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# SELCTION INDEX FOR SOME BODY MESUREMENTS TOWARDS IMPROVING MILK PRODUCTION IN DHOFARI GOAT

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## ABSTRACT

The present study investigate the possibilities of improving milk production in Dhofari goat raised at Salalah of Sultanate of Oman through selection index containing body weight and dimensions at birth. Records of 190 Dhofari does, daughters of 35 sires were available for this study. During two successive years, data were collected on the same animal at birth (birth weight, BW; body length, BL; body height at withers, BH; heart girth, HG and rear girth, RG) and after the first lactation season (total milk yield, TMY). The present study estimated genetic and phenotypic parameters for the studied traits and constructed 19 selection indices to predict TMY in Dhofari goat.

The present study estimated averages of BW, BL, BH, HG, RG and TMY as 2.9 kg, 31.4 cm, 34.7 cm, 33.6 cm, 37.0 cm and 50.0 kg, respectively. Among body dimensions, HG and RG were more variable than BL and BH. Heritability estimates for all studied traits were little and ranged from 0.002 to 0.1. The correlation coefficients among all studied traits were genetically high and phenotypically low. Genetic correlations between TMY and all live body measurements were close to one and much higher than the corresponding phenotypic ones. Genetically and phenotypically, TMY had positive correlations with BW, BL and BH and negative ones with HG and RG. The maximum accuracy of the full index was 0.45. The greatest improvement in TMY was +0.25 kg. Selection on all indices reduced HG and RG. Selection on $I_{13}$ while reducing HG (-0.31 cm) and RG (-0.42 cm), it increases the size of animal probably through BL (+0.11cm) and BH (+0.18 cm). The present study concluded that the simplified selection index ($I_{13}$) utilizing individual kid performance (HG and RG at birth) is the most efficient ($r_{TI}$ =0.38), attain adequate improvement in TMY (+0.21 kg), less expensive and being about 13% more efficient in the improvement than direct selection for milk yield alone compared with the other studied indices. Thus, $I_{13}$ can be used as a selection criterion for the simultaneous improvement of milk and meat production in Dhofari goat.

## INTRODUCTION

There is a common belief among goat breeders in Sultanate of Oman that Dhofari goat is promising milk producer compared with other local breeds. The breed is native and mostly raised in the Southern part of the country, Dhofar Governorate. However, scanty literatures are available on the characterization and production performance of that breed. Earlier, two studies had been conducted regarding the potentiality of Dhofari goat towards meat (ElGabbas and Anous, 2001) and milk production (El-Wakil and Fooda, 2013). The present study aimed to analyze preliminary data obtained through the inception phase of establishing Dhofari goat flock to help in planning for genetic improvement schemes for such promising breed of goat.

Milk production is an important trait for rearing kids and sometimes for human consumption, it is vital for producers and as an economic trait has been the primary selection emphasis in dairy breeding. On the other hand, body dimensions are important tools for phenotypic description and may be viewed as a rapid, cheap and simple form to predict milk production by animal breeders under field conditions. The accuracy of functions used to predict milk production from live animal measurements is requisite for optimum production as an early selection tool to enhance genetic gain and in some practical management situations where the scale could not be accessed. Since the feasibility of goat production system often relies on the improvement of meat and milk production, that could be achieved through breeding program based on selection index aiming to improve meat (body weight and dimensions) and milk production simultaneously. Thus, the core of the present study is to investigate the possibilities of improving milk production in Dhofari goat through selection index containing body weight and dimensions at an early stage, at birth.

## MATERIALS AND METHODS

The present study was carried out on Dhofari goat flock kept in the Livestock Research Station (LRS) at Salalah, belonging to the Ministry of Agriculture and Fisheries, Sultanate of Oman. During the inception phase of establishing this flock, the four ecotypes of Dhofari goat (Elwasat, Elsharkiya, Elgharbiya and Najd) were collected from various regions throughout the Dhofar Governorate and brought together to evaluate their performance at LRS under the same management system. Description of these ecotypes were reported by El-Wakil and Fooda (2013) who also recommended pooling these ecotypes together as one breed called Dhofari since slight differences in milk production traits were existed among them. Furthermore, a preliminary analysis was conducted to the present data using SAS (2002) and showed that ecotypes had no significant effects on the studied traits.

### *Flock management*

Animals were housed in semi open pens. They were fed mainly with concentrate ruminant mixture together with hay at adlib bases. Feed, management and breeding practices were described elsewhere (El-Wakil and Fooda, 2013).

