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Usability of the Factor Analysis Scores in Multiple Linear Regression Analyses for the Prediction of Daily Milk Yield in Norduz Goats

I. Daskiran[1*], S. Keskin[2], and M. Bingol[3]

ABSTRACT

The aim of this study was to determine the relationship between daily milk yield and udder traits using multiple regression analyses in order to predict daily milk yield in Norduz goats. 10 udder traits including upper udder height, bottom udder height, udder depth, udder width, udder circumference, left teat length, right teat length, left teat circumference, right teat circumference and teat angle. The data was collected from 27 Norduz goats raised in pastoral conditions in the Norduz region of Van province South Eastern Turkey. Factor analysis was employed to simplify the complex relationships between udder traits. After the udder traits were exposed to factor analysis, four factors with Eigen values greater than 1 were selected as explanatory (independent) variables and used for multiple linear regression analysis. First factor was named teat factor, second and third factors were named udder factors while the fourth was udder bottom height. The 2*nd* and 3*rd* factors, which were significant, were then used to fit the regression model. The study found that two udder factors had significant statistical effect on daily milk yield and these factors together had accounted for 78.6 % of the variation in daily milk yield. The findings of this study showed that both multivariate and univariate approaches can be used to determine the relationship between milk yield and udder traits. In addition, these statistical approaches may also be useful to eliminate multicollinearity problems among large number of variables. In conclusion, the study proved that both univariate and multivariate methods can be applied successfully to predict daily milk yield using udder traits in goats.

Keywords: Determination coefficient, Eigen value, Goats, Milk yield, Udder traits.

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INTRODUCTION

One of the main purposes of the animal breeding is to gain economical returns through producing milk, meat, egg or fibre. The yield of this production can on occasion be determined by measuring physiological traits on the animal. It was confirmed that udder and teat characteristics were determinants of milk yield in cattle (Rogers and Spencer, 1991; Sapp *et al.*, 2004; Tilki *et al.*, 2005), in sheep (De la Fuente *et al.*, 1999; Ayadi *et al.*, 2011; Iniguez *et al.*, 2011; Ángels Pérez-Cabal *et al.*, 2013; Merkhan, 2014) and in goats (Peris *et al.*, 1999; Akpa *et al.*, 2002; Keskin *et al.*, 2007a; Merkhan and Alkass, 2011). Various univariate models and approaches were used to determine the relationship between daily milk yield and some udder traits for selecting productive animals in animal breeding programs. However, these models or approaches failed to define complex

[1] Ministry of Food Agriculture Livestok of Turkey, Genetic Directorate Agricultural Research and Policies, Ankara, Turkey.
[*] Corresponding author; e-mail: irfan.daskiran@gmail.com
[2] Department of Biostatistics, Faculty of Medicine, Yuzuncu Yil University, Van, Turkey.
[3] Department of Animal Science, Faculty of Agriculture, Yuzuncu Yil University, Van, Turkey.

relationships among the variables related to udder traits and daily milk yield.

The above mentioned studies have shown that determination of the relationship between milk yield and udder traits plays an important role in animal breeding. In addition they have also determined the relationships between udder traits and genetic or non-genetic factors (Makovicky *et al.,* 2013; Makovicky *et al.,* 2015a; Makovicky *et al.,* 2015b). Whilst additional studies have shown further relationship factors between daily milk yield and some udder traits (Burke and Funk, 1993; Fernandez *et al.,* 1995; Peris *et al.,* 1999; Serrano *et al.,* 2002; Sapp *et al.,* 2004; Marie-Etancelin *et al.,* 2005) in small ruminants. There is only a few (Keskin *et al.,* 2007a; Eyduran *et al.,* 2012) that combined multivariate and univariate analyses. Combining these analyses simplifies the interpretation of results with use of multicollinearity and reduction of explanatory variables (Eyduran *et al.,* 2010).

This study also used multiple regression and factor analyses to interpret the multivariate relationships between daily milk yield and some udder traits. Multiple regression models are useful for predicting assumed dependent variable (Khan *et al.,* 2014). The specific goals of factor analysis are to summarize pattern of correlations among observed variables, to reduce a large number of observed variables to a smaller number of factors, to provide an operational definition (regression equation) for an underlying process by using observed variables, or test a theory about the nature of underlying processes (Tabachnick and Fidell, 2001).

