GENETIC EVALUATION OF MILK PRODUCTION TRAITS IN LOCAL GOAT

Yousif M. S. Al-Barzinji[1] **Fahad K. Zainal[2]**
Assist. Prof. **Researcher**
[1,2] College of Agriculture Engineering Science, Salahaddin University-Erbil
yousif.noori@su.edu.krd **fahid.zainal@su.edu.krd**

ABSTRACT

This study was conducted on 67 local doe goat, aged from 2-5 years old. The overall mean of TMY, DMY and lactation length of 1st and 2nd flocks were (130.541 ± 7.403 kg, 0.716 ± 0.033kg, and 182.432 ± 4.112 day) and (164.043 ± 8.788 kg, 0.832 ± 0.043 kg, 197.027 ± 2.650 day), respectively. The flock, age of doe, doe coat color, month of kidding and type of birth have significant effect on TMY and DMY, doe in 2nd flock production 33.502 and 0.116 kg milk/doe, respectively more than doe in 1st flock. Doe of five years old yielded (181.878 ± 10.171 kg /doe) and (0.892 ± 0.044 kg /doe/day) more milk than young doe. Doe kidding in Januarys were consistently produced high significantly (p≤0.001) more TMY (158.354 ± 7.076 kg /doe) and DMY (0.828 ± 0.033 kg /doe/day) in comparison with other groups. Doe with brown coat color produced significantly (p≤0.05) more TMY (165.205 ± 20.558 kg /doe) and DMY (0.835 ± 0.095 kg /doe/day) in comparison with other coat colors. Doe kidding twin's kids were significantly (p≤0.05) yielded more TMY and DMY than single kids. The flock and age of doe significantly affected the lactation length, 2nd flock have higher length with 197.027 ± 2.650 day and higher lactation length recorded of doe with 5 years old with 200 ± 3.779 day. BLUP values for TMY of doe ranged from -130.65 to 224.77 kg/doe. The repeatability of DMY, fat%, protein% and lactose% in present study arrived 0.286, 0.319, 0.067 and 0.015 respectively. The MPPA value of TMY in this study ranged from 80.988 to 329.749. These results indicated the good genetic make-up of local goat for milk traits and the selection programs can play major role to increase production ability of local goat.

KEYWORD: repeatability, MPPA, BLUP, milk composition, Lactation length.

التقييم الوراثي لأنتاج الحليب في الماعز المحلي

يوسف محمد صالح البرزنجي **فهد كوره زينل**
أستاذ مساعد **باحث**
قسم الثروة الحيوانية ، كلية علوم الهندسة الزراعية، جامعة صلاح الدين – أربيل

المستخلص

أجريت هذه الدراسة على 67 ماعز محلي بأعمار تتراوح مابين 2–5 سنوات. بلغ المتوسط العام لأنتاج الحليب الكلي و اليومي و طول موسم أدرار الحليب في القطيع الأول والثاني (130.541 ± 7.403 كغم و 0.716 ± 0.033 كغم و 182.432 ± 4.112 يوم) و (164.043± 8.788 كغم و 0.832 ± 0.043 كغم و 197.027 ± 2.650 يوم) على التوالي. كانت للقطيع و عمر المعزان و لون الفرو و شهر الولادة و نوع الولادة تأثير معنوي في كل من أنتاج الحليب الكلي واليومي، حيث اعطت معزان القطيع الثاني 33.502 و 0.116 كغم من الحليب اليكلي واليومي أكثر من معزان القطيع الأول. المعزان بعمر 5 سنوات أعطت حليب كلي (181.878 ± 10.171 كغم/ معزة) أكثر مقارنة بالأعمار الأقل.المعزان الوالدة في شهر الكانون الثاني أعطت أنتاج الحليب الكلي (158.354 ± 7.076 كغم / معزة) واليومي (0.828 ± 0.033 كغم / معزة / يوم) أكثر من المعزان الوالدة في الأشهر الأخرى. تفوقت المعزان القهوائية اللون في معدل أنتاج الحليب الكلي (165.205 ± 20.558 كغم/معزة) واليومي (0.835 ± 0.095 كغم /معزة/يوم) على نضيراتها من الألوان الأخرى. كذلك تفوقت المعزان الوالدة للتوائم على الوالدة للفردية في معدل أنتاج الحليب الكلي واليومي. كانت أعلى طول موسم أنتاج الحليب في القطيع الثاني والبالغ (197.27± 2.65 يوم) وأعلى طول موسم للمعزان بأعمار 5 سنوات والبالغ (200 ± 3.779 يوم). تراوحت قيم BLUP لأنتاج الحليب الكلي من −130.65 الى 224.77 كغم وكانت قيم المعامل التكراري لأنتاج الحليب اليوميو % للدهن و% للبروتين و % للآكتوز 0.286 و 0.319 و 0.067 و 0.015 على التوالي. كما تراوحت قيم MPPA لأنتاج الحليب الكلي من 80.988 الى 329.749. تشير النتائج الى وجود تراكيب وراثية جيدة للماعز المحلي لصفة أنتاج الحليب وأن عمليات الأنتخاب على ضوء المعالم المقدرة يلعب دورا كبيرا في زيادة وتحسين القدرة الأنتاجية للماعز المحلي.