### *DATA*

Records of 190 Dhofari does, daughters of 35 sires with their corresponding pedigree information were available for this study. During two successive years, data were collected on the same animal at birth (body weight, BW, and some body dimensions) and after the first lactation season (total milk yield, TMY). Within 24 hours after kidding, kids were weighed to the nearest 100 g and their body dimensions were taken using a measuring tape to the nearest 0.5 cm while animals were in standing normal position. Body dimensions recorded were: body length (BL): the distance between the point of shoulder and the pin bone; body height at withers (BH): vertical distance from the withers to the floor; heart girth (HG): circumference of the body just behind the fore-legs; and rear girth (RG): circumference of the body just anterior to the rear leg.

Kids were kept with their dams during the first week after parturition to freely suckle the colostrum. Milk yield was recorded from the second week after parturition up to the end of lactation period when their milk yield fell to about 0.25 kg/day. Kids were kept with their dams till weaning at an age averaging about 120 days. However, they were separated from their dams 12 hours prior to measuring the milk yield. All does were hand-milked once a day in the morning during their first lactation season for two successive years. Milk yield was recorded twice a week at a regular basis throughout the lactation period during the first (41 does) and second lactation year (149 does). The average quantity of the two milkings recorded each week was calculated and regarded as a representative of daily milk yield per week. The resultant yield was multiplied by seven to give the weekly milk yield for that animal. Total milk yield (TMY) was the sum of all individual weekly milk yield throughout the lactation period.

### *Statistical analysis*

The Animal model (derivative-free restricted maximum likelihood: DFREML, **Meyer, 1997)** was used to analyze data for milk yield according to the following model:

$$\mathbf{y = Xb + Z_a\, a + Z_c\, c + e}$$

where: y = Vector of observations, X = Incidence matrix relating fixed effects to y, b =

Vector of an overall mean and fixed effects (lactation year, ecotype and season of birth), $Z_a$ = Incidence matrix relating direct additive genetic effects to y, a = Vector of random effect (direct additive genetic associated with the incidence matrix Za, $Z_c$ = Incidence matrix for permanent environmental effect, c = Vector of permanent environmental effect associated with the incidence matrix Zc and e = Vector of random residual effects N (0, $I\sigma^2e$); I is an identity matrix. The variance-covariance of the random effects was as follows:

$$Var\begin{bmatrix}a\\c\\e\end{bmatrix}=\begin{bmatrix}A\sigma^2a & 0 & 0\\ 0 & I_e\sigma^2c & 0\\ 0 & 0 & I_n\sigma^2e\end{bmatrix}$$

Where: A = Numerator relationship matrix, $I_c$, $I_n$ = Identity matrix with order equal to number of animals and number of records, respectively. The selection index equation (I) was defined by Cunningham and Mahou (1977) as:

$$\sum_{i=1}^{m} b_i P_i$$

In matrix notation, the index can be expressed as: I = b`p Where:

b: is a (n*1) vector of weighing factors for the n traits included in I and

p: is a (n*1) vector of phenotypic observations for the n traits included in I.

The relative economic values were 1 for total milk yield (TMY) and 0 for BW, BL, BH, HG and RG.

## RESULTS AND DISCUSSION

Table (1) presented the overall means, phenotypic standard deviations, coefficient of variability and range for the studied live body measurements at birth and milk yield. Average estimates for birth weight, *BW*, body length, *BL*, body height, *BH*, heart girth, *HG*, rear girth, *RG* and total milk yield, *TMY* were found to be 2.9 kg, 31.4 cm, 34.7 cm, 33.6 cm, 37.0 cm and 50.0 kg, respectively. Among body dimensions, it appeared that *HG* and *RG* are more variable than *BL* and *BH*. The present estimates were quite close to that reported for *BW* (3.01 kg), *BL* (30.86 cm), *BH* (33.98 cm), *HG* (37.5 cm) and *RG* (36.33 cm) in the same flock (ElGabbas and Anous, 2001). Birth weight for Dhofari goat in Salalah was stated to be 3.0 kg (MoA, 2008). On the other hand, El-Wakil and Fooda (2013) found that *TMY* was 51.08 kg in Dhofari goat of the same flock.

