Estimation of breeding values of total milk yield of Egyptian buffalo under different production systems

S.A.M. Abdel-Salam, S. Abou-Bakr, M.A.M. Ibrahim, R.R. Sadek & A.S. Abdel-Aziz

Department of Animal Production, Faculty of Agriculture, Cairo University, Giza, Egypt

Summary

A total of 3 526 lactation records of 2 179 buffaloes in 51 herds at 8 governorates under four production systems was recorded by the Cattle Information System/Egypt (CISE) of Cairo University, Faculty of Agriculture during the period from 1990 to 2006, the records were used to estimate genetic and non-genetic parameters of total milk yield of recorded Egyptian buffaloes. The highest least squares means of total milk yield was 2 044 kg milk in Fayoum governorate, while the lowest was 1 444 kg milk in Ismalia governorate. The least squares means of total milk yield of commercial, experimental, flying and small holder production systems was 1 844, 1 328, 1 993 and 1 770 kg, respectively. The least squares means of total milk yield of buffaloes in first six parities ranged from 1579 kg for first parity to 1808 kg for sixth parities. The heritability estimate of total milk yield ranged from 0.05 to 0.25 in the different production systems. The repeatability estimate of total milk yield ranged from 0.07 to 0.38 in the different production systems. The maximum and minimum estimates of breeding values of total milk yield for commercial, experimental, flying and small holder production systems were 368 to -377, 297 to -302, 190 to -290 and 96 to -76, respectively.

Key words: *Total milk yield, Egyptian buffalo, Heritability, Repeatability, Breeding value.*

Introduction

The contribution of buffalo to total milk production in Egypt is around 70 per cent (Khalil *et al.*, 1992). FAO (1990) noted that Egyptian buffaloes contribute to about 5 and 14% of the world buffalo's milk and meat, respectively. Information about the phenotypic and genetic parameters of various economic traits is essential for the selection of higher productivity and efficient production systems. The formulation of breeding plans and genetic improvement necessitates defining and analyzing the production systems of Egyptian buffaloes. The main aim of selection in animal breeding is to improve targeted desirable traits. Breeding values of individual animals represent the best criteria for identifying selected animals.

There are different types of production systems to raising buffaloes in Egypt. The first system is the traditional crop/livestock system (small holders) which is traditionally integrated wit the dominating agricultural system. It contains about 96% of the cattle and buffalo population and produces about 70% of the total domestic milk output. The second system is the intensive production system which contains large commercial farms. Commercial farms contain about 4% of the total cattle and buffalo population but produce about 30% of the marketable milk. The third system raising buffalo called flying system. In this system, buffaloes are put under very intensive feeding regimes to produce high-fat milk. The fourth production system is experimental farms which keep the buffalo for educational training and research purposes.

Materials and methods

This study was carried out using milk production records of buffalo herds recorded by the Cattle Information System/Egypt (CISE) of Cairo University, Faculty of Agriculture during the period from 1990 to 2006, which were used to estimate genetic and non-genetic parameters of total milk yield of recorded Egyptian buffaloes.

Data

The data comprised 3 526 lactation records of 2 179 buffaloes in 51 herds at 8 governorates under four production systems were used. The 8 governorates were Elbehera, Baniswif, Fayoum, Giza, Ismalia, Kaliobia, Elminia and Sharkia. The four production systems were commercial, experimental, flying and small holder herds. Parities included the first six lactations.

This study was focused on calculating estimates of heritability, breeding values and the least squares means of total milk yield of Egyptian buffaloes under different production systems.

Statistical analysis

The following fixed model was used to estimate the least squares means of total milk yield of buffaloes in different governorates, production systems and parities; using the General Linear Model (GLM) procedure (SAS, 2001).

$$Y_{ijklm} = \mu + G_i + S_j + P_k + YS_l + e_{ijklm}$$

where:

Y_{ijklm} = observation of total milk yield;
μ = overall mean;
G_i = fixed effect of governorate i, (i=8);
S_j = fixed effect of production system j, (j=4);
P_k = fixed effect of parity k, (k=6 parities);
YS_l = fixed effect of year-season of calving l, (l=32) and
e_{ijklm} = random residual effect.

