GENETIC AND ECONOMIC EVALUATION FOR MILK YIELD TRAITS OF LACTATING EGYPTIAN BUFFALO INCLUDING LACTOSE AND SOMATIC CELL COUNTS

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ABSTRACT

Total milk yield (TMY), fat yield (FY), protein yield (PY) and lactose yield (LACTY) and somatic cell counts (SCC) were analyzed using a multiple-trait animal model including month and year of calving, parity, herd and type of milking as fixed effects. SCC was fit both as a fixed effect in the model and as an additional dependent variable in the analysis. Variance components were estimated using REML with an expectation maximization algorithm including sire relationships. Data on first lactation records were used to estimate direct and correlated selection response. Actual means of TMY, FY, PY, LACTY and SCC were 1674, 75, 66, 83 kg and 166,000 cells/ml milk, respectively for first lactation and 2055, 104, 71, 101 kg and 183,000 cells/ml milk, respectively for all lactations. Least square means showed that the lowest yields were in the first lactation (1594, 84, 53 and 78 kg, respectively) and the highest were in the six lactation (2481, 115, 81 and 114 kg, respectively). SCC was increased with advancing lactation order and decline in the later lactations. All studied traits were increased in Mehallet Mousa El-Gadyd herd than the other two herds. Moreover, all investigated traits increased with handing milk and decreased with milking machine. Milk yield didn't affected by SCC till 600,000 cells/ml milk. Losses in lactationally milk yield return per buffalo cow due to increase the SCC from 1 million to 4 millions cells/ml milk ranged from 105.7 to 314.8 LE (EGP). These losses indicate that the SCC is substantial in lactating Egyptian buffalo farm profit.

Heritability estimates for TMY, FY, PY, LACTY and SCC were 0.39, 0.42, 0.38, 0.42 and 0.19, respectively. Genetic correlations between milk yield traits were positive and high, ranging from 0.73 to 0.94, and milk yield traits and SCC were positive and low, ranging from 0.14 to 0.25. Corresponding phenotypic correlations between milk yield traits were between 0.84 and 0.99, but were negative ranging from -0.12 to -0.29 between milk yield traits and SCC. Single-trait selection for TMY resulted in increase of 258.96, 8.51, 10.09 and 14.30 kg of milk, fat, protein and lactose, respectively. The present results shown that selection for TMY would result in correlated changes in different traits studied, which are better than the direct selection in any other traits under investigation.

Key words: Lactose, variance components, heritability, genetic correlation, somatic cell counts, Egyptian buffaloes.

INTRODUCTION

Buffalo is the major dairy animal in Egypt. The numbers of buffaloes nearly 4 million buffaloes (IFCN, 2007), contributing approximately 65 to 70% of the total milk in the country. The dairy industry has historically considered lactose as a raw maternal necessary for the manufacture of dairy products, although of little value itself. Whey, contains about 6% total solids, 70% of which is lactose (Zall, 1984).

Variance component estimates of lactose and somatic cell counts on Egyptian buffalo are very limited. Previous studies on cows have shown heritability estimates for lactose to be less than those for fat and protein percentages (Hannson, 1956, Politiek, 1957 and Barnum et al., 1969). These studies, however, were mostly based on daughter-dam regression estimates of heritability, and several had limited amounts of data.

Robertson et al., (1956) reported heritabilities of lactose percentage to be intermediate to those for fat and protein percentages. Wilcox et al., (1971) reported that heritabilities in the Holstein population for milk, fat, protein, and lactose-minerals were 0.23, 0.25, 0.17, and 0.18, respectively.

The loss of US 8.8$ per buffalo per lactation due to mastitis indicates of its tremendous economic losses due to reduced milk production without considering the cost of disease management (Thirunavukarsu and Prabaharan, 2000). SCC is affect on milk yield and milk components, such as fat, protein and lactose (Burriel, 1997). Houben et al., (1993) found that the cow with three clinical quarters or more during first lactation had 381 kg less milk than normal cow.

Reported changes in milk composition between normal and mastitic milk showed that lactose percentage decreased markedly as measures of SCC increased (Fox and Schultz, 1985, Kitchen, 1981 and Natzke et al., 1965). This may be due to the role of lactose in maintaining the osmotic balance during the milk secretion process (Miller et al., 1983).