**Table (1).** Overall means, phenotypic standard deviations ($\sigma_P$), coefficients of variation (CV %) and range for birth weight, *BW*; body length, *BL*; body height, *BH*; heart girth, *HG*; rear girth, *RG* and total milk yield, *TMY* in Dhofari goat.

| Trait | Mean | Phenotypic | | Range |
|---|---|---|---|---|
| | | $\sigma_P$ | CV % | |
| **BW, kg** | 2.9 | 0.53 | 18 | 1.5 – 4.0 |
| **BL, cm** | 31.4 | 2.10 | 7 | 27.0 – 37.0 |
| **BH, cm** | 34.7 | 2.40 | 7 | 30.0 – 41.0 |
| **HG, cm** | 33.6 | 3.30 | 10 | 25.0 – 42.0 |
| **RG, cm** | 37.0 | 4.10 | 11 | 27.0 – 47.0 |
| **TMY, kg** | 50.0 | 13.00 | 26 | 20.0 – 87.0 |

**Table (2).** Heritability estimates (on diagonal), genetic (below diagonal) and phenotypic (above diagonal) correlations among studied traits in Dhofari goat.

| | BW | BL | BH | HG | RG | TMY |
|---|---|---|---|---|---|---|
| **BW** | 0.02 | 0.02 | 0.03 | -0.03 | -0.04 | 0.010 |
| **BL** | 0.99 | 0.02 | 0.03 | -0.04 | -0.04 | 0.010 |
| **BH** | 0.98 | 0.98 | 0.04 | -0.05 | -0.06 | 0.010 |
| **HG** | -0.99 | -1.00 | -0.98 | 0.10 | 0.08 | -0.010 |
| **RG** | -0.99 | -1.00 | -0.98 | 1.00 | 0.10 | -0.010 |
| **TMY** | 0.99 | 0.99 | 0.98 | -0.99 | -0.99 | 0.002 |

BW= birth weight; BL=body length, BH= body height, HG= heart girth, RG= rear girth and TMY= total milk yield.

Estimates of heritability, genetic and phenotypic correlations for the studied body measurements and milk yield are given in table (2). Heritability estimates for all studied traits appeared to be little ranged from 0.002 to 0.1. Such low heritabilities might indicate the importance of environmental factors to improve these traits. It is worthwhile mentioned that the present study was conducted during the inception phase of establishing this flock, consequently many of these animals are genetically unrelated. On the other hand, ElGabbas and Anous (2001) estimated much higher heritabilities than that obtained in the present study for *BW* (0.91), *BL* (0.46), *BH* (0.72), *HG* (0.81) and *RG* (0.35) in Dhofari goat using Harvey (1990) instead of animal model (Meyer, 1997). The present data contained only females while ElGabbas and Anous' data comprised of males and females. In Beetal goat, heritability estimates for *BW, BL, BH, HG* and *RG* were found to be 0.41, 0.33, 0.82, 0.90 and 0.89, repectively (Waheed and Khan, 2011). In Indian Osmanabadi goats, heritability estimates for *BH* and *HG* at 12 month of age were reported to be 0.98 and 0.91, respectively (Patil *et al.,* 2009).

Heritability estimates for *TMY* were found to be 0.08 in Dhofari goat (El-Wakil and Fooda, 2013), ranged from 0.11 to 0.14 in Egyptian Zaraibi goats (Osman *et al.,* 2010) and 0.17 in Saanen goats of Mexico (Torres-Vazquez *et al.,* 2009),

The correlation coefficients among all studied traits were genetically high and phenotypically low, whether positive or negative (Table 2). Genetic correlations of *TMY* with all live body dimensions were close to one and much higher than the corresponding phenotypic ones. Genetically and phenotypically, *TMY* had positive correlations with *BW, BL* and *BH* and negative ones with *HG* and *RG*. *TMY* appeared to be genetically related with body dimensions at birth which could be a useful tool for early prediction of milk production. In Shami goats in Egypt, daily milk yield was found to be negatively correlated with *BL, BH, HG* and hip height as -0.36, -0.33, -0.30 and -0.35, respectively (Alsheikh, 2013). In Beetal goat, correlation coefficients of *TMY* with *BW, BL, BH, HG* and *RG* were reported to be higher genetically (0.59, 0.37, 0.49, 0.43 and 0.41, respectively) than phenotypically (0.34, 0.17, 0.41, 0.34 and 0.32, respectively) according to Waheed and Khan (2011).

Estimates of genetic and phenotypic parameters calculated in the present study were used to construct 19 selection indices to predict *TMY* in Dhofari goat. Table (3) gives the weighing factors (b-values) representing the partial or simple regressions of genetic value for net merit on phenotype for each trait, standard deviation, accuracy of selection ($r_{TI}$) representing the multiple or simple correlation of selection index with genetic value for net merit and relative efficiency (RE).

