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Analyzing the Immunogenetic Constituents of Dams, Sires and Calves in Relation to Placental Retention in a Friesian Herd

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Abstract: The current study was carried out on a Friesian herd in Egypt to find out the possible association between immunogenetic constituents of dam, sire as well as calf and the occurrence of placental retention.Late pregnant cows were followed up till calving and the dropping of placenta was recorded. Blood samples were collected from cows, sires used for breeding and offsprings. Blood groups were detected using an iterative allocation procedure. Serum proteins electrophoresis was carried out using polyacrylamide gel. Frequencies of serum protein loci were estimated by direct gene counting and results were recorded in relation to the dropping of placenta. Results indicated that the most frequent alleles of blood groups in calves born after normal calving are BGKO$_g$A'0', while I_2, E_3',I' and E_1' alleles predominated in calves of dams suffering from placental retention. Moreover, blood groups analysis showed that 2 out of 10 calves were in misidentification of their genotypes. Blood serum protein polymorphism revealed that the most frequent genotypes of calves born to dams having normally dropped and retained placenta are $A1^A$, Pal^A and Hb^B and $F\alpha2^A$, Tf^D and Ptf^B, respectively.It was concluded that selection programs should put in consideration the genetic constituents of both dam and sire for breeding purposes.

Key words: Friesian · Blood groups · Protein polymorphism · Calving · Retention of placenta · Alleles · Misidentification of genotypes

INTRODUCTION

Analysis of biochemical and blood type polymorphisms has been undertaken to evaluate both productive and reproductive efficiencies of dairy cattle[1-6]. For breeding purposes, it is important to know how pedigree errors influence the precision of progeny tests and diminish the selection response. Moreover, in dairy cattle breeding, progeny tests are of central importance. The precision of these tests depends upon the number of off springs per sire, heritability of trait and the fraction of incorrectly identified individuals. These breeding values could be measured by means of blood grouping [7, 8].

Blood grouping is used not only for detection of misidentification of daughters to sires, but also of daughter to dam and can exclude errors in estimating breeding values and heritabilities [9]. Analysis of genetic variations at the red cell antigen could potentially used to evaluate temporal changes in genetic diversity. To confirm this theory, [1] used blood groups to evaluate the reproductive efficiency of North European cattle and they found that the blood group M has gained new genetic alleles associated with high ovulation rate and maintaining of gestation through gene flow. On the other hand [10] found that Z blood antigen is associated with reduced fertility, mainly due to high early embryonic mortalities.

Concerning polymorphism of blood protein loci in relation to reproductive performance, Horne *et al.* [11] reported the responsibility of MUC1 gene for embryo implantation. Also, Amin *et al.* [12] and Sahana *et al.* [13] used h2 equation to evaluate some reproductive disorders in cattle including abortion and retained placenta and they reported that calving difficulty tends to decrease with lactation numbers.

Analysis of the breeding records of 837 calvings in a Friesian herd in Egypt indicated that 65.36% of calvings was associated with problems including mastitis, inactive ovaries, retained placenta, laminitis and endometritis [4].

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Moreover, in the same herd, it was previously reported that retention of fetal membranes was associated with predominance of $F\alpha 2^{A}$ and Tf^{D} gene markers in the homozygotic status [14]. Therefore, the present study was undertaken to find out the possible association between the immunogenetic constituents of parents as well as offspring and the occurrence of placental retention in this herd.

MATERIALS AND METHODS

The present investigation was carried out on a herd of Friesian cows reared at lower Egypt.

Experimental Animals: Cows were kept under the routine managemental conditions as outlined by Ahmed *et al.* [4]. Pregnant cows were separated in a special pen during the last month of gestation and were followed up till calving and the occurrence of the next conception. Calving status was recorded as well as the time of placental droppage.

Blood Samples: Two types of blood samples were collected from calves (n = 10), dams (n = 10) and sires used for mating (n = 4). Four of these calves, were born to dams with normal dropped placenta (2-6 hrs post calving) and 6 calves were born to dams with retained placenta (>12 hrs post calving). Heparenized blood samples were used for detection of blood groups and hemoglobin while, the non heparenized samples were used for separation of serum.

Serum Protein Electrophoresis: Serum protein electrophoresis was done using polyacrylamid gel (PAGE) as outlined by Laemmali [15].

