performance and carcass traits of red karaman lambs. J. Anim. Vet. Adv., 7 (2): 130-136.