

Associations Between Marker Gene Alleles and Doe Traits in Nubian (Zaraibi) Goats in Egypt

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Abstract: Plasma proteins of Nubian goat does' blood were examined for biochemical polymorphism of Immunoglobulin M (IgM), Immunoglobulin G (IgG), Immunoglobulin P (IgP), Albumin (A), 1-Antitrypsin (Ant.T), Carbonic Anhydrase Erythrocytes (C.An.Er), Trypsinogen Pancreas (T.P) and Trypsin Inhibitor (Tr.I) by using one-dimensional sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE), with high molecular weight protein standards as reference bands. Analysis of the results revealed the existence of association between reproductive traits of homozygous Nubian doe genotypes and marker gene alleles. The lowest values of age at first kidding was associated with the allele C^b of C.An.Er marker gene, abortion in does with the allele P^c of IgP and mortality rate with the allele P^b of IgP. The results also showed that the highest values of each of litter size and litter weight at birth and at weaning were associated with the allele I^a of Tr.I marker gene and those of kilograms of kids produced/life time of doe at birth and at weaning (the latter parameter, i.e., kilograms of kids produced/life time of doe at weaning shows the final output of the traits: prolificacy, milk yield and pre-weaning mortality) with the allele A^a of A marker gene. Effects of the mentioned marker genes on the studied traits were found to be, in general, significant (P<0.01 or 0.05). Such positive results may suggest that marker-assisted selection could be carried out at a very early age on marker genotypes for improvement of Nubian goat traits, since such marker genotypes could be scored at very early ages.

Key words: Nubian (Zaraibi) goats, marker gene alleles, doe traits.

Goats are potential sources of meat and milk in the developing countries. The Egyptian Nubian (Zaraibi) goats received less attention, although they have special importance, in this respect. The Nubian breed is one of the ancestors of the Anglo-Nubian breed. Significant genetic gains in the improvement of the economic traits in livestock could be acquired by marker-assisted selection (Soller and Beckmann, 1983; Smith and Simpson, 1986). In the present study, an attempt was made to focus

on only few marker genes, possibly having effects that account for a significant part of the genetic variation in reproductive traits of Nubian (Zaraibi) does.

Materials and Methods

The study was carried out on a Nubian goat flock of 217 does, established in 1982 in El-Serw Experimental Station (30°N), Institute of Animal Production Research, Ministry of Agriculture, Egypt. The does were aged 1.3 years to more than 6 years

and weighed from 27 to 40 kg. The bucks were aged 2-3 years and weighed 32-50 kg. Off type animals were culled from the flock. The does were divided into high and low groups according to kilograms of kids produced/life time of does at weaning (that equals the output of the traits: prolificacy, milk yield and pre-weaning mortality). Blood samples were collected from 12 animals of each of the types in the first group and of the lowest values in the second group to study the serum protein polymorphism. The recorded traits of each group were calculated. The traits were: age at first mating, abortion, mortality rate, litter size and weight at birth and at weaning and kilograms produced/life time of does at birth and at weaning.

Animals were kept under feeding, adopted by Institute of Animal Research. Green Egyptian clover (berseem; *Trifolium alexandrinum*) plus pelleted concentrates mixture were offered during winter (December-February) and spring (March-May). During summer, the animals were fed on clover hay plus the same pelleted concentrates mixture. Each kilogram of concentrates mixture consisted of 200 g cottonseed cake, 200 g maize, 495 g wheat bran, 45 g rice bran, 20 g calcium carbonate, 10 g salt and 30 g molasses. Concentrates mixture was offered in two equal amounts in morning (8.00 h) and afternoon (15.00 h) and clover or clover hay was offered after concentrates. The animals were allowed to drink water for about two hours after feeding, three times daily. The kids suckled all time during the first 10 weeks of their age and between 7.00 and 16.00 h daily up to weaning at 12 weeks of age. During the period between 10 weeks

and weaning at 12 weeks of age, the kids were supplied with Starter 1 in addition to green clover or hay. Each kilogram of Starter 1 consisted of 320 g yellow maize, 200 g barley, 200 g decorticated cottonseed meal, 200 g linseed meal, 50 g wheat bran and 30 g mineral mixture. During the period of 12 to 24 weeks of age, the kids were supplied with green clover or hay plus Starter 2, of which each kilogram contained 320 g yellow maize, 300 g barley, 250 g soybean meal, 100 g wheat bran, 20 g mineral mixture and 10 g salt.