**Table (3).** Weighing factors (b-values), standard deviation ($\sigma_I$), efficiencies of selection in absolute ($r_{TI}$) and relative efficiency (RE) values in index alternatives used to improve milk yield.

| Index No. | Source of Information | B-values | | | | | | $\sigma_I$ | $r_{TI}$ | RE |
|---|---|---|---|---|---|---|---|---|---|---|
| | | BW | BL | BH | HG | RG | MY | | | |
| 1 | BW,BL,BH,HG,RG,TMY | 0.12 | 0.03 | 0.04 | -0.04 | -0.04 | 0.001 | 0.06 | 0.45 | 100 |
| 2 | BL,BH,HG,RG,TMY | - | 0.03 | 0.04 | -0.04 | -0.04 | 0.001 | 0.06 | 0.44 | 98 |
| 3 | BW,BH,HG,RG,TMY | 0.12 | - | 0.04 | -0.04 | -0.04 | 0.002 | 0.06 | 0.43 | 96 |
| 4 | BW,BL,BH,HG,RG | 0.12 | 0.03 | 0.04 | -0.04 | -0.04 | - | 0.06 | 0.45 | 100 |
| 5 | BH,HG,RG,TMY | - | - | 0.04 | -0.04 | -0.04 | 0.002 | 0.05 | 0.42 | 93 |
| 6 | BL,BH,HG,RG | - | 0.03 | 0.04 | -0.04 | -0.04 | - | 0.06 | 0.44 | 98 |
| 7 | BW,BH,HG,RG | 0.12 | - | 0.04 | -0.04 | -0.04 | - | 0.06 | 0.43 | 96 |
| 8 | HG,RG,TMY | - | - | - | -0.04 | -0.04 | 0.001 | 0.04 | 0.38 | 84 |
| 9 | BH,HG,RG | - | - | 0.04 | -0.04 | -0.04 | - | 0.05 | 0.42 | 93 |
| 10 | BW,HG,RG | 0.12 | - | - | -0.04 | -0.04 | - | 0.05 | 0.40 | 89 |
| 11 | BL,RG | - | 0.03 | - | - | -0.04 | - | 0.03 | 0.32 | 71 |
| 12 | BH,RG | - | - | 0.04 | - | -0.04 | - | 0.04 | 0.35 | 78 |
| 13 | HG,RG | - | - | - | -0.04 | -0.04 | - | 0.04 | 0.38 | 84 |
| 14 | BW | 0.15 | - | - | - | - | - | 0.01 | 0.12 | 27 |
| 15 | BL | - | 0.04 | - | - | - | - | 0.01 | 0.14 | 31 |
| 16 | BH | - | - | 0.05 | - | - | - | 0.01 | 0.21 | 47 |
| 17 | HG | - | - | - | -0.05 | - | - | 0.02 | 0.26 | 58 |
| 18 | RG | - | - | - | - | -0.04 | - | 0.03 | 0.30 | 67 |
| 19 | TMY | - | - | - | - | - | 0.002 | 0.001 | 0.05 | 11 |

BW= birth weight; BL=body length, BH= body height, HG= heart girth,
RG= rear girth, TMY= total milk yield and RE= relative efficiency = ($I_x$ / $I_1$) X 100

It appears that the maximum accuracy of selection ($r_{TI}$ =0.45) was obtained using the full index

$$I_1 = 0.12 \text{ BW} + 0.03 \text{ BL} + 0.04 \text{ BH} + (-0.04) \text{ HG} + (-0.04) \text{ RG} + 0.001 \text{ TMY}$$

This magnitude of accuracy ($r_{TI}$ =0.45) did not change when *TMY* ($I_4$) was ignored from the full index. Slight less accuracy ($r_{TI}$ =0.44) was attained when *BW* was ignored from the full index ($I_2$) and also in ($I_6$) when *BW* and *TMY* were ignored from the full index. However, the accuracy was decreased ($r_{TI}$=0.38) when *BW, BL, BH* and *TMY* ($I_{13}$) were ignored from the full index and ($I_8$) when *BW, BL* and *BH* were ignored from the full index. On the other hand, selection for *TMY* alone ($I_{19}$) would be the least efficient ($r_{TI}$ =0.05) than selection for *RG* alone ($I_{18}$ , $r_{TI}$ =0.30) or *HG* alone ($I_{17}$ , $r_{TI}$=0.26).