The main objective of this study was to establish relationships between daily milk yield and udder traits and investigate the usability of factor and multiple regression analyses in order to predict daily milk yield from 10 udder traits in Norduz goats. This study also aimed to eliminate the multicollinearity issue in multiple regression models by reducing a large number of variables and to interpret multiple regression model results by removing the indirect effect of related explanatory variables.

MATERIALS AND METHODS

Data collection

Data was collected from 27 Norduz goats raised at a pastoral farm in the Van province of East Anatolia, Turkey. The herd consisted of 2 and 3-years old does that were raised under pasture conditions and represented two sire families. Average weight (±Standard Deviation) of does was 48.73±7.34 kg. The study was conducted during the 90 day lactation period for one season. The kids suckled during the 90 day period and hand milking was carried out only in the mornings. Measurements were carried out six times in 14 day intervals using measuring cups to ascertain daily milk yield. All data were adjusted for sire families, age of goats and litter size. For the adjustment, one of the categories of the variables was specified and then adjustment was performed to other categories. The 10 udder traits were measured on days 90, 104, 118, 132, 146 and 160 of the lactation period.

The traits are defined as: 1) Udder Upper Height (UUH) is defined as the distance from the ground to the base of the teats, and measured by using measure cane.

2) Udder Bottom Height (UBH) is defined as the distance from the ground to the teats, and measured as the distance from the ground to the teats by using measure cane.

3) Udder Depth (UD) is defined as the distance between the abdominal wall at the base of the udder and the base of the teat.

4) Udder Width (UW) is defined as the distance from the fore and rear of the udder and measured by using measure cane.

5) Udder Circumference (UC) is the widest horizontal circumference across the udder and is taken using meausure tape.

6) Left Teat Length (LTL) is the length of left teat from the base to the end of teat and is measured by using measure tape.

7) Right Teat Length (RTL) is the length of right teat from the base to the end of teat and measured by using measure tape.

8) Left Teat Circumference (LTC) is the widest horizontal circumference across the left teat and measured by measure tape.

9) Right Teat Circumference (RTC) is the widest horizontal circumference across the right teat and measured by measure tape.

10) Teat Angle (TA) is the teat inclination with regard to the vertical and measured by a pivoting angle meter (Peris *et al.,* 1999; Marie-Etancelin *et al.,* 2005). The average of the six time measurements was used for analysis.

Statistical Analysis

For all variables, Kolmogorov-Simirnov normality test was performed and p values ranged from 0.10 to 0.47. After normality test, it was determined that all variables were normally distributed. KMO (Kaiser-Meyer-Olkin) measure of sampling adequacy was computed. Factor analysis was performed on 10 udder traits to rank their relative significance and to describe their interrelation patterns with daily milk yield. One of the factor analysis goals is to summarize a pattern of correlations with as few factors as possible.

For this analysis, basic equation can be represented in matrix form as:

$$Z_{px1}= \lambda_{pxm}F_{mx1}+\varepsilon_{px1}$$

Where, $\boldsymbol{Z}$ is a *px1* vector of variables, $\boldsymbol{\lambda}$ is a *pxm* matrix of factor loadings, $\boldsymbol{F}$ is a *mx1* vector of factors and $\boldsymbol{\varepsilon}$ is a *px1* vector of error (unique or specific) factors (Sharma, 1996; Tabachnick and Fidell, 2001). It is assumed that factors are not correlated with the error components. Because of differences in the units of each variables implemented in factor analysis, original variables (udder traits) were standardized and correlation matrix of variables was used to obtain Eigen values. Loadings are correlation coefficients between variables and factors. Varimax rotation was used to facilitate interpretation of factor Loadings (L_{ik}). Coefficients (C_{ik}) were used to obtain factor scores for selected factors (Eyduran *et al.,* 2013). Factors with Eigen values greater than 1 out of 10 factors were utilized in multiple regression analysis (Sharma, 1996; Tabachnick and Fidell, 2001; Johnson and Wichern, 2002; Keskin *et al.,* 2007b).

The proportion of variance in the set of variables accounted for by a factor is the Sum of Square Loading for the factor (SSL) (variance of factor) divided by the number of variables (if rotation is orthogonal).

