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Monitoring of Some Reproductive Parameters in Local Egyptian Friesian Cows with Emphasis on the Use of Immunogenetic Analysis for Evaluation of Fertility

M.M. Zaabal and W.M. Ahmed

Department of Animal Reproduction and Artificial Insemination,
Veterinary Research Division, National Research Centre, Giza, Egypt

Abstract: Investigations were carried out to monitor some reproductive parameters in Friesian cows under the prevailing local Egyptian conditions. Special emphasis was given to evaluation of fertility and the correlation between fertility index and milk production was determined using immunogenetic analyses. The available records of large governmental farm were examined, the reproductive data had been analyzed and blood samples were collected. The frequencies of 6 genetic alleles (Albumin, Postalbumin, a-globulin, Posttransferrin, transferrin and Amylase-1) were determined by means of polyacrylamide gel-electrophoresis (PAGE). Results indicated that the age at 1st service and calving averaged 1.952 and 2.719 years, respectively. The gestation period and calving interval were 272.83 and 398.050 days, respectively. Calf birth weight averaged 25.20 Kg. with sex ratio of 54.55females: 45.45males. Averaged percent of fetal mortality is 4.26 and milk production averaged 7.32 kg/day. Fertility index of the studied cows ranged form 48.17±2.99 (low fertility index) to 89.3±1.36 (high fertility index). A positive correlation was found between fertility index and milk yield in the low fertility index group whereas the Coefficient of correlation reach to 0.516. The relationship between blood protein genotypes and fertility index revealed that the high fertility index was related to $A1^{A}$ Pal^{A}, Fa_2^{A}, Ptf^{A} and $Am\text{-}1^{B}$ genes and the low fertility index was more related to Al^{B}, Tf^{E} and Pal^{B} genes. It was concluded that the reproductive parameters of Friesian cows in Egypt were within the recorded average for these cows except for milk production which was low.

Key words: Friesian · Fertility · Genes · Milk yield · Blood proteins

INTRODUCTION

The prim intention of livestock producers is usually to maximize the numbers of viable offsprings per breeding animal during his productive life, suggesting that calving intervals should be minimum. However, reproductive traits are most often characterized by intermediate optima [1]. Many investigations were carried out on the relationship between genetic polymorphism and reproductive effeciency in cattle [2-5]. However, it was reported that polyploid/aneuploid is a major cause of fertilization failure. The correlation between fertility index and milk yield can be explained according to the polygenic effect, that genes controlling differences in reproduction may affect a very large number of processes, including rate of synthesis and release of gonadotrophic hormones, number and function of gonadotropin or steroid receptors, gonadal-hypothalamic-hypophyseal feedback regulation and uterine size and function [1].

Genetic variation is undoubtedly due to changes in DNA, each resulting initially from changes of the amount or the function of a specific gene product. However, because of the many genes involved and their interactions analysis and utilization of much genetic variation will depend on use of specific methods for handling the quantitative variation [1].

In Egypt, importation of European breeds of cattle generally leads to unsatisfactory results. Performance of such breeds has often been disastrous with retarded growth, high mortality and poor fertility [6]. Therefore, the present study was planned to monitor some reproductive parameters and to evaluate the fertility of a local Fricsian herd under the Egyptian conditions wilh special emphasis on the immunogenetic analysis.

MATERIALS AND METHODS

Experimental Animals: The reproductive data of 40 purebred Friesian cows kept in a large governmental

Corresponding Author: Dr. Magdy M. Zaabal, Department of Animal Reproduction and Artificial Insemination, Veterinary Research Division, National Research Centre. Giza, Egypt

farm at Lower Egypt were analyzed from 2nd to 8th parities with live body weight of 310-460 kg. Parents of these cows were imported from Netherlands as late pregnant heifers since 1930s. Cows revealed no reproductive problems and were free from contagious diseases especially brucellosis and tuberculosis. The farm was subjected for a program to compete internal and external parasites. Cows were managed under free system, *ad libitum* fed on Egyptian clover during the green season (December-May) and green corn (Darawa) during the dry season (June-November) in addition to the commercial concentrate ration (5 kg/head/day, protein not less than 16%) and rice straw all the year round.