Table (4) shows the expected genetic changes in body measurements and milk yield for each round of selection. The improvement in *TMY* ranged from $I_{19}$ (+0.03 kg) to $I_1$ (+0.25 kg). Selection on $I_1$ and $I_4$ gave the greatest improvement in *TMY* (+0.25 kg). Selection on all indices reduced *HG* and *RG*. Selection on $I_{13}$ while reducing *HG* (-0.31 cm) and *RG* (-0.42 cm), it increases the size of animal probably through *BL* (+0.11cm) and *BH* (+0.18 cm).

The association between milk production and growth in terms of body weight and size (body dimensions) seemed to be inconsistent in the literatures. Sejrsen (1978) indicated that animals with high growth capacity would have higher growth hormone concentration in the blood and consequently better mammary development, resulting in higher milk production.

**Table (4).** Expected genetic changes (per generation) in birth weight, BW; body length, BL; body height, BH; heart girth, HG; rear girth, RG and total milk yield, TMY when using selection indexes to improve TMY (intensity of selection =1.0).

| Index No. | Source of Information | Expected genetic gain | | | | | |
|---|---|---|---|---|---|---|---|
| | | In the trait of aggregate genotype | In related traits | | | | |
| | | TMY | BW | BL | BH | HG | RG |
| **1** | BW,BL,BH,HG,RG,TMY | 0.25 | 0.02 | 0.13 | 0.22 | -0.36 | -0.50 |
| **2** | BL,BH,HG,RG,TMY | 0.24 | 0.02 | 0.12 | 0.21 | -0.35 | -0.49 |
| **3** | BW,BH,HG,RG,TMY | 0.24 | 0.02 | 0.12 | 0.21 | -0.35 | -0.48 |
| **4** | BW,BL,BH,HG,RG | 0.25 | 0.02 | 0.12 | 0.22 | -0.36 | -0.50 |
| **5** | BH,HG,RG,TMY | 0.23 | 0.02 | 0.12 | 0.20 | -0.34 | -0.47 |
| **6** | BL,BH,HG,RG | 0.24 | 0.02 | 0.12 | 0.21 | -0.35 | -0.49 |
| **7** | BW,BH,HG,RG | 0.24 | 0.02 | 0.12 | 0.21 | -0.35 | -0.48 |
| **8** | HG,RG,TMY | 0.21 | 0.02 | 0.11 | 0.18 | -0.31 | -0.43 |
| **9** | BH,HG,RG | 0.23 | 0.02 | 0.12 | 0.20 | -0.34 | -0.47 |
| **10** | BW,HG,RG | 0.22 | 0.02 | 0.11 | 0.19 | -0.32 | -0.44 |
| **11** | BL,RG | 0.18 | 0.02 | 0.09 | 0.15 | -0.26 | -0.36 |
| **12** | BH,RG | 0.19 | 0.02 | 0.10 | 0.17 | -0.28 | -0.39 |
| **13** | HG,RG | 0.21 | 0.02 | 0.11 | 0.18 | -0.31 | -0.42 |
| **14** | BW | 0.07 | 0.01 | 0.03 | 0.06 | -0.10 | -0.14 |
| **15** | BL | 0.08 | 0.01 | 0.04 | 0.07 | -0.11 | -0.15 |
| **16** | BH | 0.11 | 0.01 | 0.06 | 0.10 | -0.17 | -0.23 |
| **17** | HG | 0.14 | 0.01 | 0.07 | 0.13 | -0.21 | -0.29 |
| **18** | RG | 0.16 | 0.02 | 0.08 | 0.14 | -0.24 | -0.33 |
| **19** | TMY | 0.03 | 0.003 | 0.01 | 0.02 | -0.04 | -0.05 |

The increased milk production serves also to accelerate early growth in kids. Similarly, Irgang *et al.* (1985) suggested that selection for weaning weight and/or postweaning growth rate should be effective in increasing preweaning milk yield and preweaning growth. However, some investigations have showed that genetic associations among measures of growth and milk production in sheep are mostly positive, but very low (Turner, 1972; Mavrogenis, 1988) indicating independence of genes affecting these traits. Moreover, Adewumi and Olorunnisomo, 2009) suggested that milk yield is independent of body size. The increase in the latter, when occurred, is probably the consequence of better feeding, improved management and environmental conditions. Even in dairy cattle, while some suggesting that larger cows produce more milk (Ahlborn and Dempfle, 1992), other studies (Persaud *et al.,* 1991) stated that smaller dairy cows produced more milk or were more efficient than larger cows.