The objectives of this study were determine the economic effect of SCC on milk yield traits, genetic and phenotypic relationships between somatic cell counts and milk yield traits and estimate the direct and correlated response to selection based on a single trait of lactating Egyptian buffalo, kept at Mehallet Mousa farm.

MATERIALS AND METHODS

Data

Data of 1851 lactation records of 336 Egyptian buffalo cows mated by 104 sires raised at Mehallet Mousa Experimental Station of the Animal Production Research Institute (APRI), Ministry of Agriculture, Egypt, were used in the present study. Records covered the period from 2003 to 2006. Number of daughters per sire were 21.11. Buffalo cows were mated naturally. Artificial insemination was only practiced when there was a probability of genital disease infection. Pregnancy was detected by rectal palpation 60 days after the last service. Traits studied were total milk yield (TMY), fat yield (FY), protein yield (PY), lactose yield (LACTY) in kg and somatic cell counts (SCC) in 1000 cells/ml milk.

Animals were kept under semi-open sheds. Lactating buffaloes were milked by hand or machine twice daily at 7.00 a.m and 4.00 p.m throughout the lactation period, and milk production was recorded daily. Buffaloes were maintained under the same system of feeding in the farm. The animals were grazed on Egyptian clover (*Trifolium Alexandrinum*) during December to May with concentrate mixture and rice straw. While, during June to November, animals were fed on concentrate mixture, rice straw and limited amount of clover hay. Animals were feed according to their live weight, milk production and pregnancy status. The concentrate feed mixture was given twice daily before milking, while rice straw was offered once daily at 9.00 a. m, whereas clover hay or (silage) in the summer was offered at 11.00 a. m. Animals were allowed to drink water three times a day from water troughs. Multi mineral licking blocks were available for animals in the stalls.

Sampling of somatic cell counts

The somatic cell counts was measured by (Fossomatic 5000 (Foss Electric A/S 69, Stangerupade DK 3400 Hilleroed, Denmark Company) from a sample of milk collected during the morning milking. The determinations of the somatic cell counts were performed in Dairy Services Unit which belong to the (APRI), Sakha, Kafr El-sheikh, Government. Somatic cell counts was arithmetic mean monthly from calving to the end of lactation expressed as 1000 cells/ml. TMY (kg), FY (kg), PY (kg) and LACTY (kg) were based on completed lactations. Somatic cell counts classified into nine levels (≤50,000, 100,000, 200,000, 400,000, 600,000, 800,000, 1000,000, 2000,000 and 4000,000 cells/ml of milk).

Economic losses:

The economic losses due to increasing the levels of SCC measured by losses in milk returns than the normal animal as the follow equation: Milk returns = selling price of one kg milk * milk production losses. Which the selling price of one kg of milk equal 2.75 LE (EGP) according estimation of Mehallet Mousa farm (2009) (one $US = 5.50 Egyptian pound (EGP) on the basis average of 2009 prices).

Statistical Analysis

Table 1. shows the data structure and observations in the first and all lactations considered in the analytical as well as the means of total milk yield (TMY), fat yield (FY), protein yield (PY) and lactose yield (LACTY) in kg and somatic cell counts (SCC) in 1000 cells/ml of milk.

Table (1): Actual means, standard deviations (SD) and coefficient variabilities (CV%) for total milk yield (TMY), fat yield (FY), protein yield (PY), lactose yield (LACTY) and somatic cell count (SCC) of lactating Egyptian buffaloes

Item / Trait	First lactations			All lactations (1 to 10)		
	Mean	*SD*	*CV%*	*Mean*	*SD*	*C.V%*
TMY, kg	1674	664	39.67	2055	778	37.86
FY, kg	75	28.81	38.41	104	32.46	31.21
PY, kg	66	27.91	42.29	71	29.37	41.37
LACTY, kg	83	38.83	46.78	101	40.69	40.29
SCC	166	115.47	69.56	183	122.20	66.78
Observations	336			1851		

Data were first analyzed using least squares analysis of variance (Harvey, 1990 program) in order to determine the fixed effects to be included in the model. The statistical model included month (1 to 12) and year (2003 to 2006) of calving, parity (1 to 10), herd (1- Mehallet Mousa El-Gadyd, 2- Mehallet Mousa and 3- Mehallet Mousa El Kadim) and, type of milking (1= handing and 2 = machine).

