A Cytogenetic Study on the Angora Breed of Goat (*Capra hircus*) Reared in Turkiye

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The Angora breed of goat plays an important role for the Turkiye's Native Animal genetic resources point of view; nevertheless, so far, no comprehensive cytogenetic investigation has been performed on this important economic breed. The present preliminary cytogenetic study has been conducted upon a sample of Angora goat breed reared in Turkiye in order to ascertain the basic chromosomal status of the breed and to start a cytogenetic screening at a population level. Blood cultures have been noted according to the conventional methods and synchronized with thymidine. Conventional and GTG-RBA-RBG-banded karyotypes have been produced to determine the relative length and centromeric index of the chromosomes of the breed. Banding comparison confirmed similarity of the Angora breed of goat with the established standardized RBA-RBG banding a pattern of the goat species. Further cytogenetic studies should now be addressed at a population level to identify carriers of numerical and/or structural chromosomal abnormalities in the Angora breed population for implementation of its productive and reproductive efficiency.

Key Words: Angora goats, cytogenetic, karyotype

Türkiye'de Yetiştirilen Ankara Keçisi (*Capra hircus*) Irkında Bir Sitogenetik Çalışma

Ankara Keçi ırkı Türkiye yerli hayvan genetik kaynakları acısından önemli rol oynamasına karşın bu ırkla ilgili kapsamlı bir sitogenetik çalışmaya rastlanmamıştır. Sunulan ön sitogenetik çalışma ırkın temel kromozomal yapısını araştırmak ve populasyon düzeyinde sitogenetik çalışmalara başlangıç yapmayı amaçlamaktadır. Kan kültürleri hem geleneksel metoda göre ve hem de Timidin metoduna göre düzenlenmiştir. Geleneksel ve GTG-RBA-RBG band karyotipleri elde edilerek ırkın kromozomlarının sentromer indeksleri belirlenmiştir. Band modeli karşılaştırmaları Ankara keçi ırkının keçi türü için standardize edilmiş RBA-RBG band modeli ile benzerliğini doğrulamıştır. Bu çalışma sonucunda Ankara keçisi ırkında populasyon düzeyinde sayısal ve yapısal kromozom anomalilerinin taşıyıcılarının tanımlanması, ırkın verim özeliklerinin geliştirilmesinde daha ileri düzeyde sitogenetik çalışmalara ihtiyaç duyulduğu değerlendirilmiştir.

Anahtar Kelimeler: Ankara keçisi, sitogenetik, karyotip

Introduction

The Angora goat breed represents a remarkable source in Turkiye's Native Animal genetic resources point of view, mainly due to his valuable fibber (Mohair). The main regions in which this breed is raised are Middle Anatolian Region (especially Ankara), Siirt, Mardin and Bitlis. Average Mohair production is 2,8 Kg/year (Soysal M.I., 2007) and about Major gross income for Angora Goat breeders

generally comes from the sale of Mohair in Past.

The knowledge of the chromosomal pattern and arrangement and their effects on economic traits is helpful in planning animal breeding strategies. Investigations on the chromosomal profile in livestock provide a useful tool to evaluate the reproductive health and fertility status of the breeding animals even at an early age (Basumatary, 2003). Chromosomal abnormalities, actually, account for a substantial loss in animal production (Yadav, 1996); these economic losses are more severe in seasonal species like the goat, for instance, for which reproduction failures can mean the shift of the pregnancy to the next mating season. Cytogenetic screening of species and breed is also important in Animal genetic resources conservation and management. In 'in situ' conservation programs it is of fundamental importance, on account of the small number of available subjects, to identify and prevent from breeding those subjects that carry a chromosomal abnormality. For the same reasons, in 'exsitu' programs, it is important to check that the cryopreserved material (cells, sperms, oocytes and embryos) belongs to animals that show a normal karyotype. In this way the cryopreserved materials could be used in the future to build up the breed or to shift into the future the reproductive capacity of the animals.

Despite its cultural and economical importance, no efforts have been done up to now, to our knowledge, to cytogenetically characterize this breed of goat. To correctly set up a cytogenetic screening program it's -first of all- necessary to ascertain the basic karyotype of the breed, in order to assess if there are differences with the standard karyotype of the species. Cytogenetic analysis of the goat has been previously reported by various authors on several breeds (Burguete et al., 1987; Di Berardino et al., 1987; Iannuzzi et al., 1996; Di Berardino and Burguete, 1998) but no information is available on the Angora goat breed reared in Turkiye. The aim of the present study was thus to conduct a preliminary cytogenetic survey for the Angora goat breed reared in Turkiye in order to check the agreement with the standard karyotype for the species (ISCNDB, 2001) and to verify the technical possibilities for starting a cytogenetic screening program for this breed.