It could be concluded that the simplified selection index ($I_{13}$) utilizing individual kid performance (*HG* and *RG* at birth) is the most efficient ($r_{TI}$ =0.38), attain adequate improvement in *TMY* (+0.21 kg), less expensive and being about 13% more efficient in the improvement than direct selection for milk yield alone compared with the other studied indices. The index $I_{13}$ probably describes the shape of higher milk producing Dhofari does to be taller, longer and narrower in chest and girth. Thus, $I_{13}$ can be used as a selection criterion for the simultaneous improvement of milk and meat production. Since the results obtained from the present study is probably the first to be done for Dhofari goat, further investigation is required to verify such recommendation.


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## الملخص العربى

## دليل إنتخابى لبعض مقاييس الجسم لتحسين إنتاج اللبن فى الماعز الظفارى

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(1). قسم بحوث تربية الجاموس ، معهد بحوث الإنتاج الحيواني، الدقي، جيزة، مصر.

استهدفت الدراسة التعرف على إمكانية تحسين إنتاج اللبن فى الماعز الظفارى المربى فى صلالة بسلطنة عمان من خلال دليل انتخاب يتضمن وزن الجسم وبعض مقاييس الجسم عند الميلاد. استخدمت فى هذه الدراسة سجلات لعدد 190 عنزة ظفارى بنات لعدد 35 تيس. تم جمع بيانات على نفس الحيوان خلال عامين متتاليتين عند الميلاد (وزن الميلاد، طول الجسم، ارتفاع الجسم، محيط الصدر ومحيط البطن) وكذلك بعد نهاية موسم الحليب (إنتاج اللبن الكلى). تم تقدير المعالم الوراثية والمظهرية للصفات المدروسة وكذلك حساب عدد 19 دليل انتخابى للتنبؤ بإنتاج اللبن الكلى فى للتنبؤ بإنتاج اللبن الكلى فى الماعز الظفارى.

تم تقدير متوسطات وزن الميلاد، طول الجسم، إرتفاع الجسم، محيط الصدر، محيط البطن، إنتاج اللبن الكلى بمقدار 2.9 كجم، 31.4 سم، 34.7 سم، 33.6 سم، 37.0 سم، 50.0 كجم على التوالى. كان محيط الصدر ومحيط البطن الأكثر تباينا مقارنة بطول الجسم وإرتفاعة. تراوحت المكافئات الوراثية للصفات المدروسة ما بين 0.002 و 0.1. كانت معاملات الإرتباط بين الصفات المدروسة أعلى وراثيا وأقل مظهريا. كانت الإرتباطات الوراثية بين إنتاج اللبن الكلى وجميع مقاييس الجسم قريبة من الواحد الصحيح وعالية جدا مقارنة بمثيلاتها المظهرية. كانت الإرتباطات الوراثية والمظهرية لإنتاج اللبن الكلى موجبة مع كل من طول الجسم وإرتفاعة بينما كانت سالبة مع كل من محيط الصدر ومحيط البطن. كانت أقصى كفاءة للدليل الانتخابى الكامل هى 0.45 وكان أقصى تحسين ممكن لإنتاج اللبن الكلى هو (0.25+ كجم). أدى الإنتخاب لكل الدلائل الإنتخابية المدروسة إلى نقص محيط الصدر ومحيط البطن. بينما أدى الإنتخاب بالدليل رقم 13 إلى نقص محيط الصدر (0.13- سم) ومحيط البطن 0.42- سم)، فقد أدى إلى زيادة حجم الحيوان من خلال طول الجسم (0.11+ سم) وإرتفاعة (0.18+ سم). أوصت الدراسة باستخدام الدليل الإنتخابى رقم 13 الذى يشتمل على محيط الصدر ومحيط البطن عند الميلاد وهو الأعلى كفاءة (0.38)، حيث حقق أفضل تحسين لإنتاج اللبن الكلى (0.21+ كجم)، الأقل تكلفة، كما حقق كفاءة تحسين أعلى بمقدار 13% مقارنة بالانتخاب المباشر لإنتاج اللبن الكلى مقارنة بباقى الأدلة الانتخابية. لذلك فإنه يمكن استخدام الدليل الانتخابى رقم 13 كوسيلة للإنتخاب لزيادة إنتاج اللحوم والألبان فى نفس الوقت فى الماعز الظفارى.