Covariance components among all traits were obtained with derivative-free restricted maximum likelihood (REML) procedures using the MTDFREML program of Boldman et al., (1995). The basic multiple model was:

$$\mathbf{Y = Xb + Za + e}$$

Where: Y = a vector of observations, b = a vector of fixed effects (level of month and year of calving), a = a vector of the direct genetic effects, and e = the vector of residual effects. X and Z are incidence matrices relating records to fixed and direct genetic effects, respectively.

The variance-covariance structure for the model was as follows:

E(y) =Xb and

$$V = \begin{bmatrix} a_1 \\ a_n \\ e_1 \\ e_n \end{bmatrix} = \begin{bmatrix} A\sigma^2 a_1 & \sigma a_1 a_n & 0 & 0 \\ \sigma a_2 a_n & A\sigma^2 a_n & 0 & 0 \\ 0 & 0 & In_1\sigma^2 e_1 & \sigma e_1 e_2 \\ 0 & 0 & \sigma e_2 e_n & In_2\sigma^2 e_n \end{bmatrix}$$

d, is the number of dams and N is the number of records, A is the number relationship matrix among animals, $\sigma^2 a_{1,}$ $\sigma^2 a_n$ is the additive direct genetic variance, and σ a_i a_j is the direct genetic covariance items between any pair of the traits studies, σ^2 e_1, σ^2 e_n is the residual variance and I_a, I_n are identity matrices of appropriate order, the number of dam and number of animals with records respectively.

Heritability (h^2) was estimated from the equation:

$$h^2_a = \sigma^2_a / (\sigma^2_a + \sigma^2_e)$$

Where: σ^2_a = additive genetic variance; and σ^2_e = the variance of the random residual effect associated with each observation.

Estimation of direct and correlated responses

According to Falconer and Mackey (1997), expected direct (DR) and correlated (CR_Y) response to selection for one trait based on first lactation records were calculated as:

$$\mathbf{DR} = i * h^2 * \sigma_p \quad \text{and}$$

$$\mathbf{CR_Y} = i * hx * hy * r_g * \sigma_{py}$$

Where:

I = intensity of selection on X,

h^2 = the heritability estimate of X trait,

σ_p = the standard deviation of phenotypic values,

hx = the square roots of heritability estimate of trait X,

hy = the square roots of heritability estimate of trait Y,

r_g = the genetic correlation between the two traits, and

σ_{py} = the standard deviation of phenotypic values of trait Y.

The expected genetic change in one generation were calculated assuming selection based on cow side. the selection intensity, and for a trait was set to be 1.00 for only the purpose of comparisons.

RESULTS AND DISCUSSION

Actual means

Actual means, standard deviation and variation of variabilities for investigated traits are presented in Table (1). The present means for TMY in all lactations was higher than the most those reported in the literature [Khattab et al., 2003 (1253 kg) on Egyptian buffaloes, Tonhati et al., 2000 (1496 kg), Tonhati et al., 2004 (1713 kg) on Brazilian buffaloes and Afzal et al., 2007 (1831 kg) with Nili Ravi buffaloes]. The same trend was reported in FY, PY and LACTY. The higher present yields may be due to two reasons: the first including the data on Mehallet Mousa El-Gadyd herd, this herd is the nucleus herd and the animals in it consider improvement animals, the second reason may be due to limited of years covering the data (2003 to 2006).

The mean of SCC in the present study (183,000 cells/ml) was higher than those obtained by [Cerón-Muñoz et al., 2002 (63,000 cells/ml) on Murrah buffaloes, but was agree with (181,000 cells/ml) found by Moioli (2007)]. Moreover, the present result was lower than that estimated by Sharif et al., (2007) in dairy buffaloes (206,000 cells/ml). However, SCC in dairy buffalo cows is lower compare with dairy cows, i.e El-Arian and El-Awady (2008) found that the average of SCC in Friesian cows was (426,000 cells/ml), also Fadlelmoula et al., (2008) on dairy cows was (317,000 cells/ml).