الكلمات مفتاحية: المعامل التكراري، BLUP , MPPA ،تركيب الحليب، طول موسم.

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INTRODUCTION

Goat is one of the most ruminant domesticate animals that people brought up from the beginning of discovery (15, 45) ten thousand years ago farmers adapted goats at Zagrose Mountains. The biological name of goat is *Capra hircus*, more than 1153 goat breeds are listed in the Food and Agriculture Organization (FAO) of the United Nations (28). A goat population in Iraq estimated to be approximately 1.5 million heads, which again depends on cereal by-products and extensive pastures for feeding which is linked closely to the grazing patterns of other ruminants (27, 32, 38), as well the goat considered an important livestock in Iraq and has a significant function for the meat and milk products, especially under the systems of agriculture surviving in the country (8). Reproductive efficiency is always considered to be the most important factor ensuring increase in productivity for certain environmental conditions (36). Increased production efficiency can be obtained from goats since they have a high reproductive efficiency with the potential for increased litter size and shorter generation interval in comparison to other farm animals (13, 50). The information on factors affecting goat milk yield and composition such as breed (54), stage of lactation (22), parity (12), sex and type of birth and season of kidding (24) are very important since they consequently influence the yield and quality of the final product (29) and its necessary to calculated the genetic parameters and evaluation of economical traits in farm animals. The main goal of dairy goat production is to improve traits related with milk performance. It is possible to apply stronger selection in goats than in dairy cows due to higher fertility and shorter generation interval. Nevertheless, the lack of suitable Genetic Evaluation System (GES) is a serious obstacle for more intensive genetic progress in dairy goats (23). Milk yield trait is a quantitative trait controlled by numerous genes and environmental factors. Estimates of breeding value of animals are the key of any genetic improvement program. Best Linear Unbiased Prediction (BLUP) can be used with different models to predict breeding values and estimate environmental effects. BLUP is generally used to predict sire breeding values, given measurements on progeny, or to predict breeding values of animals with repeated records, or to predict breeding values of all animals in the pedigree (21). BLUP is the procedures for genetic evaluation of livestock require accurate estimates of genetic and environmental parameters. Best linear unbiased prediction is one of the current methods of choice for genetic evaluation of quantitative traits. Repeatability and The most probable producing ability (MPPA) is also known as expected producing ability. (EPA) or Breeding Value of dairy animal, used to predict future performance from past records. When the repeatability for a trait is high, selection for the trait on the basis of the first record itself would be effective in improving the over-all performance of the herd in the next year. Therefore, the aim of this study was to determine the effect of fixed factors on milk yield and milk composition and determine the reputability, BLUP and MPPA of milk yield traits in local goats.