The following repeatability animal model was used to estimate heritability, repeatability and breeding values using the Derivative-Free Restricted Maximum Likelihood (DF-REML) procedure (Meyer 2000).

$$Y_{ijklm} = \mu + A_i + P_j + YS_k + H_l + e_{ijklm}$$

where:

Y_{ijklm} = observation of total milk yield;
μ = overall mean;

A_i = additive genetic random effect of the individual i;
P_j = fixed effect of parity j, (j=6 parities);
YS_k= fixed effect of year-season of calving k, (k=32);
H_l= fixed effect of herd l, (l=51) and
e_{ijklm}= random residual effect.

Results and discussion

The least squares means of total milk yield of recorded buffalo ranged from 2 044 kg milk in Fayoum governorate to 1 444 kg milk in Ismalia governorate (Table 1). The difference in total milk yield between governorates is due mainly to the environment, management and prevailing production systems.

Table 2 shows the least squares means of total milk yield in different production systems used to raise Egyptian buffaloes. The highest production was 1 993 kg milk yield for flying herds which raise very highly producing buffaloes. The flying herds use good management and high quality feed to produce more milk. This system is usually located outskirt cities. Also, the lactation period was the longest (326 day). While the least squares means of total milk yield of buffalo under commercial herds was 1 844 kg milk yield. These commercial herds have high producing animals, good management, and nutrition system and use machine milking.

Small holdings present the dominant production system in Egypt as contains about 95% of the total number of buffaloes in Egypt. The least squares means of total milk yield of buffaloes located under this system was 1 770 kg which is lower than the average milk yield of all buffalo herds (1 884 kg). The buffaloes raised under this system usually receive special attention from the farmer although family

Table 1. Least squares means(X) of total milk yield (kg) and their standard error (SE) of buffaloes in eight governorates.

Governorate	No. of records	X (kg) [1]	SE
Fayoum	334	2044[b]	36
Giza	1496	1873[c]	21
Elminia	318	1846[ce]	36
Kaliobia	385	1767[ef]	35
Baniswif	229	1652[a]	41
Sharkia	46	1639[af]	77
Behera	660	1603[a]	27
Ismalia	58	1444[d]	68

[1]Means followed by different letters differ significantly (*P*<0.01).

Table 2. Least squares means (X) of total milk yield (kg) and their standard error (SE) and average Lactation period (LP) in days of buffaloes under different production systems.

Production systems	No. of records	X (kg)[1]	SE	LP, day
Commercial	1 340	1844[a]	25	293
Experimental	472	1328[b]	34	255
Flying	307	1993[c]	37	326
Small holders	1 407	1770[d]	26	319

[1]Means followed by different letters differ significantly (*P*<0.01).

management practice used. Buffaloes located under experimental herds had the lowest milk production (1 328 kg). The differences between least squares means of total milk yield in different production systems was highly significant ($P<0.01$). Galal and Elbeltagy,(2006) observed the same characteristics of different buffalo's production system in Egypt.

Table 3 shows the least squares means of total milk yield of buffalo in different parities. Under different production systems the number of parities of Egyptian buffaloes ranged from 1 to 6 parities. The total milk yield increases gradually from the first to the sixth parity. The least squares mean of total milk yield of second parity was higher than the first parity by 8% and different significantly ($P<0.0001$). No significant differences between total milk yield of both second and third parities ($P=0.92$).Slight increase about 62, 77and 90kg in total milk yield from the second to the fourth, fifth and sixth parities, respectively, and different significantly ($P<0.05$). The differences between total milk yield of fourth, fifth and sixth parities was not significant ($P>0.05$). Similar results observed by Badran *et al.,*(2002).

The estimates of heritability and repeatability of total milk yield of Egyptian buffaloes are presented in table 4. The heritability estimate of total milk yield for all buffalo herds was 0.17. The highest heritability estimates of total milk yield were 0.25 and 0.24 for buffalo under experimental and commercial herds in respectively. Heritability estimate of total milk yield for buffaloes recorded in the flying herds was 0.19. The lowest heritability estimate of total milk yield for buffaloes recorded in small holder herds was 0.05. The low value of heritability was may be due to that the low input environment in these herds might suppress genetic variedicty among individuals. These results are in agreement with those reported by (Abdel-Aziz and Badran, 2000) and (Mourad and Mohamed, 1995) which showed that heritability estimates ranged between 0.03 and 0.20 for total milk yield. Metry *et al*., (1994)

Table 3. Least squares means (X) of total milk yield (kg) and their standard error (SE) of buffaloes for different parities.