Fixed effects

All fixed effect were significantly effected ($P<0.05$ or $P<0.01$) on different studied traits except the effect of month and year of calving on FY and PY was not significant (Table 2) .The present results indicate that the yields increased with increase lactation order (Table3), but don't steadily increase. Better feeding and longer lactation might be possible reasons for this result.

The maximum yields obtained in the 6th lactation. The decline in milk yield has been reported after 4th lactation in buffaloes (Ahmed and Shafiq, 2002). However in the present study milk yield did not differ between 2nd to 7th lactation. The reason may be that the only high milk yielders were retained for 6 plus lactation. About 31% from animals were retained by 6th lactation in this study. The same conclusion was reported by Afzal et al., (2007) on Nili Ravi buffaloes. SCC was lower in the first and second lactation, beginning increase with the 3rd till 7th lactation and decreased in later lactations.

Table (2): Test of significant effect of independent variable on different studied traits.

Effects	df	F – Significance *				
		TMY, kg	FY, kg	PY, kg	LACTY	SCC
Sires	103	12.67**	7.20**	6.91**	7.49**	3.38**
Cow:sire	203	43.75**	18.9**	11.8**	15.7**	11.51**
Month of calving	11	19.58**	0.17 ns	0.41 ns	2.55*	3.66**
Year of calving	3	15.39**	0.75 ns	0.04 ns	17.5**	4.51**
Parity	9	10.07**	7.59**	7.60**	8.54**	2.09*
Herd	2	48.59**	46.9**	46.8**	58.7**	4.87**
Milk type	1	3.74**	7.05**	5.09*	3.99*	4.17*
Residual	1519	309228	541.9	529.8	858.2	227726

* significant at $P<0.05$, ** significant at $P<0.01$, ns = not significant.

Table (3) show that the highest yields and SCC were in the herd (Mehallet Mousa El-Gadyd) while the lowest were in herd (Mehallet Mousa El-Kadim). Similarly, on Murrah buffaloes, Tonhati et al., (2004) found that the farm have significant effect on daily milk and milk yield. In Egypt, Hassan et al., (2005) arrived to the same result.

The present results indicate that the hand milking increased all milk yields and SCC ,while vice-versa found with milking machine (Table 3). This results are agreement with those reported by Lakhani et al., (1990) on Murrah buffaloes and Saleh (2005) with Egyptian buffaloes.

Losses and return profit

Somatic cell counts (SCC) did not any effect on milk yield till 600,000 cells/ml of milk, the milk yield beginning slightly decrease till 800,000 cells/ml of milk. Higher decrease in milk yield was at level 4000,000 cells/ml of milk (Table 4).

The highest percentage of animal (92.11%) had the level lower than or equal 600,000 cells/ml. Increased SCC from 1000,000 cells/ml to 4000,000 cells/ml lead to increase lactationally milk yield losses from 38.42 kg to 114.48 kg [losses 105.66 to 314.82 LE (EGP)]. In this respect, the same trend found in PY and LACTY, while the vice-versa was in FY which was decreased in the first level of SCC (≤50,000 to 600,000 cells/ml) and increase in the later levels of SCC (for 800,000 to 4000,000 cells/ml, Table 5).

Table (3) Least square means (± S.E) of some non genetic factors affecting TMY, FY, PY, LACTY and SCC of lactating Egyptian buffalo.

Effects	No. of observations	Traits				
		TMY, kg	FY, kg	PY, kg	LACTY	SCC
		Mean ± S.E	*Mean ± S.E*	*Mean ± S.E*	*Mean ± S.E*	*Mean ± S.E*
Overall means	1851	2144±244	102±8.80	73±7	104±9	196±13
Parity of dam						
1st	336	1594±238	84±6.54	53±4.58	78±7.30	180±59
2nd	296	2166±237	106±6.39	75±5.38	104±7.28	171±64
3rd	243	2369±243	107±7.44	77±5.44	111±7.09	203±78
4th	213	2213±280	99±7.54	78±4.54	109±8.95	266±11
5th	193	2270±247	100±12.74	78±5.74	112±11.2	206±12
6th	181	2481±260	115±9.28	81±6.28	114±10.2	271±81
7th	156	2228±283	111±11.53	80±3.53	110±11.9	198±10
8th	105	2200±254	106±8.20	75±4.20	107±8.8	167±79
9th	75	2006±237	98±6.51	68±4.51	99±6.9	176±93
10th	53	1913±232	94±6.31	65±4.31	94±6.7	121±48
Herd						
El-Gadyd	608	2282±228	107±11.17	78±6.45	113±12.5	250±13
Mehallet Mousa	629	2177±235	105±9.98	76±5.95	106±11.8	226±13
El-Kadim	614	1972±229	94±7.20	65±5.19	93±8.8	112±87
Milk type						
Handing	1224	2182±222	103±6.83	74±4.93	105±9.2	212±14
Machine	627	2106±134	101±7.40	72±5.38	103±8.8	180±13