MATERIALS AND METHODS

This study was carried out in Khalana, Village/ Akre district/ Duhok governorate located (20 km south of Akre), during August, 2020 to September, 2021 on two private flocks (67 doe) of local goat with different coat colors (black, gray and dark brown), 2-5 years old. During middle of August, 2020 to the middle of September, 2021 Goats were exposed to bucks for mating so the goats start kidded at middle of January. Age and doe coat color, sex and type of birth and date of birth were recorded at kidding. From 8 am to 4 pm in the autumn and winter Goats were allowed to graze natural pasture. Whereas, the animals were grazed from 8 am to 12 middays and return again to pasture from 4 pm to 7 pm in spring and summer. Straw, barley and wheat were provided in winter whenever required. Hand milking method used to measure the daily milk yield. All kids were separated for doe the day before milking, at 8 pm till milking in the next day at 8 am (12 hours). Test day milk production of individual goat was multiplied by 2 to get the daily milk production (kg /doe/day) and multiplied by 30 to get the monthly milk production (kg /month/doe). Milking was started after 2 and 4

weeks of kidding, after that till the end of lactation (when milk production was less than 50 gm/day/doe) goats were milked monthly. The milk composition (fat%, protein%, lactose%, and SNF%) also were measured by (FUNKE GERBER Lacto Star) at three times through experiment (beginning of milk production, at the top of production and at the end of production) in the laboratory of food technology, College of Agricultural Engineering Science, Salahaddin University-Erbil. Goats were treated against common diseases, parasite, viral and bacterial diseases such as Toxoplasmosis, Brucellosis, Pest Des Petites Ruminants (P.P.R), Foot and Mouth Disease (FMD), and enterotoxaemia, and were drenched against endo-parasites by anthelminthic. Dipping all animals by insecticide used twice a year to control the external parasites.

Statistical analysis

The PROC GLM (General Linear Model) procedure (52) was used to analyze the data. Fixed effects: flock, age of doe, doe coat color, sex of lambing, type of birth and month of lambing, were fitted in the following model:

$$Y_{ijkluem} = \mu + F_i + A_j + S_k + T_l + M_u + C_e + \varepsilon_{ijkluem}$$

Where: *Y ijkluem* = TMY, DMY, Lactation period, Fat, Protein, lactose and SNF% of m th doe, of i th flock (Fi, i=1and 2); of j th age of doe (Aj, j= 2, 3, 4 and ≥5 years); of k th sex of lambing (STk, k=1, male; k=2, female) of l th type of lambing (Tl, l= 1, single and l=2, twins) of Uth month of lambing (Mu, u=1, Janewary; u=2, February; u=3, March) and of Eth doe coat color (Ce, e=1, black, e=2, brown and e=3, gray). μ = Population mean; $\varepsilon_{ijkluem}$ = random error. It was assumed that ε_{ijklm} was normally and independently distributed with mean zero and variance $\delta^2 e$.

For genetics evaluation of doe for various performance traits, Best Linear Unbiased Prediction (BLUP) procedure described by (34) was applied. The model used for this purpose was the Mixed Model (fixed + random effects) of SAS (52) software. The MPPA was calculated by used the following equation (50):

$$MPPA = [\bar{X} - (nr/(1+(n-1)r)(x - \bar{X})]$$

Where: X population mean, x individual mean, n number of records, and r is repeatability. The repeatability of DMY was estimated by used REML methods using SAS (52) software.

