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Original Research

Effect of selection intensity for different ranges in estimation of the direct and correlate expected genetic response to milk yield in Cyprus goats

Authors:
Al-Azzawi ZMM

Institution:
Department of Animal Production, University of Diyala, College of Agriculture, Iraq.

Corresponding author:
Al-Azzawi ZMM

ABSTRACT:

This study was carried out at the ruminant Research Station, State Board for Agricultural Research (20 km west of Baghdad) during 2016 and 2017 in 318 Cyprus goat to investigate the estimation of direct and correlated genetic response dependent on phenotypic values for Total Milk Yield (TMY), Lactation Period (LP) and Economic Value (EV) of both traits to different criteria of selection program (90, 80, 70, 60 and 50%) were used to select doe's from the flock. The selection depend on phenotypic values TMY, LP and EV. The percentage of direct genetic response for TMY 1.97, 4.04, 6.29, 8.83 and 11.37% from the flock mean at the selection percentage 90, 80, 70, 60 and 50% respectively. Direct genetic response of LP corresponding were 0.311, 0.462, 0.612 and 2.14% at the selection percentage 90, 80, 70 and 60% from the flock mean. The percentage of direct genetic response for EV 1.32, 2.80, 4.53, 6.21 and 8.12 from the flock mean at the selection percentage 90, 80, 70, 60 and 50% respectively. The selection at 50% of doe showed a high of direct genetic response 11.37, 2.14 and 8.12% for TMY, LP and EV respectively. The direct selection for EV showed increase in the percentage of correlated genetic response for TMY 8.12 % at selection criteria 50% and 0.046% at selection criteria 70% to LP. However, the direct selection for TMY and EV showed a decrease in the percentage for LP at all selection criteria. In conclusion, a positive genetic response dependent on direct selection was found.

Keywords:

Genetic response, Milk production, Cyprus goat, Economic value.

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INTRODUCTION

Goats are one of the first animal species that humans have adapted for the purpose of producing meat, milk, skin and hair, and goats are spread almost all over the world. Asia ranked first, followed by Africa. According to FAO estimates for 2013, head (FAOSTAT, 2013). Goat milk is high in protein, minerals and vitamins and it does not contain agglutinin protein, an allergy protein found in cow's milk, Goat milk is easier to digest than cow milk, although the chemical composition of milk is similar to that of goats and cows (Reynolds, 2009). The importance of goats in Iraq is shown to be adapted to the harsh environmental conditions and poor nutrition, therefore improvement of these animals has begun to be noticed, especially since breeds have a wide range of genetic improvement, which will contribute to filling part of the deficit resulting from the lack of meat and milk and high prices (Al-Hamadani, 2000). Milk production is an economic traits that is influenced by genetic and non-genetic factors as any other economic traits, and phenotypic value is a function of the genetic factors and the extent of non-genetic factors (Falconer and Mackay, 1996). Setting a criterion for selection would determine the market criterion by highlighting the traits of milk production and lactation period as well as reproductive traits (Facó *et al*., 2011). The criterion of selection varies according to the goal of breeding. In Sincal, milk production is considered an important criterion in cattle, and the resistance to disease, milk production and growth rate are the criteria for selecting a head of cattle in the state of Kambia. The most important criteria for selection in sheep in the Sunni state lies in body size, growth rate and milk production, while the criterion for selecting milk production is important in sheep in Kambia (Ignacio, 2012). Estimates of economic values are based on the goal of breeding, which determines the criterion for selection in some countries (Bett *et al*., 2007; Bett *et al*., 2012a; Bett *et al*., 2012b; Lopes *et al*., 2012; Solis-Ramirez *et al*., 2012). Genetic response was phenotypic value mean between offspring of the selected parents and the average value of the parents' generation before the selection is based on that the average value of the selected parents is higher than the average of all the parents, which is called selection differential (Falconer, 1990). And thus obtain the offspring of average production above the average output of the original flock so the goal of the breeder increase selection differential to increase the genetic response, which is achieved by increasing the intensity of selection. Due to the lack of studies on the criteria of selection in goats, the aim of the study is to estimate the direct and correlated genetic response with the dependent on phenotypic values of Total Milk Yield (TMY), Lactation Period (LP) and the Economic Value (EV) from both traits by selecting criteria for selection and for several options for selected animals (90, 80, 70, 60 and 50%) to choose between selection options to maximize genetic and economic response.