Parity	No. of records	X (kg)[1]	SE
1	347	1579[a]	34
2	383	1718[b]	33
3	590	1722[b]	29
4	677	1780[c]	28
5	593	1795[c]	28
6	936	1808[c]	27

[1]Means followed by different letters differ significantly ($P<0.01$).

Table 4. Estimates of heritability (h^2) and repeatability (r) of total milk yield for all buffalo herds and under different production systems.

Item	h^2	R
All buffalo herds	0.17	0.30
Commercial herds	0.24	0.26
Experimental herds	0.25	0.38
Flying herds	0.19	0.20
Small holder herds	0.05	0.07

Table 5. Maximum and minimum estimates of breeding values of total milk yield (kg) for all buffalo herds and different production systems.

Item	Max.	Min.
All buffalo herds	322	-305
Commercial herds	368	-377
Experimental herds	297	-302
flying herds	190	-290
Small holder herds	96	-76

showed that the heritability estimate of experimental herds was 0.28. The same trend was observed in the estimates of repeatability for total milk yield. The low repeatability estimate is a good indictor to high changes of temporary environmental effect from record to record on the same individual (Bourdon, 1997). Metry *et al*., (1994) and Mourad and Mohamed, (1995) and Mourad *et al*. (1991) obtained similar estimate of repeatability for experimental herds.

Table 5 showed the maximum and minimum estimates of breeding values of total milk yield for all buffalo herds and different production systems. The highest breeding value of total milk yield found in commercial herds. Commercial herds have high producing buffaloes. Also, experimental herds had a good producing. Flying herds utilize a high producing and highly genetic buffaloes for once lactation and then slighting them which led to low breeding value estimates of total milk yield (190 kg) under this production system. The lowest estimate of breeding value for total milk yield was observed in small holder herds (96 kg).

List of references

Abdel-Aziz, M and A. E. Badran. 2000. Effect of data imbalance and small herd size on the heritability estimated by different methods (a case study of milk yield in a buffalo herd). Alexandria Journal of Agricultural Research. 45(3):1.

Badran, A.E., A. El-Barbary, A. E. Mahdy and G.M. Assar. 2002. Genetic and non-genetic factors affecting the lifetime production traits in Egyptian buffaloes. Buffalo Journal. 18(2):235.

Bourdon, R.M. 1997. Understanding Animal Breeding. Prentic Hall, Upper Saddle River, New Jersey 07458, USA.

FAO. 1990. Production yearbook, Rome, Italy, FAO, pp. 420. (no. 49).

Galal, S. and A. Elbeltagy. 2006. Achievement of research in the field of buffalo production in Egypt. WAAP Book of the Year 2006: 177.

Khalil, M.H., Afifi, E.A., Bedeir, L.H. and Zedidan, S.M. 1992.Genetic analysis of lactation traits in Egyptian buffaloes. Anim. Prod. 92: 155-172.

Metry, G.H., J.C. Wilk, R.E. McDowell and H.A. El-Rigalaty. 1994. Factors affecting the performance of Egyptian buffalo. Annals of Agricultural Science, Moshtohor, 32: 827.

Meyer, K. 2000. DFREML (Derivative – Free Restricted Maximum Likelihood) package. Version 3.1á <*http://agbu.une.edu.au/~kmeyer/*>.

Mourad, K.A., M.M. Mohamed and A.S. Khattab. 1991. Genetic parameters for milk production traits in a closed herd of Egyptian buffaloes. Egyptian Journal of Animal Production. 28: 11.

Mourad, K.A. and M.M. Mohamed. 1995. Genetic and phenotypic aspects of milk yield traits and reproductive performance of Egyptian buffaloes. Egyptian Journal of Animal Production. 32: 125.

SAS Procedures Guide. 2001. Version 8.2, 2001. SAS Inst., Inc., Cary, NC.