Score values of selected factors were considered as independent variables for predicting daily milk yield. The regression equation is presented as;

$$DMY= a+ b_1FS_1+b_2FS_2+b_3FS_3+b_4FS_4+e$$

Where, '*a*' is regression constant (its value is zero because of using standardized variables), 'b_1', 'b_2' b_3, and 'b_4' are regression coefficients of Factor Scores (FS). *FS* is Factor Scores and *e* is the error term of the regression model. Regression coefficients were tested by using t test. Determination coefficient (R^2) was used as predictive success criteria for regression model (Draper and Smith, 1998). All data were analyzed using MINITAB (Version: 14) statistical package program (Anonymous, 2000).

RESULTS AND DISCUSSION

Descriptive statistics and Pearson correlation coefficients for all traits are presented in Tables 1 and 2, respectively.

As presented in Table 2, most of the correlation coefficients among variables (traits) were significant ($P< 0.01$). In addition, KMO (Kaiser-Meyer-Olkin) measure of sampling adequacy was found to be 0.828 (We took 0.6 as minimum value). We concluded this correlation coefficient as factorable. Therefore, factor analysis was carried out for udder traits and the results are

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Table 1. Descriptive statistics for udder traits and daily milk yield.[a]

Variable	Mean	SD	Minimum	Maximum
UUH (cm)	42.2	2.42	35.0	46.0
UBH (cm)	28.6	6.05	23.0	58.0
UD (cm)	8.7	1.32	5.0	10.5
UW (cm)	13.3	1.66	10.0	16.5
UC (cm)	38.7	4.43	30.0	48.0
LTL (cm)	3.7	1.87	1.2	8.9
RTL (cm)	3.8	1.81	1.3	9.1
LTC (cm)	2.4	1.19	1.1	6.3
RTC (cm)	2.6	1.32	1.0	5.9
TA (angle)	14.3	2.55	10.0	19.0
DMY (g)	763	244	150.0	1250.0

[a] UUH: Udder Upper Height; UBH: Udder Bottom Height; UD: Udder Depth; UW: Udder Width; UC: Udder Circumference; LTL: Left Teat Length; RTL: Right Teat Length; LTC: Left Teat Circumference; RTC: Right Teat Circumference; TA: Teat Angle; DMY: Daily Milk Yield, *SD*: Standard Deviation.

presented in Table 3. In this analysis, the number of Eigen values is equal to the number of original variables.

Because Eigen values represent variances and that each standardized variable contributes to principal component extraction, only factors with Eigen values greater than 1 are retained for subsequent analysis (Sharma, 1996; Tabachnick and Fidell, 2001). Thus, only four factors of Eigen values greater than 1 were retained for multiple regression analysis.

Selected factors explained 87.8% of total variation of variables in factor analysis. Communality values for variables were found to be very high (i.e. for UBH it was 95.5% showing that 95.5% of the variance in UBH is accounted for by Factors 1, 2, 3 and 4). The first factor variance was seen as 3.691 (Table 3) showing that 36.9 % of the variance in the variables was accounted for by the first factor. The second factor accounted for 23.1%, the third factor accounted for 16.1% and the fourth factor accounted for 11.7% of the total covariance. For the selected four factors, factor loading and factor score coefficients are also presented in Table 3. After orthogonal rotation, the values of loading are correlations between variables and corresponding factors. The bold marked figures indicate the highest correlations between variables and the corresponding factors. The greater loading, the more the variables are a pure measure of a factor. For instance, LTL, RTL, LTC and RTC which showed the highest correlation with Factor 1 were considered as a group. The highest values of communalities indicate that the variances of variables were efficiently reflected in factor analysis. From the 10 variables included in the four selected factors only some possessed high loads; LTL, RTL, LTC and RTC in Factor 1, UW, UC and TA in Factor 2, UUH and UD in Factor 3 and UBH in Factor 4.

Certain factors may be interpreted as being directly correlated with certain variables. For instance the first factor primarily has teat measurements and may be referred to as teat factor; the second factor has primarily udder measurements while the third factor has UUH and UD. These two factors may be termed udder factors. The fourth factor on the other hand only has UBH measurement.