MATERIALS AND METHODS

This study was carried out at the ruminant Research Station, State Board for Agricultural Research Abu Ghraib (20 km west of Baghdad) and the during 2016 and 2017. The total milk yield of 318 Cyprus doe's covered in the study was calculated for the two seasons of 2016 and 2017 depending on the daily milk production, which was measured monthly and for each doe in the normal milking method. The doe's were milking in the morning depending on the morning milk yield and the daily production (ICAR, 2004) and the total milk yield was calculated using the equation given by Pollott and Gootwine (2000):

$$TMY = (T_1-T_0)\, M_1 + \Sigma^{11} (T_r - T_{r-1})\, (M_r + M_{r-1}) / 2$$

where, TMY: Total Milk Yield; T_0: date of Birth; T_1: First measurement date; M_1: First measurement (quantity of milk kg); T_r: The date of measurement in the current month; T_{r-1}: Date of measurement for the previous month; M_r: Measurement in the current month

(milk quantity kg); M_{r-1}: Measurement in the previous month (milk quantity kg).

The economic response was calculated in dinars during the period of the research and according to the following equation:

Economic response = Total milk yield × 1000

Counting 1 liter of milk at 1000 Iraqi dinars.

The general linear model (GLM) was used within the statistical program SAS (2012) and the modification of fixed effects (year of production, month of birth, age of the doe, type of birth and sex of born) and estimation of the components of variation of the random effects in the studied traits. The heritability was estimated using REML according to the mathematical model below, which was used to calculate the genetic response of each phenotype trait (Maria *et al*., 2009):

$$Y_{ijklmno} = m + C_i + O_j + A_k + T_l + S_m + R_n + e_{ijklmno}$$

$Y_{ijklmno}$: the value of the observation 'o' belonging to the year of production 'i' and the month of birth 'j' and the age of the goat 'k' and the type of birth 'l' and the sex of the child 'm'; μ: The overall mean of total milk production μ; C_i: Effect of year of production (2016 and 2017); O_j: Effect of month of birth (January, February, March, April); A_k: Effect of the age of goat (2-6 years) T_l : Effect of birth type (Single, Twin, Triple); S_m: The effect of the sex of the child (male, female); R_n: The effect of sire to extract the variance components; $e_{ijklmno}$: Random error distributed by natural and independent distribution with an average of zero and a variation of $\sigma^2 e$.

The doe's were arranged in descending order according to each recipe and each doe. The following criteria were applied for selection: The first criterion is according to the Phenotypic Value of Total Milk Yield (PVTMY) and the following selection options:

- 90% of doe's were selected to study the direct effect in PVTMY and correlated with phenotypic value of lactation period (PVLP) and the economic value (EV) for TMY and LP.
- 80% of the doe's to study the direct effect in PVTMY and correlated with PVLP and EV.
- 70% of the doe's to study the direct and correlated effects mentioned above.
- 60% of the doe's to study the same direct and correlated effects mentioned above.
- 50% of the doe's to study the same direct and correlated effects mentioned above.

And the second criterion in the same direction by adopting the Phenotypic Value of Lactation Period (PVLP) and the above-mentioned selection options. The third criterion is the criterion of the economic value of TMY and LP and the choices of the selection itself.

The genetic response was estimated of the three criteria of selection for TMY, LP and EV and the percentage used for each criterion (50, 60, 70, 80 and 90%) were estimated using the following equation:

Genetic response = (trait value mean of post-selection - trait value mean of pre-selection) × heritability of trait. (Al-Anbari, 2005)

The ratio of direct and indirect (correlated) genetic response was calculated according to the following equation (Al-Anbari, 2005)

$$\text{Percentage of direct and correlated genetic response} = \frac{\text{The genetic response of trait at each selection}}{\text{Overall mean}} \times 100$$

RESULTS AND DISCUSSION

The estimates of heritability to TMY, LP and EV were 0.22, 0.08 and 0.15 (heritability of the EV derived from the rate heritability of TMY and LP), respectively. Table 1 shows that the overall mean TMY, LP and EV from both traits were 218.57 kg, 172.99 days and 229,667.2 dinars for the original flock (before the application of criterion of selection).