RESULTS AND DISCUSSION

TMY, DMY and Lactation length: The overall mean of total milk yield (TMY) and daily milk yield (DMY) averaged 147.292 ± 8.096 and 0.774 ± 0.038 kg/doe, respectively. The flock, age of doe, doe coat color, month of kidding and type of birth have significant effect on TMY and DMY, doe in 2nd flock production 33.502 and 0.116 kg milk/doe, respectively more than doe in 1st flock, this result may due to differences in genetic make-up of the doe, management and feeding system of the two flocks. These results were agreements with (6,33, 47).The age of doe had a high significant (p≤0.001) effect on TMY and DMY. Doe of five years old yielded (181.878 ± 10.171 kg /doe) and (0.892 ± 0.044 kg /doe/day) more milk than young doe. This may have attributed to the biological condition and physiological maturity of five years old doe. This finding is in agreement with many research works (1, 4, 5, 7, 17, 31, 51, 40, 41).On the other hands non-significant effect was reported by (51). Doe kidding in Januarys were consistently produced high significantly (p≤0.001) more TMY (158.354 ± 7.076 kg /doe) and DMY (0.828 ± 0.033 kg /doe/day) in comparison with other groups. This may due to availability of natural pasture in spring (March – May), which coincided the peak of milk production. Significant effect of month of kidding on TMY and DMY was reported by (17, 44). Doe with brown coat color produced significantly (p≤0.05) more TMY (165.205 ± 20.558 kg /doe) and DMY (0.835 ± 0.095 kg /doe/day) in comparison with other coat colors, this result may due to differences in genetic make-up of the doe with different coat colors (3). This results were agreement with (7). Doe kidding twin's kids were significantly (p≤0.05) yielded more TMY and DMY than single kids. This may be due to mechanical stimulation of the twins by emptying the udder faster than single births. Similar results were reported by (15, 25, 39, 40, 41, 44). However, the non-significant effect of type of birth on

milk is in contradiction with other findings by (35). Doe kidding male kids non-significantly produced more TMY and DMY than doe kidding females (Table, 1), these founding agreements with these obtained by (30, 35). As in the results the overall mean of lactation length averaged 189.73 ± 3.38 day. The flock and age of doe significantly affected the lactation length (Table, 1), 2nd flock have higher length with 197.027 ± 2.650 day and higher lactation length recorded of doe with 5 years old with 200 ± 3.779 day. These results may due to management and feeding system of the two flocks and differences in genetic make-up of the doe with the biological condition and physiological maturity of old does. Non-significant different were found to does coat color, moth of kidding, type and sex of kids on lactation length of local goat (Table, 1).

Milk compositions: As in table (2) the lactation stage significantly affected on DMY and all milk composition under study. The higher percentage of fat and protein recorded at 1st stage with 3.596 and 4.964%, respectively. While higher lactose and Solid non-fat recorded at 3rd stage with 4.949 and 9.309%,

Table 1. Mean ± SE for fixed factors effect on Milk yield and lactation period in local goat.

Factor	Levels	No.	Traits		
			Total milk yield (kg / doe)	Daily milk yield (Kg / doe / day)	Lactation length (Day)
Flock	1	36	130.541 ± 7.403 b	0.716 ± 0.033 b	182.432 ± 4.112 b
	2	31	164.043 ± 8.788 a***	0.832 ± 0.043 a**	197.027 ± 2.650 a**
Age of does (year)	2	5	87.69 ± 9.43 b	0.436 ± 0.03 c	198.00 ± 4.90 ab
	3	23	116.58 ± 6.29 b	0.628 ± 0.029 b	187.200 ± 4.248 ab
	4	23	164.343 ± 11.947 a	0.896 ± 0.056 a***	183.461 ± 4.988 b
	5 & more	16	181.878 ± 10.171 a***	0.892 ± 0.044 a	200.000 ± 3.779 a*
Does coat color	Black	33	134.213 ± 6.704 b	0.716 ± 0.030 b	186.000 ± 3.743 a
	Gray	20	155.170 ± 8.027 ab	0.821 ± 0.040 ab	191.250 ± 4.862 a
	Brown	14	165.205 ± 20.558 a*	0.835 ± 0.095 a*	196.000 ± 4.000 a
Month of kidding	January	49	158.354 ± 7.076 a***	0.828 ± 0.033 a*	192.000 ± 2.879 a
	February	11	118.631±11.373 b	0.624 ± 0.047 b	185.000 ± 8.008 a
	March	7	109.511 ± 12.819 b	0.608 ± 0.071 b	180.000 ± 1.080 a
Type of birth	Single	66	138.263 ± 5.838 b	0.723 ± 0.026 b	191.000 ± 2.794 a
	Twins	7	185.989 ± 16.915 a*	0.994 ± 0.079 a**	184.286 ± 5.714 a
Sex of kids	Female	32	143.862 ± 8.914 a	0.781 ± 0.043 a	185.625 ± 3.831 a
	Male	41	149.905 ± 7.881a	0.769 ± 0.036 a	192.857 ± 3.304 a