Factor score coefficients were used to obtain factor score values which were used as independent variables in multiple linear regression analysis to determine significant factors for daily milk yield. Two of the

Table 2. Pearson correlation coefficients among all traits.[a]

	UUH[a]	UBH[b]	UD[c]	UW[d]	UC[e]	LTL[f]	RTL[g]	LTC[h]	RTC[i]	TA[k]
UBH	0.030	1								
UD	0.463**	-0.286**	1							
UW	0.235*	-0.383**	0.543**	1						
UC	0.311**	-0.382**	0.684**	0.911**	1					
LTL	0.248*	0.161	0.027	-0.222*	-0.285**	1				
RTL	0.198	0.274**	-0.010	-0.233*	-0.282**	0.915**	1			
LTC	0.299**	0.187	0.009	-0.216*	-0.303**	0.933**	0.918**	1		
RTC	0.179	0.430**	-0.004	-0.215*	-0.258**	0.778**	0.933**	0.854**	1	
TA	0.093	-0.267**	.255**	0.558**	0.528**	-0.293**	-0.379**	-0.368**	-0.315**	1
DMY[l]	0.473**	-0.057	0.678**	0.773**	0.823**	0.014	0.050	0.054	0.119	0.417**

[a] Udder Upper Height; [b] Udder Bottom Height; [c] Udder Depth; [d] Udder Width; [e] Udder Circumference; [f] Left Teat Length; [g] Right Teat Length; [h] Left Teat Circumference; [i] Right Teat Circumference; [k] Teat Angle, [l] Daily Milk Yield. * $P< 0.05$, ** $P< 0.01$.

Table 3. Communalities, factor score coefficients and rotated factor loadings for the variables.[a]

Variable	Factor score Coefficients (C_{ik})				Rotated factor Loadings (L_{ik}) and communalities				
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 1	Factor 2	Factor 3	Factor 4	Communality
UUH[a]	-0.107	0.233	0.720	-0.185	0.178	-0.055	**0.876**[m]	-0.124	0.817
UBH[b]	-0.075	-0.124	0.085	-0.931	0.158	0.205	-0.030	**-0.942**	0.955
UD[c]	-0.019	0.038	0.452	0.133	0.042	-0.406	**0.723**	0.260	0.757
UW[d]	0.092	-0.426	-0.062	0.005	-0.103	**-0.844**	0.295	0.229	0.863
UC[e]	0.018	-0.303	0.117	-0.003	-0.191	**-0.780**	0.451	0.225	0.899
LTL[f]	0.293	-0.030	-0.058	0.162	**0.939**	0.155	0.073	0.029	0.912
RTL[g]	0.296	-0.082	-0.084	0.032	**0.967**	0.150	0.042	-0.096	0.968
LTC[h]	0.273	0.011	0.004	0.132	**0.946**	0.199	0.123	-0.007	0.950
RTC[k]	0.270	-0.182	-0.098	-0.208	**0.905**	0.071	0.032	-0.299	0.914
TA[l]	0.086	-0.587	-0.329	-0.236	-0.233	**-0.827**	-0.064	-0.012	0.742
Variance					3.691	2.306	1.609	1.173	8.778
% Variance					0.369	0.231	0.161	0.117	**0.878**

[a] Udder Upper Height; [b] Udder Bottom Height; [c] Udder Depth; [d] Udder Width; [e] Udder Circumference; [f] Left Teat Length; [g] Right Teat Length; [h] Left Teat Circumference; [k] Right Teat Circumference; [l] Teat Angle, [m] Bold numbers indicate the highest load in the factor for each variable.

selected factors (Factors 2 and 3) were found to have significant (P< 0.01) linear relationships with daily milk yield. Furthermore, 80.6% of the variance in the daily milk yield was accounted for by these four factors. Afterwards, only significant factors (Factors 2 and 3) were included in the regression model. Results, except for determination coefficient (R^2) and S values, were the same as those of four-factor model. There was no statistically significant difference regarding determination coefficient between the two models. Therefore, the parsimonious model that includes two factors may be favorable.

Original variables (UW, UC, TA, UUH, and UD) in significant Factors (F1 and F2) were used for ordinary regression analysis (Table 4). Although determination coefficient of the model was found as 74.8% and statistically significant, none of the coefficients of the variables were significant. This result indicates a typical multicollinearity problem. Therefore, factor analysis might be useful to eliminate the multicollinearity problem as well as to reduce large number of original variables. Positive effect of Factor 1 and negative effect of Factor 4 were not statistically significant. Authors felt that teat measurements in Factor 1 could play an important role in case mechanical milking rather than milk yield in general. In the same way, Emediato *et al.* (2008) pointed out that udder traits can be considered for the selection of dairy ewes for machine milking when those animals are not nursing their offspring.