Experimental Design

- **Blood Sampling:** Blood Samples were collected from jugular vein, centrifuged at 3000xg. for 15 minutes at 4°C. Serum was separated and kept at -20°C for immunogenetic analysis.
- **Electrophoresis:** Electrophoresis was performed by using polyacrylamide gel electrophoresis (PAGE) according to [7].
- **Genotyping and Gene Frequencies:** Genotyping of six blood proteins (Albumin, postalbumin, a-globulin, transferrin, posttransferrin and Amylase-1) was calculated according to [20].
- **Fertility Index:** Fertility index has been calculated by two formulas (formula of Olikokos and formula of Douki) cited by [8].
- **Statistical Analysis:** Data were statistically analysed using Student "t", test as outlined by [9].

RESULTS

Some Reproductive Parameters of Local Friesian Cows in Egypt: Table 1 shows that local Friesian cows were successfully mated at age of 1.95 year and gave birth at 2.72 year of age and most of calving were during winter (45.00%) followed by spring (27.50%), autumn (15.00%) then summer (12.50%) with calf birth weight of 25.2kg. The uterus got involutedly 34.112 days post partum, with calving interval of 398.050 days. Fetal mortality averaged 4.26% and was mainly due to diarrhea and respiratory disorders. Milk production averaged 7.323 kg. Cow/day.

Table 1: Some reproductive parameters of local Friesian cows in Egypt (Mean±S.E)

Parameter	Values
Age at first service (year)	1.952±0.530
Number of services/conception	1.30±0.146
Gestation length (days)	272.83±0.29
Sex ratio (♀:♂)	54.55: 45.450
Age at first calving (year)	2.719±0.526
Calf birth weight (Kg)	25.200±0.726
Uterine involution (days post partum)	34.112±1.690
1st post partum heat (days)	42.370±1.390
Calving interval (days)	398.050±2.429
Milk production (kg /day)*	7.323±0.240
Average No, of calving /cow.	4.230±0.29
Fetal Mortality (%)	4.26

* For 305 days/a year

Fertility Index: According to number of offsprings, calving interval and age at 1st calving, cows were grouped into 3 groups

- 1st group: Cows with high fertility index (HFI)
- 2nd group: Cows with moderate fertility index (MFI)
- 3rd group: Cows with low fertility index (LFI)

As shown in Table 2. The HF1 of the 1st group reached to 89.3±1.36 and 51.69+0.92 according to Olikokos and Douky, respectively with no big difference between the mean value of the two indexes.

Table 2: Correlation between fertility index and milk yield in Friesian cow in Egypt(Mean±S.E)

	Fertility index according to Olikokos formula		Fertility index according to Douky formula		
Animal Groups with	FI Mean±S.E.	Milk yield* Mean±S.E.	FI Mean±S.E.	Milk yield Mean±S.E.	Coefficient of correlation "r"
High fertility index	89.3±1.36	7.8±0.36	51.69±0.92	6.89±0.16	-0.039
Moderate fertility index	74.9 ±1.17	7.36±0.53	43.33±0.44	7.36±0.49	-0.005
Low fertility index	48.17±2.99	6.89±0.39	35.47±0.99	7.29±0.35	+ 0.516**

** P<0.01

Table 3: Distribution of blood protein genotypes and gene frequencies according to fertility status two alllelic loci and three allelic loci