Table (4): Effect of SCC levels on milk yield losses per lactation of lactating Egyptian buffalo.

SCC levels (1000 cell/ml)	No	Traits	
		Milk yield losses, kg	Losses (L.E)
		Constant ± S.E	per lactation/ cow
0-50	701	84.17 ± 31	
51-100	407	65.31 ± 27	
101-200	300	44.51 ± 19	
201-400	212	33.19 ± 21	
401-600	85	19.18 ± 17	
601-800	58	-10.55 ± 8	29.01
801-1000	38	-38.42± 26	105.66
1001-2000	28	-92.57 ± 71	254.57
2001-4000	22	-114.48 ± 87	314.82

Table (5): Effect of SCC levels on milk constitutes losses per lactation of lactating Egyptian buffalo.

SCC levels (1000 cell/ml)	No.	Traits		
		FY, kg	PY, kg	LACTY, kg
		Const. ± S.E	Const. ± S.E	Const. ± S.E
0-50	701	-3.31 ± 0.22	0.16 ± 0.01	1.29 ± 0.04
51-100	407	-1.27 ± 0.17	0.09 ± 0.03	0.87 ± 0.03
101-200	300	-2.05 ± 0.21	0.81 ± 0.05	0.88 ± 0.06
201-400	212	-3.19 ± 0.09	0.55 ± 0.04	1.61 ± 0.04
401-600	85	-0.93 ± 0.14	-0.52 ± 0.04	-0.78 ± 0.06
601-800	58	3.39 ± 0.54	-0.53 ± 0.05	-1.31 ± 0.06
801-1000	38	1.99 ± 0.18	-0.44 ± 0.03	-0.64 ± 0.05
1001-2000	28	2.38 ± 0.34	-0.79 ± 0.08	-0.66 ± 0.07
2001-4000	22	2.99 ± 0.53	-1.23 ± 0.09	-1.26 ± 0.8

The present results (Tables 4 and 5) indicate that the SCC in Egyptian buffaloes were low and slightly lower influence on milk and yield components, therefore the Egyptian buffaloes is resistance for the mastitis disease than the dairy cows.

Genetic parameters

The estimates of genetic and phenotypic variance and covariances components of various investigated traits are in Table(6). All genetic and phenotypic covariances between different traits studied were positive except phenotypic covariances between SCC and milk yield traits were negative

Table (6) Estimates of genetic and phenotypic variances (on diagonal) and (co)variances (below diagonal) for various traits studied.

Traits	TMY, kg	FY, kg	PY, kg	LACTY	SCC
	Additive genetic variance and (co)variances				
TMY	1789				
FY	625.9	407			
PY	429.5	176.8	117		
LACTY	768.7	277.9	189.9	397	
SCC	303.9	129.4	91.7	95.3	1138
Residual variance and (co)variances					
TMY	2796				
FY	491.3	560			
PY	198.7	39.6	189		
LACTY	302.7	115.4	116.7	526	
SCC	651.4	296.9	163.1	528.2	4864
Phenotypic variance and (co)variances					
TMY	4585				
FY	1769.8	967			
PY	1152.4	469.6	306		
LACTY	2038.8	748.6	495.8	923	
SCC	-1523.3	-369.1	-258.9	-290.4	6002

Heritability estimates of different traits are shown in Table (6). Heritability estimates ranged from 0.38 to 0.42 for yield traits. Heritability for lactose yield is similar to those for fat yield and slightly higher than protein yield (0.04). SCC exhibited the lowest heritability estimate (0.19), although the present estimate of SCC higher than obtained by El-Bramony (2004) (0.01) with Egyptian buffaloes.