UW, UC, TA, UUH and UD variables in Factors 2 and 3 can be important traits for udder formation and determining of udder volume. Ayadi *et al.* (2011) emphasized that udder morphology traits were positively correlated with milk yield and could be considered in selection programs of Sicilo-Sarde dairy sheep. Furthermore, Iniguez *et al.* (2011) noted that udder circumference and teat width appear to be the most useful from the udder measurements taken in their study for predicting total milk yield of Awassi sheep. It is also reasonable to consider that udder volume is related to daily milk yield. Therefore increasing udder volume could lead to higher milk production in animals and these variables could play an important role for increasing milk production in goats. Moreover, Tilki *et al.* (2005) indicated that teat length, udder height, distances between front teats, between rear teats and between front and rear teats and mammary type scores significantly affected milk yield.

The study showed that multivariate models or combining multivariate and univariate models can determine relationships among large number of variables. The present study also showed relationships between daily milk yield and some udder traits by examining both multivariate and univariate approaches. Our results showed that daily milk yield can be predicted at a success rate of 78.6%. Similarly, Keskin *et al.* (2007a) used the combination of factor and regression analysis in Akkeci goats for prediction of Daily Milk Yield (DMY). Their results showed that four factors had significant effect on DMY and determination coefficient for regression analysis was found to be 71.3%. Their results also indicated that RTL, LTL, RTC and RTC are grouped into the first factor, UD, UV and UC into the second factor, UUH and UBH into the third factor, while the fourth factor consist of only TA. In other studies trait factors and regression analysis were used to make similar predictions. Keskin *et al.* (2007b) combined factor and regression analysis for prediction of carcass weight by using 10 body measurements in Akkeci goat kids. The authors reported that 10 body measurements were grouped into 3 factors and determination coefficient was 83.9%. Similarly, Eyduran *et al.* (2012) applied both factor and regression analyses to predict carcass weight of fish. Their results indicated that three factors were statistically significant and these factors accounted for 95.2% of the total variation in the regression analysis.

CONCLUSIONS

The present study indicated the relationship between daily milk yield and some udder traits (UUH, UD, UW, UC and TA) in goats by combining both multivariate and univariate methods. The results showed that udder traits appear to have a predictive ability for daily milk yield in dairy goat and can be used in programs for improvement of milk yield. Furthermore our findings indicated that these present models can be useful to eliminate multicollinearity problems among a large number of variables. Our approach simplified the use of multiple regression models by reducing a large number of variables and interpretation of multiple regression model results by removing indirect effect of related explanatory variables.