*** It means there are significant at (P≤0.05), ** It means there are significant at (P≤0.01), *** It means there are significant at (P≤0.001). The same letters in same Colom for each factor mean non-significant difference**

respectively. These results were agreement with (18, 37, 51). Flock significantly affected milk composition, higher fat (3.585) and solid non-fat (7.588) % found in 2nd flock while higher protein and lactose% recorded in 1st flock. These results due to different in management and nutrition between two flocks. Higher protein and lactose % observed in doe milk with 2 years old, but higher solid non-fat% recorded in doe with 5 years old (7.563%). Many researchers observed effect of doe age on milk compositions in different goat breeds (39 and 34). Black coat color doe gives higher significantly fat (3.535%), protein (4.158%) and lactose (6.625%) compared with other groups. Month of birth have significant effect only on solid non-fat% with higher value averaged 7.768%. As in the results doe reared single kids produced significantly higher fat (3.54%), protein (4.11%) and lactose (6.531%) compared with doe reared twin's kids. These results may be return to negative correlation between amount of milk yield with milk composition. Doe reared males kid significantly gives higher protein and solid non-fat%. A table (3) shows the correlation coefficient among milk composition traits in local goat. Negative non-significant correlation recorded between DMY with fat% (-0.097) and SNF% (-0.122), and between fat% with SNF% (-0.009). While higher significant negative correlation observed between protein% with SNF% (-0.764) and lactose% with SNF% (-0.860). On the other hands positive significant correlation were recorded between lactose% with both fat% and protein% were arrived 0.244 and 0.962, respectively. Many researches show that there are significant correlation between DMY with percentage milk compositions (26, 45).

Table 2. Mean ± SE for fixed factors effect on Milk composition in local goat

Factors	Levels	No.	Traits				
			Daily Milk yield (g / doe)	Fat (%)	Protein (%)	Lactose (%)	Solid non-fat (%)
Lactation stages	1	67	964.270 ± 36.106 a	3.596 ± 0.028 a**	4.964 ± 0.039 a***	3.863 ± 0.152 b	9.268 ± 0.070 a
	2	67	1056.081 ± 45.116 a***	3.343 ± 0.076 b	3.563 ± 0.029 b	4.918 ± 0.032 a	9.167 ± 0.062 a
	3	59	530.846 ± 27.638 b	3.495 ± 0.061 ab	3.577 ± 0.025 b	4.949 ± 0.036 a**	9.309 ± 0.054 a
Flock	1	101	846.933 ± 33.793 a	3.363 ± 0.052 b	4.136 ± 0.054 a*	6.626 ± 0.152 a**	7.136 ± 0.222 b
	2	92	880.092 ± 34.278 a	3.585 ± 0.043 a**	3.976 ± 0.051 b	6.261 ± 0.143 b	7.588 ± 0.165 a**
Age of does (year)	2	15	483.667 ± 41.251 c	3.576 ± 0.115 a	4.135 ± 0.154 a*	6.602 ± 0.433 a**	7.507 ± 0.519 ab
	3	65	753.239 ± 31.063 b	3.485 ± 0.068 a	4.105 ± 0.066 ab	6.524 ± 0.185 a	7.052 ± 0.268 b
	4	59	993.015 ± 48.312 a***	3.471 ± 0.058 a	4.071 ± 0.066 ab	6.499 ± 0.188 a	7.497 ± 0.232 ab
	5 & more	54	945.733 ± 49.735 a	3.449 ± 0.056 a	3.954 ± 0.065 b	6.229 ± 0.184 b	7.563 ± 0.232 a**
Does coat color	Black	95	809.347 ± 33.004 b	3.535 ± 0.051 a**	4.158 ± 0.055 a***	6.627 ± 0.156 a***	7.486 ± 0.206 a
	Gray	57	882.456 ± 32.776 ab	3.460 ± 0.060 ab	3.942 ± 0.059 b	6.189 ± 0.171 c	7.301 ± 0.235 a
	Brown	41	960.455 ± 73.549 a*	3.369 ± 0.069 b	3.989 ± 0.086 b	6.394 ± 0.237 b	7.199 ± 0.295 a
Month of kidding	January	134	933.815 ± 30.155 a***	3.459 ± 0.040 a	4.039 ± 0.041 a	6.414 ± 0.119 a	7.278 ± 0.171 b
	February	38	698.659 ± 42.681 b	3.490 ± 0.080 a	4.091 ± 0.087 a	6.453 ± 0.241 a	7.494 ± 0.328 ab
	March	21	683.809 ± 63.734 b	3.578 ± 0.109 a	4.086 ± 0.158 a	6.589 ± 0.411 a	7.768 ± 0.316 a*
Type of birth	Single	173	819.139 ± 25.370 b	3.540 ± 0.038 a**	4.110 ± 0.043 a**	6.531 ± 0.119 a**	7.281 ± 0.162 b
	Twins	20	1057.500 ± 64.519 a**	3.204 ± 0.070 b	3.811 ± 0.066 b	6.038 ± 0.206 b	7.741 ± 0.198 a**
Sex of kids	Female	83	861.606 ± 36.176 a	3.445 ± 0.052 a	4.003 ± 0.057 b	6.383 ± 0.158 a	7.206 ± 0.211 b
	Male	110	865.714 ± 32.837 a	3.502 ± 0.045 a	4.094 ± 0.049 a*	6.483 ± 0.139 a	7.495 ± 0.181 a*