Genetic correlations for different traits are in table (7). There were high positive genetic correlations between lactose yield and milk, fat and protein yields. Correlations between lactose yield and milk and protein yields were 0.91 and 0.88. The relationship between lactose yield and fat yield was somewhat less at 0.69.

Table (7) Heritability estimates (diagonal), genetic correlations (below) and phenotypic correlations (above) diagonal between various traits studied.

Trait	TMY, kg	FY, kg	PY, kg	LACTY	SCC
TMY	0.39 ± 0.13	0.84	0.97	0.99	-0.29
FY	0.73 ± 0.18	0.42 ± 016	0.86	0.79	-0.15
PY	0.94 ± 0.21	0.81 ± 0.19	0.38 ± 0.16	0.93	-0.19
LACTY	0.91 ± 0.18	0.69 ± 0.17	0.88 ± 0.21	0.42 ± 0.19	-0.12
SCC	0.21 ± 0.11	0.19 ± 0.12	0.25 ± 0.11	0.14 ± 0.09	0.19 ± 0.08

SCC had a small positive genetic correlations with milk yield traits, ranged from 0.14 to 0.25, Table (7). Phenotypic correlations between lactose yield and other milk yields were very similar to the genetic relationships reported, although the phenotypic and genetic correlations between lactose yield and SCC were opposite sign. phenotypic correlations between SCC and milk, fat, protein and lactose yields were all slightly negative, ranging from -0.12 to -0.29 (Table7). The phenotypic relationship of SSC with lactose yield was -0.12, in agreement with the literature finding that lactose decreased under mastitic conditions. Based on this correlation, lactose yield or percentage would not be a very reliable indicator of mastitis if used alone

Expected direct and correlated response to selection

The phenotypic and genetic variance and covariances based on first lactation were used to estimate direct and correlated response to selection for one trait in one generation of selection. Expected responses to selection for investigated traits are in Table (8). It was found that the direct selection for each of TMY, FY, PY and LACTY yields could be expected to increase of 258.96, 12.10, 10.61 and 16.31 kg, respectively per generation for examined Egyptian buffalo herds (Table8).

Table (8) Expected direct and correlated response per generation to selection for a single trait for different traits studied (maximum responses on diagonal).

Trait	TMY, kg	FY, kg	PY, kg	LACTY	SCC
TMY	**258.96**	8.51	10.09	14.30	6.60
FY	196.18	**12.10**	9.03	11.25	6.20
PY	240.28	9.32	**10.61**	13.65	7.76
LACTY	244.55	8.35	9.81	**16.31**	1.54
SCC	37.96	1.55	1.87	4.57	**21.94**

Selection for TMY resulted in increase of 258.96, 8.51, 10.09 and 14.30 kg of milk, fat, protein and lactose, respectively. The present results shown that the selection for TMY would result in correlated changes in different traits studied, which are better than the direct selection in any other traits under investigation. The present result indicated that a single traits selection for milk yield alone will be effective to improve simultaneously TMY, FY, PY and LACTY and very slightly increase in SCC.

CONCLUSION

The present results indicated that about 31% of animals were retained by 6th lactation, this is indicator that the lactating Egyptian buffalo have a long lifetime production. Moreover, the animals did not affected by SCC till 600,000 cells/ml milk and the percentage of buffalo cows which increased than 1000,000 cells/ml to 4000,0000 cells/ml were very small (4.75%) compare with the animals which less than 600,000 cells/ml (92.11%), therefore they have resistance to mastitis. The results obtained permitted us to infer that high SCC has a negative effect on milk and lactose yield in lactating Egyptian buffalo, and measuring lactose can reveal a change in SCC of buffalo milk in comparison with normal. The change in lactose and SCC causing losses to producers due to reduced milk production and quality.

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التقييم الوراثى والإقتصادى لصفات محصول اللبن فى الجاموس المصرى الحلاب متضمنا اللاكتوز وأعداد الخلايا الجسمية

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تهدف هذه الدراسة إلى تحليل صفات محصــول اللــبن الكلــى، محصول الدهن ،محصول البروتين، محصول اللاكتوز وأعداد الخلايــا الجسمية /ملى لبن باستخدام نموذج الحيوان متعدد الصفات مشتملا ســنة وشهر الولادة، ترتيب موسم الحليب، القطيع ونوع الحليــب كتــأثيرات ثابتة. استخدمت أعداد الخلايا الجسدية كتأثير ثابت على اللبن ومكوناتــه وكصفة مرة أخرى فى التحليل. قدرت مكونات التباين باستخدام طريقــة الاحتمالات العظمى المحددة REML.