Phenotypic values of total milk production - TMY (criterion 1)

The mean value of TMY were 238.16, 258.81,

Table 1. Least square Mean to PVTMY (kg) , PVLP (day) and EV (dinar) by adopting an selection criterion for TMY

S. No	Selected percentage (%)	Trait	No. of animals	Mean ± SD	CV (%)	Genetic response
		PVTMY		138.06 ± 218.57	63.16	-
1	100%	PVLP	318	30.52 ± 172.99	17.64	
		EV		172473.3 ± 229667.2	75.09	
		PVTMY		131.75 ± 238.16	55.32	4.31
2	90%	PVLP	286	27.41 ± 175.80	15.59	0.224
		EV		169528.9 ± 250569.3	67.65	3135.3
		PVTMY		126.12 ± 258.81	48.73	8.85
3	80%	PVLP	254	26.64 ± 175.64	14.97	0.212
		EV		167841.6 ± 272929.6	61.49	6489.36
		PVTMY		120.21 ± 281.16	42.75	13.76
4	70%	PVLP	222	26.01 ± 174.08	14.94	0.087
		EV		120917.2 ± 277811.5	43.52	7221.64
		PVTMY		112.76 ± 306.42	36.79	19.32
5	60%	PVLP	191	24.22 ± 171.90	14.09	0.087-
		EV		114676.6 ± 302335.1	37.93	10900.1
		PVTMY		107.68 ± 331.62	32.47	24.87
6	50%	PVLP	159	20.67 ± 172.27	11.99	0.057-
		EV		111212.5 ± 326690.4	34.04	14553.4

281.16, 306.42 and 331.62 kg, respectively, at the selection of 90, 80, 70, 60 and 50% respectively of the original flock Table 1, which showed an increase of direct genetic response to the decrease of selection percentage, while correlated genetic response was decreased. These values represent TMY expected for the doe's during the coming season, as the selection will allow only the superior doe's in the production of milk to remain in the flock and will depend on them to be dams of the next generation.

Direct effect of the selection criterion

It is clear from Table 1 that the direct genetic response of TMY resulting from the selection of doe's according to the phenotypic values of the TMY is increased by decreasing the percentage of the selected animals, The direct genetic response of this trait was 4.31, 8.85, 13.76, 19.32 and 24.87 kg at the selection of 90, 80, 70, 60 and 50% of the original flock and these genetic response percentages were 1.97, 4.04, 6.29, 8.83 and 11.37% of TMY of the original flock respectively (Table 2). We found that the efficiency of the selection is increased by the low proportion of does selected, which requires a flock of high productivity to maintain or increase flock size and is important to maintain genetic variation to ensure the possibility of selection and genetic improvement and this was in line with what Al-Anbari (2005) confirmed that the rate of genetic response increases with an increase in the intensity of selection for the TMY 1.89, 3.49 and 5.44%, respectively, at the percentage of selection 90, 80 and 70%, respectively.

Correlated effect of criterion of selection

Results showed that the criterion for the determination of phenotypic values of PVTMY would result no increase in the selection differential, resulting is not genetic improvement in LP. The selection of 80% depend on TMY to decrease PVLP to 175.64. Thus, phenotypic values decreased by an increase of selection intensity to 174.08 and 171.90% at 70% and 60%, while the phenotypic value of the LP increased by 50%. In the same context, EV increased by 250569.3 ± 169528.9, 272929.6 ± 167841.6, 277811.5 ± 120917.2, 302335.1 ± 114676.6 and 326690.4 ± 111212.5 dinars at the selec-

Table 2. Percentage of direct genetic yield (numbers in axis) and correlated (values outside axis) at different percentages of election depending on the phenotypic values

Trait	Selection of percentage (%)	TMY	LP	EV
TMY	90	1.97	0.129	1.365
	80	4.04	0.122	2.82
	70	6.29	0.050	3.14
	60	8.83	0.050-	4.74
	50	11.37	0.032-	6.33
LP	90	1.07	0.311	0.783
	80	0.631	0.462	0.568
	70	0.113-	0.612	0.308
	60	0.505-	2.14	0.271-
	50	2.00-	0.965	1.082-
EV	90	1.68	0.145	1.32
	80	3.77	0.124	2.80
	70	5.92	0.046	4.35
	60	8.44	0.038-	6.21
	50	8.12	0.028-	8.12

tion of 90, 80, 70, 60 and 50% of the doe's respectively (Table 1).