*** It means there are significant at (P≤0.05), ** It means there are significant at (P≤0.01), *** It means there are significant at (P≤0.001). The same letters in same colom for each factor mean non-significant difference**

Table 3. Correlation Coefficients among milk yield and milk composition in local goat

	Traits				
	Milk yield (g/day/ doe)	Fat%	Protein%	Lactose%	SNF%
Milk yield (g/day/ doe)	1	-0.097 N.S	0.064 N.S	0.099 N.S	-0.122 N.S
Fat%		1	0.375 ***	0.244 ***	-0.009 N.S
Protein%			1	0.962 ***	-0.764 ***
Lactose%				1	-0.860 ***
SNF%					1

N.S: Non-significant., * It means there are significant at (P≤0.001)**

BLUP for TMY: The estimated Best Linear Unbiased Prediction (BLUP) of doe for the TMY is presented in Table (4). BLUP values for doe ranged from -130.65 to 224.77 kg/doe. This results indicated that there are big genetic variations among doe for TMY trait. It means that selection can play a big role in improving TMY trait. Reported (9) that BLUP values for total milk yield for Awassi ewes ranged from -28.29 to 82.61 kg ; (1) estimated BLUP values for TMY in two flocks of Hamdani sheep. The range was -68.160 to 139.951 kg for TMY; (48) reported that BLUP values of Kurdi rams for average daily milk yield ranged from -1.5265 to 1.9080 kg; (33) estimated BLUP values for TMY of Karadi ewes. The range was -34.20 to 7.380 respectively, and (10) estimated the wide range between the BLUP values of rams for TMY were -39.17 to 48.49 kg indicated that selection of elite rams will improve the total milk yield in Awassi sheep.=

Repeatability and MPPA: Repeatability is a measure of the tendency of animals to maintain their ranking over time. It describes the accuracy with which early records of an animal's performance in a particular trait can predict its lifetime performance. It's used to assess which sheep to cull and which to keep, rather than which are the most suitable for breeding. The repeatability of DMY, fat%, protein% and lactose% in present study arrived 0.286, 0.319, 0.067 and 0.015 respectively. These results indicated that the repeatability of DMY and fat% are moderately high, it means the selection program of both traits can speed up the genetic improvement of local goat for milk yield. (16) showed that repeatability estimates of Kurdish Mountain Goat were 0.24, 0.26 for ADMY, and fat%, respectively; (11) Estimates repeatability of MY and fat% for Murciano-Granadina Goats were 0.39, 0.36 respectively and (53) estimated of repeatability for total milk yield in Zaraibi Goat was 0.43.