REFERENCES

1. Akpa, G. N., Asiribo, O. E., Oni, O. O., Alawa, J. P., Dim, N. I. and Osinowo, O. A. 2002. Milk Production by Agro Pastoral Red Sokoto Goats in Nigeria. *Trop. Anim. Health Prod.*, **34**: 525-533.
2. Ángels Pérez-Cabal, M., Legaz, E., Cervantes, I., De la Fuente, L. F., Martínez, R., Goyache, F. and Gutiérrez, J. P. 2013. Association between Body and Udder Morphological Traits and Dairy Performance in Spanish Assaf Sheep. *Arch. Tierzucht,* **56:** 430-442.
3. Anonymous. 2000. *MINITAB Statistical Software*. Minitab Inc. USA.
4. Ayadi, M., Such, X., Ezzehizi, N., Zouari, M., Najar, T., Ben, M., Rad, M. and Casals, R. 2011. Relationship between Mammary Morphology Traits and Milk Yield of Sicilo-Sarde Dairy Sheep in Tunisia. *Small Rumin. Res***., 96:** 41–45.
5. Burke, B. P. and Funk, D. A. 1993. Relationship of under Different Linear Type Traits and Herd Life Management Systems. *J. Dairy Sci.*, **76:** 2773-2782.
6. De la Fuente, L. F., Fernandez, G. and San Primitivo, F. 1999. A Linear Evaluation System for Udder Traits of Dairy Ewes. *Livestock Prod. Sci.,* **45:** 171-178.
7. Draper, N. R. and Smith, H. 1998. *Applied Regression Analysis*. John Wiley and Sons Inc., New York, 706 PP.
8. Emediato, R. M. S., Siqueira, E. R., Stradiotto, M. M., Maesta, S. A and Fernandes, S. 2008. Relationship between Udder Measurements and Milk Yield in Bergamasca Ewes in Brazil. *Small Rumin. Res.*, **75**: 232–235.
9. Eyduran, E., Topal, M. and Sonmez, A. Y. 2010. Use of Factor Scores in Multiple Regression Analysis for Estimation of Body Weight by Several Body Measurements in Brown Trouts (*Salmo trutta* Fario). *Int. J. Agric. Biol*., **12:** 611-615.
10. Eyduran, E., Topal, M., Sonmez, A.Y. and Keskin, S. 2012. Carcass Weight Estimation from Some Morphological Traits of *Capoeta capoeta* Capoeta (Güldenstädt, 1772) Using Factor Scores in Multiple Regression Analysis. *Pak. J. Stat.,* **28:** 159-165.
11. Fernandez, G., Alvarez, P., San Primitivo, F. and De La Fuente, L. F. 1995. Factors Affecting Variation of Udder Traits of Dairy Ewes*. J. Dairy Sci.,* **78:** 842-849.
12. Iniguez, L., Hilali, M., Thomas, D. L. and Jesry, G. 2011. Udder Measurements and Milk Production in Two Awassi Sheep Genotypes and Their Crosses. *J. Dairy Sci.,* **92**: 4613–4620.
13. Johnson, R. A. and Wichern, D. W. 2002. *Applied Multivariate Statistical Analysis*. Prentice Hall, upper Saddle River, New Jersey, USA, 766 PP.
14. Keskin, S., Kor, A. and Karaca, S. 2007a. Use of Factor Analysis Scores in Multiple Linear Regression Model for Determining Relationships between Milk Yield and Some Udder Traits in Goats. *J. Appl. Anim. Res.,* **31:** 185-188.
15. Keskin, S., Daskiran, I and Kor, A. 2007b. Factor Analysis Scores in a Multiple Linear Regression Model for the Prediction of Carcass Weight in Akkeci Kids. *J. Appl. Anim Res.*, **31**: 201-204.
16. Khan, M. A., Tariq, M. M., Eyduran E., Tatliyer, A., Rafeeq, M., Abbas, F., Rashid, N., Awan M. A. and Javed, K. 2014. Estimating Body Weight from Several Body Measurements in Harnai Sheep without Multicollinearity Problem*. J. Anim. Plant Sci.,* **24(1):** 120-126
17. Makovicky, P. Nagy, M. and Makovicky, P. 2013. Comparison of External Udder Measurements of the Sheep Breeds