Genetic Constitution: Allele frequencies at the dominant loci (antigenic factors) within blood groups were detected using an iterative allocation procedure [16] which gives maximum likelihood estimates of frequencies. B blood group system has been used as a symbol of highly polymorphic bovine blood group as it contained more than 40 antigens [17].

Codominant loci (serum proteins), Al, Pal, Hb, Am, Tf and Ptf frequencies were estimated by direct gene counting according to Hardi-Weinberg low [17].

Results were tabulated for comparison between the genetic constitutions of calves born to dams with normal dropped or retained placenta.

RESULTS

Table 1 represents the genetic constitution of B blood groups system in relation to the calving status of the Friesian herd under investigation. It is noticed that the genotype of dams is formed from a combination of 4 to 7 alleles, while the genotype of sires ranged between 1 and 6 alleles. It is clear that the most frequent alleles in calves born to dams that dropped their placenta normally (2-6 hrs postpartum), are BGKOxA'O', while, I_2, E'_3, I' and E'_1 alleles predominated in calves born to dams that retained their placenta for > 12 hrs pot calving. Moreover, from studying the genotypes of calves, it is observed that from 10 matings, 8 are in suitable genetic combination, while, 2 calves number 1 and 4 are in misidentification of their genotypes which means that these calves gain their parental genotype from other sires (misidentification of daughter to sires 0.2%)

Concerning blood protein polymorphism, it has been shown (Table 2) that the 7 blood protein included in this study are polymorphic. The most frequent genotypes of calves following normal calving and retention of placenta are Al^{A}, Pal^{A} and Hb^{B} and $Fa2^{A}$, Tf^{D} and Ptf^{B}, respectively. Moreover, from parentage test point of view, there is no misidentification between daughter/sire or daughter/dam.

Table 1: Genetic polymorphism of B blood group alleles in relation to occurrence of retained placenta in a Friesian herd in Egypt

Calf	Dam genotype	Sire genotype	Calf genotype	Placental dropping
1	$BGO_XY_2A'O'$	I'	BGKOA'O' *	Normal
2	$GO_XY_2A'O'$	I'	Y_2I'	Normal
3	$BGO_XY_2A'O'$	PI'	$BGKO_xY_2A'I'O'$	Normal
4	$BGO_XY_2A'O'$	I_2	$BGKO_xY_2O'$ *	Normal
5	$BGO_XY_2A'O'$	$OxY_2D'E'1F'O'$	$BGKO_xY_2A'D'O'$	Retained
6	$BGO_XY_2A'O'$	E'_3H_3	$BGKO_xE'_3O'H_3$	Retained
7	$BO_3Y_2AE'_3G'P'$	E'_3H_3	$Y_2E'_3G'$	Retained
8	$BO_3Y_2AE'_3G'P'$	$I_1QE'_1I'$	$O_3QA'E_1'$	Retained
9	$I_1QE'_1I'$	I_2	I_2I'	Retained
10	$I_1OJ'K'O'$	I_2	$I_2OJ'K'O$	Retained

* Misidentification of parentage (daughter to sire)

Table 2: Genetic polymorphism of 7 blood protein loci and their allele frequencies in relation to occurrence of retained placenta in a Friesian herd in Egypt

Bood protein loci	Dam genotype	(%)*	Sire genotype	(%)	Calf genotyp	(%)	Alleles	Allele frequencies Normal	Retained
Al	AA/AB	85	AA/AA	84	AA/AA	91	Al^A	0.753	0.477
							Al^B	0.246	0.532
Pal	AA/AB	90	AA/AB	89	AA/AA	90	Pal^A	0.825	0.518
							Pal^B	0.175	0.481
$F\alpha_2$	AC/AC	87	AC/AC	83	AA/AA	82	$F\alpha_2^A$	0.554	0.718
							$F\alpha_2^c$	0.445	0.282
Hb	AB/BB	83	AB/BB	82	BB/BB	82	Hb^A	0.258	0.611
							Hb^B	0.742	0.389
Am	AB/BB	85	AB/BB	88	BB/BB	85	Am^A	0.317	0.453
							Am^B	0.682	0.546
Tf	AD/AD	89	AD/AD	81	DD/DD	87	Tf^A	0.432	0.285
							Tf^D	0.568	0.714
Ptf	AB/BB	88	AB/BB	90	BB/BB	88	Ptf^A	0.604	0.333
							Ptf^B	0.396	0.666

* % = The percent of given genotype in No of tested animals

DISCUSSION

Calving associated problems cause great economic losses, especially, in large herds and even after treatment due to long days open and calving intervals with a recorded genetic predisposition [4]. In this investigation, the possible association between genetic constitution of dam, sire as well as offspring and the occurrence of calving associated problems, mainly placental retention was concerned.