Nubian does were mated once during the year. However, the flock was divided into two groups. Mating began at first of June in one group and at first of September in the second group. The duration of each mating period was 45 days. The doe which did not conceive during any mating period were mated in the next mating period. In each period, hand mating was followed and the does/buck ratio was 20-30:1. The flock was housed in semi-open sheds. After parturition, kids were kept with their dams all the time during the first 10 weeks between 7 and 16.00 h up to 12 weeks of age.

Blood samples were collected from the chosen animals by jugular vein puncture. Blood plasma was prepared by centrifugation (3000 rpm for 10 minutes), then collected in coded sterilized screw cap glass vials and stored in deep-freeze at -20°C until used for electrophoresis analysis. Electrophoresis was performed in a BIO-RAD Co. model 3000XI vertical slab gel apparatus containing two gels.

Plasma proteins of Nubian does blood samples were examined for biochemical polymorphism of Immunoglobulin M (IgM;

Table 1. Associations between reproductive traits of Nubian doe homozygous genotypes and the marker gene alleles studied

Traits	Overall means± S.E	Trait levels	Doe traits (Means± S.E)	Marker genes	Site		Alleles	Homozygous genotypes
					F-ratio	D.F.		
Age at first kidding	691.4±24.3	H	856.0±50.8	IgP ⁽¹⁾	7.33**	2	P ^b	P ^b P ^b
		L	591.4±9.5	C.An.Er ⁽²⁾	21.44*	3	C ^b	C ^b C ^b
Abortion	1.4±0.4	H	2.5±0.2	C.An.Er ⁽²⁾	7.67*	3	C ^a	C ^a C ^a
		L	0.2± 0.5	IgP ⁽¹⁾	11.67*	2	P ^c	P ^c P ^c
Mortality rate	26.8±5.7	H	45.5±6.1	IgP ⁽¹⁾	0.49*	2	P ^c	P ^c P ^c
		L	9.7± 14.8	IgP ⁽¹⁾	0.49*	2	P ^b	P ^b P ^b
Litter size at birth	2.9±0.3	H	3.0±0.3	Tr.I ⁽³⁾	36.40**	1	I ^a	I ^a I ^a
		L	2.0±0.4	Ant.T ⁽⁴⁾	1.21 NS*	1	E ^a	E ^a E ^a
Litter size at weaning	2.3±0.2	H	3.0±0.25	Tr.I ⁽³⁾	28.3**	1	I ^a	I ^a I ^a
		L	1.9±0.1	C.An.Er ⁽²⁾	1.34 NS	1	C ^a	C ^a C ^a
Litter weight at birth	4.9±0.4	H	5.9±0.2	Tr.I ⁽³⁾	12.42**	1	I ^a	I ^a I ^a
		L	4.0±1.0	C.An.Er ⁽²⁾	1.16 NS	3	C ^c	C ^c C ^c
Litter weight at weaning	25.3±2.3	H	32.9±1.6	Tr.I ⁽³⁾	22.72**	1	I ^a	I ^a I ^a
		L	20.6± 0.9	C.An.Er ⁽²⁾	1.77 NS	3	C ^a	C ^a C ^a
Kilograms produced/ doe at birth	19.8±2.0	H	31.0± 3.5	A ⁽⁵⁾	22.95**	1	A ^a	A ^a A ^a
		L	5.5±3.7	C.An.Er ⁽²⁾	16.74NS	3	C ^c	C ^c C ^c
Kilograms produced/doe at weaning @	83.7±8.2	H	149.7±13.9	A ⁽⁵⁾	44.85**	1	A ^a	A ^a A ^a
		L	21.0±16.3	Ant.T ⁽⁴⁾	59.64**	2	E ^b	E ^b E ^b

Means with different superscripts within each trait, differ significantly (P). ** P and * P and NS = Not significant.