	Albumin			Postalbumin			a-globulin			Posttransferrin			Amylase-1			Transferrin					
Gene frequencies																					
Fertility status	AA	AB	BB	AA	AB	BB	AA	AB	BB	AA	AB	BB	BB	BC	CC	AA	AD	DD	DE	AE	EE
High fertility	8	4	2	7	3	4	8	3	3	10	2	2	8	2	4	5	3	1	2	2	1
index N=14	(7.1)*	(5.7)	(1.1)	(5.1)	(6.7)	(2.1)	(6.4)	(6.1)	(1.4)	(8.6)	(4.7)	(0.7)	(5.7)	(6.4)	(1.7)	(4)	(3.8)	(0.8)	(1.5)	(3.2)	(0.6)
	Gene frequencies			Gene frequencies			Gene frequencies			Gene frequencies			Gene frequencies			Gene frequencies					
	Al^A= 0.714			Pal^A= 0.607			$Fa2^A$= 0.678			Ptf^A = 0.785			$Am\text{-}_1^B$ = 0.642			Tf^A = 0.535					
	Al^B= 0.285			Pal^B= 0.392			$Fa2^B$= 0.321			Ptf^B = 0.215			$Am\text{-}_1^C$ = 0.357			Tf^D = 0.25					
	X^2 = 1.34			X^2 = 4.46			X^2 = 3.7			X^2 = 5.3			X^2 = 7.0			Tf^E = 0.214					
																X^2 = 1.34					
Moderate fertility	4	3	2	2	2	5	6	2	1	2	1	6	6	1	2	2	1	1	3	1	1
index N=9	(3.4)	(4.3)	(1.3)	(1.1)	(3.9)	(3.9)	(5.4)	(3.1)	(0.4)	(0.7)	(3.6)	(4.7)	(4.7)	(3.6)	(0.7)	(0.9)	(1.9)	(0.9)	(1.9)	(1.9)	(1.9)
	Gene frequencies			Gene frequencies			Gene frequencies			Gene frequencies			Gene frequencies			Gene frequencies					
	Al^A= 0.611			Pal^A= 0.333			$Fa2^A$= 0.777			Ptf^A = 0.278			$Am\text{-}_1^B$ = 0.723			Tf^A = 0.333					
	Al^B= 0.389			Pal^B= 0.666			$Fa2^B$= 0.222			Ptf^B = 0.722			$Am\text{-}_1^C$ = 0.277			Tf^D = 0.333					
	X^2 = 0.86			X^2 = 1.96			X^2 = 1.35			X^2 = 4.5			X^2 = 3.5			Tf^E = 0.333					
																X^2 = 5.1					
Low fertility	4	2	11	4	1	12	7	6	4	9	2	6	8	5	7	4	3	2	2	1	5
index N=17	(1.5)	(7.0)	(8.4)	(1.2)	(6.5)	(9.2)	(5.8)	(8.2)	(2.9)	(5.8)	(8.2)	(2.9)	(6.4)	(8.0)	(2.5)	(2.1)	(3.2)	(1.2)	(3.4)	(4.6)	(2.5)
	Gene frequencies			Gene frequencies			Gene frequencies			Gene frequencies			Gene frequencies			Gene frequencies					
	Al^A= 0.294			Pal^A= 0.264			$Fa2^A$= 0.588			Ptf^A = 0.588			$Am\text{-}_1^B$ = 0.617			Tf^A = 0.353					
	Al^B= 0.705			Pal^B= 0.735			$Fa2^B$= 0.411			Ptf^B = 0.411			$Am\text{-}_1^C$ = 0.382			Tf^D = 0.365					
	X^2 = 8.4			X^2 = 11.95			X^2 = 1.2			X^2 = 9.6			X^2 = 9.6			Tf^E = 0.382					
																X^2 = 8.11					

*The theoretical number of genotypes

Correlation Between FI and Milk Yield: Correlation coefficient analysis of these parameters showed non significant relation in 1st and 2nd group, while there was significant correlation in the 3rd group ($r = 0.516$, $P < 0.01$) as shown in Table 2.

Relationship Between Some Genetic Loci and Fertility Index: From material of table 3, it is evident that high fertlity was related to $A1^A$, Pal^A, Fa_2^A, Ptf^A and Am- 1^B genes, while moderate fertility was related to Fa_2^A, Tf^A, Ptf^A and Am-1^B genes. Concerning the 3rd group (low fertility) it was more related to $A1^B$, Pal^B and Tf^E genes, on the other hand from the 6 studied loci only Ptf and Am-l revealed drifft of genes $x^2 = 9.6$.