We find the low genetic response of LP based on TMY at selection 90, 80, 70 and 60, which amounted to 0.224, 0.212, 0.087 and -0.087 respectively, This decrease is an increase in the negative trend in genetic response percentage due to non-significant correlation between TMY and LP was 0.129, 0.122, 0.050 and -0.050 when the doe's were selected according to the above mentioned percentages depending on TMY (Table 2). The economic response increased at the above mentioned to 3135.3, 6489.36, 7221.64, 10900.1 and 14553.4 dinars, respectively (Table 1). These rates increase the genetic response of economic response for the original flock by 1.365, 2.820, 3.140, 4.740 and 6.33% for the 90, 80, 70, 60 and 50%, respectively (Table 2). We found that there is a positive genetic response between TMY and EV, which came in line with what Al-Anbari (2005) found in the Holstein cows at the percentage of selection 90, 80 and 70%, respectively. While the genetic response is negative between TMY and LP as found out by Luxford and Beilharz (1990) who pointed out that average of genetic response increases with increased selection intensity.

Phenotypic values of Lactation Period (LP) (criterion 2)

The mean of LP was 179.72, 182.99, 186.24, 189.84 and 193.89 days at the above mentioned rates of the original flock (Table 3). We found an increase in LP in linear terms and thus increase the direct genetic response, which represents LP expected during the next season, because the selection will allow the superior Individuals to remain in the flock as will depend on them to be dams of the next generation.

Direct effect of the selection criterion

It is clear from Table 3 that the direct genetic response of LP resulting from the selection of doe's based on the phenotypic values of LP is increased by decreasing the percentage of the selection. The direct genetic response of this trait was 0.538, 0.80, 1.06 and 3.70 days at the selection of 90%, 80%, 70% and 60% of the doe's. These genetic response percentage were the result of the above mentioned percentages, which were 0.311, 0.462, 0.612 and 2.14% respectively, while the genetic response decreased (0.965) at 50% (Table 2) of the average LP in the original flock.

Correlated effect for the criterion of selection

The results showed that the criteria for selecting the PVLP showed a decrease in the selection differen-

Table 3. Least square Mean to PVTMY (kg) , PVLP (day) and EV (dinar) by adopting an selection criterion for LP

S. No	Selected percentage (%)	Trait	No. of animals	Mean ± SD	CV (%)	Genetic response
1		PVTMY		138.06 ± 218.57	63.16	-
	100%	PVLP	318	30.52 ± 172.99	17.64	
		EV		172473.3 ± 229667.2	75.09	
2		PVTMY		137.15 ± 229.23	59.83	2.34
	90%	PVLP	286	21.23 ± 179.72	11.81	0.538
		EV		1174528.8± 241657.1	72.22	1798.4
3		PVTMY		138.61 ± 224.84	61.64	1.38
	80%	PVLP	254	20.41 ± 182.99	11.15	0.80
		EV		1180117.6± 238376.3	75.56	1306.3
4		PVTMY		136.70 ± 217.44	62.86	0.248-
	70%	PVLP	222	19.96 ± 186.24	10.71	1.06
		EV		184490.8± 234385.8	78.71	707.79
5		PVTMY		135.40 ± 213.55	63.40	1.104-
	60%	PVLP	191	19.56 ± 189.84	10.30	3.70
		EV		170546.5± 225506.3	75.62	624.1-
6		PVTMY		120.47 ± 198.65	60.64	4.38-
	50%	PVLP	159	19.13 ± 193.89	9.86	1.67
		EV		167063.7± 213091.7	78.39	2486.3-

tial, which negatively affected the genetic improvement of the TMY and EV. The criterion for selecting 90, 80, 70, 60 and 50% of the doe's was based on the phenotypic values of LP to genetic response decrease for TMY (2.34, 1.38, -0.248, -1.104 and -4.38 kg), respectively, as well as the decreased genetic response of the EV (1798.4, 1306.3, 707.79, 624.1 and -2.486.3 dinars) respectively. These were obtained using 90, 80, 70, 60 and 50% (Table 3). These values represent the low of genetic response (1.07, 0.631, 0.113, 0.505 and 2.00) for TMY and 0.783, 0.568, 0.271 and 1.082 to EV, respectively, at 90, 80, 70, 60 and 50% respectively of the flock average (Table 2). This indicates that there is a negative genetic response between LP and each of the TMY and EV at the above mentioned selection percentages.