(1) = Immunoglobulin P (97400), (2) = Carbonic Anhydrase Erythrocytes (29000), (3) = Trypsin Inhibitor (20000), (4) = 1 - Antitrypsin (45000), (5) = Albumin (66000), H = Highest value and L = Lowest value.

ds produced/life time of doe at weaning shows the final output of the traits: prolificacy, milk yield and pre-weaning mortality.

205000), Immunoglobulin G (IgG; 116000), Immunoglobulin P (IgP; 97400), Albumin (A; 66000), 1-Antitrypsin (Ant.T; 45000), Carbonic Anhydrase Erythrocytes (C.An.Er; 29000), Trypsinogen Pancreas (T.P; 24000) and Trypsin Inhibitor (Tr.I; 20000). Proteins were separated on the basis of their molecular weights by using one-dimensional- polyacrylamide gradient slab gel electrophoresis (PAGE) in the presence of sodium dodecyl sulfate (SDS) with protein-high molecular weight standards as reference bands. The discontinuous buffer system of the high resolution of one-dimensional SDS-PAGE was used to fractionate the proteins as described by Laemmli (1970) and Ramunno *et al.* (2000).

The data were analyzed statistically using General Linear Model Procedures (SAS 1996). The mathematical model used for each trait separately, was as follows:

$$T_{ij} = \mu + M_i + e_{ij}, \text{ where:}$$

T_{ij} = an observation of any trait,
 μ = overall mean of the genotype,
 M_i = effect due to the i th marker gene and
 e_{ijk} = residual effect.

Results and Discussion

Least square means of homozygous genotypes of Nubian doe reproductive traits, associated with each of the marker genes studied, are shown in Table 1. Association between the marker genes and the studied reproductive traits of homozygous genotypes was studied for each trait with each marker gene separately. The studies on polymorphism of the studied marker genes (Table 1) revealed significant ($P < 0.01$ or 0.05) relationships between some of their allelic variants and some doe traits. This indicates

a direct influence or the presence of high degree of association between polymorphisms at the known loci and the quantitative traits studied.

Carbonic Anhydrase Erythrocyte allele C^b was found to be significantly ($P < 0.05$) associated with the shortest age at first kidding. The Trypsin Inhibitor allele I^a was significantly ($P < 0.01$) associated with the highest values of each of litter size and litter weight at birth and at weaning. The Albumin allele A^a was significantly ($P < 0.01$) associated with the highest estimates of each kilogram of the kids produced/life time of doe at birth and at weaning. The allele P^c of IgP marker gene was associated ($P < 0.05$) with the lowest abortion percentage.

On the other side, the Immunoglobulin P allele P^b was found to be associated significantly with the highest age at first kidding ($P < 0.05$) and the lowest mortality rate ($P < 0.05$). The P^c of the same marker gene was associated with the highest mortality rate. The $\alpha 1$ - Antitrypsin allele $E\alpha$ was associated with the lowest litter size at birth and E^b of the same marker gene was associated with the lowest kilograms of kids produced/life time of doe at weaning ($P < 0.01$). The carbonic Anhydrase Erythrocyte allele Ca was associated with the highest abortion ($P < 0.05$) and lowest of each of litter size and weight at weaning. The allele Cc of the same marker gene was associated with the lowest of each of litter weight at birth and kilograms of kids produced/life time of doe at birth. The significant ($P < 0.01$ or 0.05) positive effects of some of the marker genes on the traits studied suggest that marker-assisted selection (Dekkers and Dentine, 1991) could be carried out at a very early age on marker genotypes

for improvement of Nubian goat traits. Such practice will save time, effort and costs. On the other hand, the IgM, IgG and T.P seemed to be unimportant marker genes in Nubian (Zaraibi) goat traits studied. Further studies on the same breed on higher numbers of animals in the different parts of the country need to be carried out.

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