DISCUSSION

Reproductive efficiency is the most important factor affecting production in most domestic animals species. In the same time, high reproductive rates facilitate genetic progress in other traits Moreover, change within population is a function of product of heritability and phenolypic variation [1]. However, genetic variation is essential to permit improvement of farm animals. This may be created both from new mutations, or from conserving of the existing genetic variation. New mutations generally have deleterious effects on fitness, for instance on reproductive performance [5] Reproductive performance may also vary as a result of changes in frequency of different genotypes, without a change in gene frequency. An increase in proportion of homozygous loci is typically associated with a decrease in performance, while increased reproductive fitness often result from an increase in heterozygosity (Heterosis) [1,2]. The present study revealed that the fertility of local Friesian cows is favorable as monitored by the age of the fertile mating and 1st calving, number of cervices/conception, calving interval and calves mortality. Moreover, these parameters were optimal in comparison with the findings of [10-12]. This indicated that the mangmental measures under which these cows were maintained such as feeding and heat detection as well as climatic condition such as photperiod and temperature are optimal for promoting the expression of the metabolic pathways that enable cows to achieve their genetic potential for reproduction [13,14]. However milk production of these cows is reduced if it is compared

Table 4: Comparison of gene frequency of transferrin and amylase of Friesian cattle in different locations

	Transferrin			Amylase-1		
Location	Tf^A	Tf^D	TF^E	$Am\text{-}1^B$	$Am\text{-}1^C$	Author
Russian	0.366	0.631	0.004	0.627	0.373	Merkoreva,1977
Ukraine	0.462	0.517	0.021	-	-	Merkoreva,1977
Uzbekistan	0.224	0.453	0.321	-	-	Merkoreva,1977
Estonia	0.619	0.369	0.12	0.626	0.373	Merkoreva,1977
Egyptian Baladi	0.292	0.243	0.325	0.792	0.208	Gramel *et al.* 1986
Egyptian Friesian	0.407	0.282	0.309	0.660	0.338	Present study

with the same breed elsewhere, the condition may be related to energy defect espicially during the first 2-3 weeks after calving [14]. Moreover, this herd become adopted under the Egyptian condition since it was imported during 1930s.

The relationship between fertility and milk production as well as the relationship between fertility status and immunogenetic constituents of Friesian cattle were evaluted. The association between reproductive traits in cattle and genetic polymorphism has been reported. Interlocus association of transferrin and ceruloplasmin was reported whereas the gene for both being on chromosome 1, while the gene of Amylase-1 being on chromosome 9 [15-18]. On the other hand, estimates of heritability of fertility traits in dairy cattle and in beef cattle are typically very low 5% or less and 7% for age at first calving, respectively [1]. The value for first calving may be affected by variation in age at puberty as well as infertility. In the present study, all protein systems were polymorphic, transferrin locus have 12 alleles [19], but the most famous in European cattle breeds are A_1, D_1, D_2 and E and these alleles are found in Friesian cattle in Egypt. The closer connection between Friesian breeds in Europe and Egypt is due to the genome of breed and the difference in frequencies of some alleles may be due to drifft of gene and/or effect of environment on gene expression. Data of amylase locus in the present study showed the absence of $Am\text{-}1^A$ and similar results was observed in Italian catllc breed [20]. However, $Am\text{-}1^A$ was observed in most cattle breed in Canada and Mangolia as in Table 4.