استخدمت بيانات الموسم الأول لتقدير مكونات التبــاين لحســاب التحسين بالانتخاب المباشر والاستجابة للانتخــاب. بلغــت متوســطات صفات محصول اللبن الكلى، محصول الــدهن، محصــول البــروتين، محصول اللاكتوز وأعداد الخلايا الجسمية /ملى لــبن ١٦٧٤، ٧٥، ٦٦، ٨٣ كجم و ١٦٦,٠٠٠خلية /ملى لبن على التوالى فى الموســم الأول و ٢٠٥٥، ١٠٤، ٧١، ١٠١ كجم و ١٨٣,٠٠٠ خلية /ملــى لــبن علــى التوالى لجميع المواسم.

أوضح تحليل أقل متوسط للمربعات أن أقل صفات محصول اللبن كانت فى الموسم الأول (١٥٩٤، ٨٤، ٨٣، ٧٨ كجم) لمحصول اللــبن الكلى، محصول الدهن، محصول البروتين ومحصول اللاكتــوز علــى التوالى بينما كان أعلاها فى الموســم الســادس (٢٤٨١، ١١٥، ٨١، و ١١٤ كجم) لنفس الصفات السابقة على التوالى.

زادت أعداد الخلايا الجسمية مع زيادة رتبة موسم الحليــب. كمــا زادت جميع الصفات المدروسة فى قطيع محلــة موســى الجديــد عــن القطيعين الآخرين. أيضا زادت جميع الصفات المدروسة مــع الحليــب اليدوى وانخفضت مع الحليب الآلى. ولم يتأثر إنتاج اللبن بأعداد الخلايا الجسمية حتى ٦٠٠,٠٠٠ خلية /ملى لبن وتراوح الفقد فى موسم الحليب لكل جاموسة حلابة بزيادة أعداد الخلايا من ١ مليون خلية /ملى لبن إلى ٤ مليون خلية /ملى لبن من ١٠٥,٧ إلى ٣١٤,٨ جنية مصرى وهذا الفقد

يدل على أن أعداد الخلايا الجسمية يعتبر شئ هام للحكم علـــى ربحيـــة مزارع الجاموس المصرى الحلاب.

كانت تقديرات المكافئ الوراثى لمحصول اللبن الكلى، محصـــول الدهن، محصول البروتين، محصول اللاكتوز، وأعداد الخلايا الجســمية /ملى لبن ٠,٣٩، ٠,٤٢، ٠,٣٨، ٠,٤٢، ٠,١٩ على الترتيب.

كانت الارتباطات الوراثية بين صفات محصول اللـــبن مرتفعـــة وموجبة وتراوحت من ٠,٧٣ إلى ٠,٩٤ وبين صفات محصـــول اللـــبن وأعداد الخلايا الجسمية /ملى لبن موجبة ومنخفضة وتراوحت من ٠,١٤ إلى ٠,٢٥. أيضا كانت الارتباطات المظهرية بين صفات محصول اللبن عالية وموجبة وتراوحت من ٠,٨٤ إلى ٠,٩٩ ولكنهـــا كانـــت ســـالبة وتراوحت بين -٠,١٢ إلى -٠,٢٩ بين صفات محصول اللبن وأعـــداد الخلايا الجسمية /ملى لبن.

أدى الانتخاب لمحصول اللبن الكلى إلى زيـــادة بــــ ٢٥٨,٩٦، ١٠,٠٩، ٨,٥١ و١٤,٣٠ كجم فى اللبن، الدهن، البروتين واللاكتوز على التوالى كما أوضحت النتائج أن الانتخاب لمحصول اللبن الكلـــى ســـوف يؤدى إلى استجابة فى مختلف الصفات المدروسة حيث يكون أفضل عن الانتخاب المباشر لأى صفة اخرى تحت الدراسة.