Economic values (criterion 3)

The economic values were 249930.6, 272567.9, 296369.4, 324825.5 and 354124.7 dinars at the 90, 80, 70, 60 and 50% respectively of the original community of doe's (Table 4). These values represent the EV expected during the next season, as it is noted that the increase in the intensity of selection and thus increase the genetic response.

Direct effect of the selection criterion

The genetic response of EV was 3039.5, 6435.1, 10005.3, 14273.7 and 18668.8 dinars at the 90, 80, 70, 60 and 50%, respectively (Table 4). The genetic response percentage of EV from the average economic value of the original flock at the above mentioned percentages were 1.32, 2.80, 4.35, 6.21 and 8.12%, respectively (Table 2). This is in line with the findings of Al-Anbari (2005). The percentages of selection 90, 80 and 70%, were amounted to 5.465, 6.966 and 8.644%.

Correlated effect of the criterion of selection

The results confirmed that the criterion of economic value selection resulted in the genetic improvement of TMY. The criterion of selecting 90, 80, 70, 60 and 50% of doe's based on economic values led to genetic improvement of 3.69, 8.25, 12.96, 18.46 and 23.90 kg respectively (Table 4), which represents the genetic response percentage of 1.68, 3.77, 5.92, 8.44 and 8.12% (Table 2) for the average TMY when adopting the economic value of the selection. While this criterion did not

Table 4. Least square Mean to PVTMY (kg), PVLP (day) and EV (dinar) by adopting an selection criterion for EV

S. No	Selected percentage (%)	Trait	No. of animals	Mean ± SD	CV (%)	Genetic response
		PVTMY		138.06 ± 218.57	63.16	
1	100%	PVLP	318	30.52 ± 172.99	17.64	-
		EV		172473.3 ± 229667.2	75.09	
		PVTMY		131.62 ± 235.35	55.92	3.69
2	90%	PVLP	286	27.40 ± 176.14	15.55	0.252
		EV		169573.9± 249930.6	67.85	3039.5
		PVTMY		125.85 ± 256.09	49.14	8.25
3	80%	PVLP	254	26.64 ± 175.70	15.16	0.216
		EV		167475.9± 272567.9	61.44	6435.1
		PVTMY		120.39 ± 277.49	43.38	12.96
4	70%	PVLP	222	25.91 ± 174.00	14.89	0.081
		EV		166193.0± 296369.4	56.07	10005.3
		PVTMY		114.12 ± 302.52	37.72	18.46
5	60%	PVLP	191	24.20 ± 172.15	14.06	0.067-
		EV		165375.7± 324825.5	50.91	14273.7
		PVTMY		111.04 ± 327.22	33.93	23.90
6	50%	PVLP	159	20.66 ± 172.36	11.98	0.050 -
		EV		168326.0± 354124.7	47.53	18668.8

lead to a genetic improvement in LP. The genetic response decreased by 0.252, 0.216, 0.081, and 0.067 days at 90, 80, 70 and 60% respectively (Table 4), which represented 0.145, 0.124, 0.046 and -0.038 % for genetic response percentage of mean LP for the original flock at the time of the EV selection was 90, 80, 70 and 60% respectively (Table 2). Genetic response was increased to 0.050 days at 50%, which represents 0.028% for the genetic response percentage. This indicated that there is a positive genetic improvement between EV and TMY, while there was a genetic deterioration between EV and LP. The genetic response of economic traits increased by increasing the intensity of selection and thus increasing economic response (Luxford and Beilharz, 1990; Fogarty *et al*., 1994, Sakul *et al*., 1994 and Al-Anbari, 2005).

CONCLUSION

A positive genetic improvement between EV and TMY and a genetic deterioration between EV and LP was observed. A positive genetic response dependent on direct selection was found.

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