Another aim of the present study was to detect the correlation between fertility index and milk yield from immunogenetic point of view. There are certain alleles of B-group linkage with milk production. In this respect, [21,22] reported that the genotype of K-casein had a significant effect on milk fat and DM percentage, Substitution of gene B for C at $á_{s1}$ casein locus affected 305 day milk yield but not fat percentage. Moreover it was shown that the additive genetic variance was contributed to milk protein loci of 305 day milk yield and fat. Also correlation of immunogenetic with milk production has been reported [23-26]. These authors reported a positive correlation of age at 1st calving with milk yield, milk composition and milk component. It was suggested [27] that milk yield was significantly affected by breed type. The findings of the present study are similar to those obtained by [28] who added that genetic correlation varied with parity and trait (milk peak yield, lactation length, service period and calving interval). The correlation of fertility index with milk production in the present study was similar to results obtaind by [29] they reported no significant correlation between milk yield and number of services/conception and they also reported that reduced fertility in high yielding cows is not directly related to increased milk yield but rather to loss of weight and body condition. The relationship between productivity and genetic make-up coordination of breeding programmes, selective culling, sire evaluation and evaluation of offspring from immunogenetic point of view has been also reported by [30-32].

In conclusion, the reproductive parameters of local Friesian herd in Egypt were within average records for this breed except for milk production which was lower herein if compared to their yields in other countries. On the other hand the fertility index was significantly correlated to milk production in the low fertile cows. From the immunogenetic aspect high fertility index was closely related to Pal^A, $Fa_2{}^A$ Ptf^A and $Am\text{-}1^B$ gene while low fertility index was more related to Al^B, TF^E and Pal^B genes.

REFERENCES

1. Bradford, G.E., J.L. Spearow and J.P. Hanrahan, 1991. Genetic variation and improvement in reproduction in reproduction in domestic animals, 4th Edn. Academic Press. Inc. USA.