The present results revealed that B blood group system as well as blood protein loci of all calves are polymorphic with allele frequencies < 0.95. These findings coincide with those reported by Kantanen *et al.* [1]. Moreover, the presence of BGK alleles as a complex unit confirm the finding of Kantanen *et al.* [1] and Grosshans [18]. A polymorphic condition is the existence of two or more alleles of a gene in a population. Natural selection acts to promote some alleles and to inhibit others, depending upon the breeding system and management circumstances, however, many variations may be equivalent or natural and thus not subject for selection pressure [19]. Moreover, the bovine erythrocyte antigen (Dominant loci) and blood protein systems (Co dominant loci) are usually assumed to be neutral. Thus, far association of production, viability and fertility traits with blood groups and blood protein polymorphisms have been studied [5, 20, 21].

In this study, the most frequent alleles that associated with normal calving are $BGKO_xA'O'$. Similar result have been reported by Grosshans *et al.* [18] and Zaabal [22]. On the other hand, I_2, E'_3, I' and E'_1 alleles were observed in calves born to dams suffering from placental retention. In this respect, Zaabal *et al.* [23] in goats and Horne *et al.* [11] in cattle found that the presence of I or E alleles separately or in combination is responsible for the occurrence of birth problems and dystocia.

Concerning blood protein polymorphism; previous studies confirmed the existence of significant relationship between reproductive disorders in general and some blood protein loci such as $F\alpha2^A$ and Tf^D [22, 24-26]. In the same time, the present genetic constitutions of calves born to dams normally dropped their placenta, which are characterized by the predominance of $A1^A$, Pal^A and Hb^B alleles, are in agreement with those reported by Zaabal *et al.* [27] in Egyptian Friesian cows, especially for $A1^A$, Pal^A loci. On the other hand, the prevalence of $F\alpha2^A$, Tf^D and Ptf^B alleles in calves born to dams retained their placenta for > 12 hrs are coiincide with the findings of Siratsky et al. [28], especially for Tf^D locus.

The relationship between polymorphic genetic loci and retained placenta could be attributed to pleiotropic effects of variation at the marker locus or to linkage disequilibrium between the marker locus and one or more genes influencing the last stage of pregnancy [29, 30]. On the other hand, there is a growing evidence that a given allele correlates with one or more physiological regulators such as metabolites, hormones and enzymes which may cause delayed placental droppage [31, 32]. Another explanation related this condition to combination between

estrogen receptors gene and its influence on fetal size [33]. However, this phenomenon still needs further research that will help to define the actual mechanism of genes involved in the pathophysiology of reproductive disorders [31].

In the present study the parentage test revealed misidentification (of daughter to sires) of 2 out of the 10 calves, despite this observation was not detected by analysis of blood protein polymorphism. The condition may be attributed to fraction of incorrectly identified individuals [7, 9]. Moreover, it has been reported that the usage of dominant alleles is more accurate than the co dominant alleles, whereas the former alleles are individually inherited, while the later inherited in a mixed manner [8].

Concerning to reproductive disorders, Guillaume *et al.* [34] found that two QTL affecting female fartility were mapped affects early fertility SLC35A3 which causes complex vertabral malformation excluded this gene from the QTL intervel on chromosome 7 a QTL was almost significant for non- return rate at 282 dayes. This QTL was associated with abortion and stillbirth problems. On the other hand, [35] reported that POU1F1 gene is associated with economically important traits specially milk yeild and productive life.

It could be concluded that placental retention in large dairy herds could be reduced by selecting both dams and sires with genetic constitution free from I and E blood antigens as well as $F\alpha 2^{A}$, Tf^{D} and Ptf^{D} blood protein loci.

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