The MPPA or BV of dairy animal, used to predict future performance from past records. When the repeatability for a trait is high, selection for the trait on the basis of the first record itself would be effective in improving the over-all performance of the herd in the next year. The MPPA value of TMY in this study ranged from 80.988133 to 329.74994 Table (5). This range indicated the big genetic variations among doe for TMY trait. It means that individual selection can play a major role in improving TMY trait of local goat. Reported (47) that The MPPA value of DMY of cows ranged from 8.25 to 16.97 kg and (56) showed that the individuals who have positive breeding values also have positive MPPA values, so it could be seen that these individuals have the ability to pass its traits also to the offspring**.**

CONCLUSION

In conclusion, the high milk yield with (TMY and DMY averaged 147.292 ± 8.096 and 0.774 ± 0.038 kg/doe, respectively) good milk composition, long lactation length (averaged 189.73 ± 3.38 day) and high BLUP (ranged from -130.65 to 224.77 kg/doe) with MPPA (ranged from 80.988133 to 329.74994) values of TMY in present study indicated the good genetic make-up of local goat for milk yield and the selection programs can play major role to increase production ability of local goat.

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Table 4. BLUP values of total milk yield(Kg) in local doe

Doe No.	BLUP	Doe No.	BLUP	Doe No.	BLUP	Doe No.	BLUP
496	224.77	429	-9.5250	474	-47.4750	490	-101.18
479	139.75	455	-12.2250	491	-48.3750	485	-101.78
454	116.71	460	-14.4750	426	-50.7000	462	-103.58
497	109.72	435	-16.1250	421	-52.2000	484	-104.10
498	102.82	425	-16.2000	441	-58.4250	487	-108.68
430	89.7000	440	-17.6250	470	-59.9250	428	-109.43
437	67.7250	493	-18.2250	459	-64.5000	481	-110.33
448	48.6150	423	-19.1250	458	-65.0250	445	-114.23
486	46.1250	494	-20.0250	480	-65.7750	475	-125.25
488	42.6750	446	-22.7250	436	-66.2250	464	-130.65
466	40.3050	444	-24.1500	476	-67.2750		
439	28.1250	461	-26.4750	449	-69.9750		
453	14.1750	424	-29.4750	465	-74.1000		
438	6.3750	472	-30.6750	482	-81.0750		
463	6.0000	431	-31.7250	478	-83.6250		
492	3.8250	483	-33.9750	450	-86.3250		
495	1.4250	422	-36.3750	433	-88.5750		
499	0	473	-41.7750	427	-92.1750		
468	-1.5750	434	-45.1500	442	-94.3500		

Table 5. Most Probable Producing Ability (MPPA) of doe for total milk yield.

Doe No.	MPPA	Doe No.	MPPA	Doe No.	MPPA	Doe No.	MPPA
496	329.74994	429	157.13329	434	130.88716	442	94.639868
479	267.11286	455	154.81405	491	128.51119	481	93.493131
454	250.13852	460	153.22608	426	126.79828	475	91.46967
497	244.98875	435	152.27084	421	125.69318	462	90.342325
498	239.90529	425	152.00863	441	121.10702	484	89.971798
430	230.23567	440	151.16574	470	120.00192	490	89.611662
437	214.04595	493	150.7237	449	118.31855	487	86.742918
448	199.96697	423	149.94427	459	117.92013	428	86.213593
486	198.1325	494	149.05039	436	116.70269	445	82.825916
488	195.59077	446	147.4084	458	116.24458	464	80.988133
466	193.84472	444	146.35856	465	115.78064		
439	184.8713	461	144.75689	480	115.69203		
453	174.59387	424	142.43545	476	114.58693		
463	168.57107	472	142.0983	482	111.48925		
438	167.9413	431	140.7778	478	104.42236		
495	165.20052	483	139.12015	450	100.55215		
492	165.09401	422	137.7698	433	98.894504		
499	163.44204	473	133.37363	485	98.753536		
468	162.99032	474	130.90039	427	96.242263		

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