Improved Valachian, Tsigai, Lacaune and Their Crosses. *Chile. J. Agric. Res.,* **73(4):** 366-371.
18. Makovicky, P., Margetin, M. and Makovicky, P. 2015a. Genetic Parameters for the Linear Udder Traits of Nine Dairy Ewes: Short Communication. *Veterinarski Arhiv.,* **85(5):** 577-582.
19. Makovický, P., Margetín, M. and Milerski, M. 2015b. Estimation of Udder Cistern Size in Dairy Ewes by Ultrasonography. *Mljekarstvo*, **65(3):** 210-218.
20. Marie-Etancelin, C., Astruc, J. M., Portec, D., Larroqued, H. and Robert-Granie´, A. C. 2005. Multiple-Trait Genetic Parameters and Genetic Evaluation of Udder-Type Traits in Lacaune Dairy Ewes. *Livest. Prod. Sci.,* **97:** 211-218.
21. Merkhan, K. Y. 2014. Milk Traits and Their Relationship with Udder Measurements in Awassi Ewes. *Iran. J. Appl. Anim. Sci.,* **4(3):** 521-526.
22. Merkhan, K. Y. and Alkass, J. E. 2011. Influence of Udder and Teat Size on Milk Yield in Black and Meriz Goats. Res. Opin. Anim. Vet. Sci., **1(9):** 601-605
23. Milerski, M., Margetin, M., Čapistrak, A., Apolen, D., Španik, J. and Oravcova, M. 2006. Relationships between External and Internal Udder Measurements and the Linear Scores for Udder Morphology Traits in Dairy Sheep. *Czech J. Anim. Sci.,* **51**: 383-390.
24. Peris, S., Caj, A. G. and Such, X. 1999. Relationships between Udder and Milking Traits in Murciano-Granadina Dairy Goats. *Small Rumin. Res.,* **33**: 171-179.
25. Rogers, O. W. and Spencer, S. B. 1991. Relationship among Udder and Teat Morphology and Milking Characteristics. *J. Dairy Sci.,* **74(12):** 74418-74431.
26. Sapp, R. L., Rekaya, R. and Bertrand, J. K. 2004. Teat Scores in First-Parity Gelbvieh Cows: Relationship with suspensory Score and Calf Growth Traits. *J. Anim. Sci.,* **82:** 2277–2284.
27. Serrano, M., Perez-Guzman, M. D., Montoro, V. and Jurado, J. J. 2002. GeneticA of udder Traits in Manchega Ewes. *Livest. Prod. Sci.,* **77:** 355–361.
28. Sharma, S. 1996. *Applied Multivariate Techniques*. John Wiley and Sons, Inc., New York, USA, 493 PP.
29. Tabachnick, B. G. and Fidell, L. S. 2001 *Using Multivariate Statistics.* Allyn and Bacon A Pearson Education Company, Boston, USA, 966 PP.
30. Tilki, M., Inal, S., Colak, M. and Garip, M. 2005. Relationships between Milk Yield and Udder Measurements in Brown Swiss Cows. *Turk. J. Vet. Anim. Sci.,* **29:** 75-81.

قابلیت استفاده از نمرات تجزیه و تحلیل فاکتورها در تجزیه و تحلیل رگرسیون خطی چندگانه برای پیش بینی عملکرد شیر روزانه در بز های Norduz

ی. دسکیران، س. کسکین، و م. بینگول

چکیده

هدف از این مطالعه تعیین رابطه تولید شیر روزانه و صفات پستان با استفاده از تحلیل رگرسیون چندگانه جهت پیش بینی تولید شیر روزانه در بز های Norduz است. ۱۰ صفت پستان شامل ارتفاع بالایی، ارتفاع پایینی، عمق پستان، عرض پستان، حدود پستان، طول پستانک چپ، طول پستانک راست، محدوده پستانک چپ ، محدوده پستانک راست، و زاویه پستانک میشود. داده ها از ۲۷ بز نژاد Norduz پرورش یافته در منطقه Norduz ون استان جنوب شرقی ترکیه جمع آوری شده است. از

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تجزیه و تحلیل فاکتورها برای ساده سازی روابط پیچیده بین صفات پستان استفاده شد. بعد از آنالیز کردن صفات پستان با آنالیزهای فاکتورها، ۴ فاکتور با مقدار ویژه بزرگتر از ۱، به عنوان متغیرهای توضیحی (مستقل) انتخاب شدند و برای تجزیه و تحلیل رگرسیون خطی چندگانه استفاده شد. اولین فاکتور صفات پستانک، دومی و سومی فاکتورهای پستان بود درصورتیکه چهارمی ارتفاع پایینی پستان نامیده شد. سپس از فاکتورهای دومی و سومی که معنادار بودند، برای تناسب مدل رگرسیونی استفاده شد. نتایج نشان داد که دو عامل فاکتورهای پستان اثر معناداری بر تولید شیر روزانه دارند و این فاکتورها با همدیگر نقش ۷۸درصدی در تنوع عملکرد شیر روزانه دارند. یافته های این مطالعه نشان داد که هر دو روش چند متغیره و یکنواخت برای تعیین رابطه بین صفات تولید شیر و ریشه می تواند مورد استفاده قرار گیرد. علاوه بر این، این رویکردهای آماری نیز ممکن است برای از بین بردن مشکلات چندگانه بین تعداد زیادی متغیر، مفید باشد. در نتیجه، این مطالعه ثابت کرد که هر دو روش چند متغیره و چند متغیره می تواند به طور موفقیت آمیز برای پیش بینی عملکرد شیر روزانه با استفاده از صفات پستان در بز ها مورد استفاده قرار گیرد.

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