2. Tsukahara, Y., Choumei, K. Oishi, H. Kumagai, A.K. Kahi, J.M. Panandam, T.K Mukherjee and H. Hirooka, 2008. Effect of parental genotypes and parental heterosis on litter traits in crossbred goats. J. Animal Breeding and Genetics, 125: 84-88.
3. Kushner, H.F., L.A. Zubareva, O.N. Smonova and N.L. Kuznetsov, 1973. The relationship between types of transferrin, amylase and hemoglobin and cow fertility in two cattle breeds. Animal Blood Group, Biochemistry and Genetics, 4: 119.
4. Hargrove, G.L., C.A. Kiddy, C.W. Young, A.G. Hunter, G.W. Trimberger and R.E. Mother, 1980. Genetic polymorphism of blood and milk and reproduction in Holestein cattle. J. Dairy Sci., 63: 1154-1166.
5. Gerhard, D. and L. Martina, 1997. Conservation of rare breeds of animals-objectives and possibilities. J. Animal Res. Devolop., 46: 47-54.
6. Ahmed, W.M., 1993. Potentials of native Egyptian cattle. A Rev. Egyptian J. Vet. Sci., 30: 1-27.
7. Carlstrom, A. and B.G. Johnson, 1983. Electrophoresis immune fixation Scand. J. Immunol., 17: 23-30.
8. Zaveriatev, B.P., 1987. Increasing of Fertility of Farm Animals. Roccelkozez date, Moscow, pp: 190.
9. Snedecor, G.W. and W.G. Cachran, 1980. Statistical Methods 7th ed., lowa state Univ. Press, Ames. USA.
10. Jonsson, N.N., M.R. McGowan, K. Mccwlgon, T. Davison, A.M. Hussion, M. Kafy and A. Mahctross, 1997. Relationship among calving season, heat load, energy balance and postpartum ovulation of dairy cows in subtropical environment. Animal Reproduction Sci., 74: 315-326.
11. Kume, S.I. and T. Toharmat, 1998. Effect of age at 1st calving and sex on blood backed cell volume, haemoglobin and plasma mineral of calfs born from primiparous cows. J. Animal Sci. Technol., 68: 568-571.
12. Reyes, L.A., 1998. Performance of dairy cattle according to calving season in Mexicoli, Lower California. Coban. J. Agricul. Sci., 32: 19-24.
13. Dunn, T.G. and G.E. Moss, 1992. Effect of nutrient difficiences and excess on reproductive effeciency of livestock. J. Animal Sci., 70: 1580-1593.
14. Robinson, J.J., 1996. Nutrition and reproduction. J. Reproductive Sci., 42: 25-34.
15. Vagonis, A. and A. Travidas, 1975. Genetic polymorphism of blood components and its significance in cattle breeding. Gyr. Mosk. Tryriom. Darbi, 13: 53-66.
16. Mashorov, A.M., V. Deksin and K. Kaume, 1992. Immunogcnetic composition between the cattle of latvian brown breed and 86 other breeds. Latv. Akd. Vet. Dabazinat, 8: 59-61.
17. Shung, H.Y., H.K. Lee, K.J. Chen, C.H. You, K.D. Park and F.R. Chung, 1996. Studies on relationship between biochemical polymorphism and production traits in dairy cattle. Korean J. Dairy Sci.., 18: 7-16.
18. Glazko, V.T., S.D. Kirilenke and A.A. Sozinov, 1997. Interlocus association of some genetic biochemical systems in cattle. Genetika (Moskva), 33: 512-517.
19. Giblett, E.R., C.C. Hiekmann and O. Smithies, 1959. Serum Trasnferrin. Nature, 183: 1581.
20. Merkoreva, E.K., 1977. Genetic Base of Animal Selection. Moskva, Kolos, pp: 235.
21. Ryaboval, L.A., 1996. Milk productivity and immunogcnetic characteristics of kholmogry X Holstein hybrid raved in komi Rebuplic. Russ. Agric. Sic., 10: 19-21.
22. Luojun, H. and W. Shuanghe, 1996. Genetic effects of milk protein loci on first lactation traits. Zootechnica Sinica, 27: 308-314.
23. Michalak, B.W., 1995. Genetic and production aspects of cow milk protein polymorphism. Biuletyn informacyiny instytut Zootechniki, 33: 5-18.
24. Szwaczkowski, T. and H. Czeiusniak, 1994. Genetic and phenotypic relationship between age at 1st calving and milk traits of black and white cattle. World Rev. Anim. Produc., 29: 13-17.
25. Vlloa-Arvizu, R., A. Gayosso-Vazquez, M. Ramos-Kuri, F.J. Esttada, M. Montano and T.R.A. Aonso, 2008. Genetic analysis of Mexican criollo cattle population. J. Animal Breeding and Genetics, 125: 351-359.
26. Ben Jemaa, S., S. Fritz, F. Guillaume, T. Druet, C. Denis, A. Eggen and M.Gautier, 2008. Detection of quantitative trait loci affecting non-return rate in french dairy cattle. J. Animal Breeding and Genetics, 125: 280-288.
27. Malik, Z.S., B. Singh, S.S. Dhaka and S.K. Chhikara, 1996. Genetic and non-genetic factors influencing lactation milk yield in crossbred dairy cattle. Indian J. Anim. Res., 30: 61-64.
28. Gaur, G.K. and A.K.L. Rahej, 1996. Variation in genetic and phenotypic relationship in three parities of sahiwal cows for some economic traits. Indian J. Animal Res., 30: 137-138.
29. Hegazy, M., S. Essawi and A.H. Youssief, 1997. Relationship between body condition, milk yield and reproductive performance of dairy cows. Vet. Med. J. Giza, 45: 147-154.

30. Dedov, M.D., V.L. Seltsov and N.V. Sivkin, 1996. Selection in dairy cattle. Zootekhniyn, 5: 2-4.
31. Heydarpour, M., L.R. Schaeffer and M.H. Yazdi, 2008. Influence of population structure on estimat of direct and maternal parameters. J. Anim. Breeding Genetics, 125: 89-99.
32. Holmberg, M., G. Sahana and L. Andersson-Eklumd, 2007. Fine mapping of a quantitative tratits locus on chromosone 9 affecting non-return rate in swedish dairy cattle. J. Anim. Breed. Genetics, 124: 275-263.
33. Afolaxan, R.A., N.M. Fogarty, A.R. Gilmour, V.M. Ingham, G.M. Gaunt and L.J. Cummins, 2008. Reproductive performance and genetic parameters in first cross ewes from different maternal genotypes. J. Animal Sci., 86: 804-814.