Material and Methods

Peripheral blood samples were obtained from 2 males and 2 females reared at the Yagmurdere village of The Ayas district of Ankara province. The lymphocyte cultures were prepared according to the standard cytogenetic techniques. Briefly, 1 ml of heparinized venous blood was cultured in 9 ml of RPMI 1640 medium (Dutch modification), enriched with 0,1 ml of L-glutamine, 20 % fetal bovine serum (FBS), 10 µl of antimycotic and antibiotic, 10 µl of sodium heparin, 50 µl of Concanavalin A (0.15 mg/ml, Sigma) as mitogen, and incubated for 48 hours at 37.5°C. Cells were synchronized by adding thymidine excess (0.3 mg/ml, final concentration) for 18 hours. The S-phase block was relased by washing the cultures in fresh RPMI medium. The cells were then recultured in growth medium of the same composition as described above, in presence of BrdU (Sigma, 20 µg/ml, final concentration) and Hoechst 33258 (Sigma, 20 µg/ml, final concentration) to induce R-banding, for additional six hours. Colcemid (Sigma) was added to a final concentration of 1.0 µg/ml 40 minutes before harvest. Cells were hypotonized in KCl (0.075 M) for 25 minutes, fixed in Carnoy's fixative (methanol-acetic acid, 3:1) three times, and the suspension of cells was dropped onto clean microscopic slides. For RBA-banding slides were stained with acridine orange (0.01% in P-buffer, pH 7.0) for 5 minutes. For RBG-banding slides were stained with Hoechst 33258 (25 µg/ml) and exposed to UV light for 30 minutes, washed with water and stained with Giemsa (3% in distilled water) for 5 minutes. For each animal 3 karyotypes were prepared with a different degree of chromosome contraction. A sequential 'Conventional+GTG-banding' technique was applied to the male slides in order to calculate the relative length (RL) of individual chromosomes, which has been determined as the ratio between the length of the chromosome upon the total chromosome length of the haploid karyotype. For the X-Y sex chromosomes also the centromerix index (CI) was calculated as the ratio between the lenght of the short arm upon the total

chromosome lenght. Measurements were made using the software Leica CW4000.

Results

Figure 1 shows a female metaphase plate of the Angora goat (a) and the conventional karyotype (b) arranged from the plate shown in (a) . The karyotype analysis of the Angora goat revealed, as expected, a diploid (2n) chromosome number of 60 in all complete metaphases examined. Figures 2 and 3 show, respectively, the RBA- and RBG-banded karyotypes of a male and female individuals, arranged according to the ISCNDB (2001) lines. The karyotypes of the animals investigated resulted chromosomally normal and thus the sample used in the present study has to be considered useful for the purposes of this investigation. Detailed comparison between the present karyotypes with those previously reported for this species (Di Berardino and Burguete, 1998; ISCNDB, 2001), did not reveal any significant structural difference in the banding pattern of individual chromosomes. All the 29 autosomes were acrocentrics and the RL of individual chromosomes varied from 6.18 of chrom. 1 to 1.74 of chrom. 29, whereas the RL and CI of the X and Y chromosomes were, respectively, 5.30 and 1.08, and 0.10 and 0.45 respectively (Table 1). These values are in agreement with those previously reported for the species, thus confirming that the investigated animals did not differ from the standard of the species.

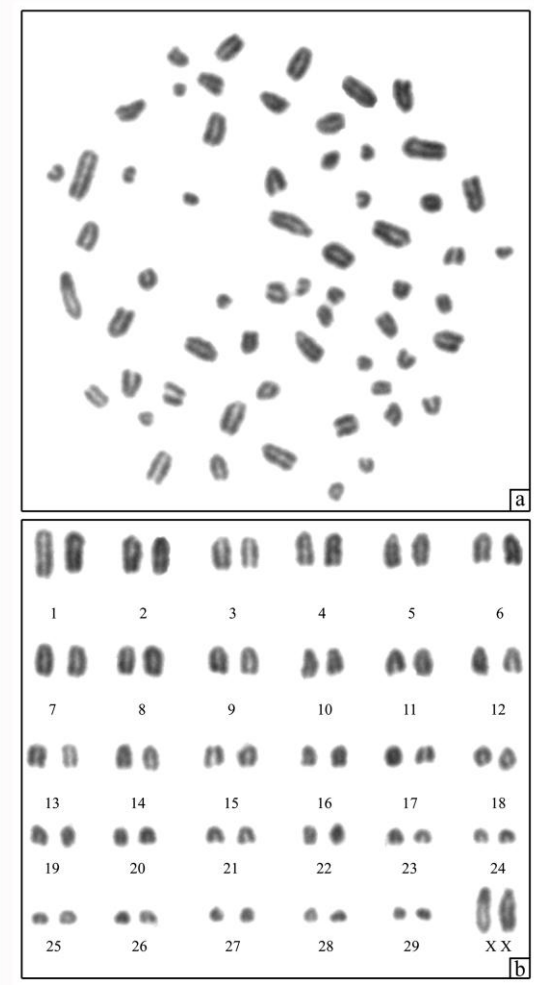

Figure 1. (a) Metaphase plate of a female Angora goat; (b) conventional karyotype from the plate shown in (a).

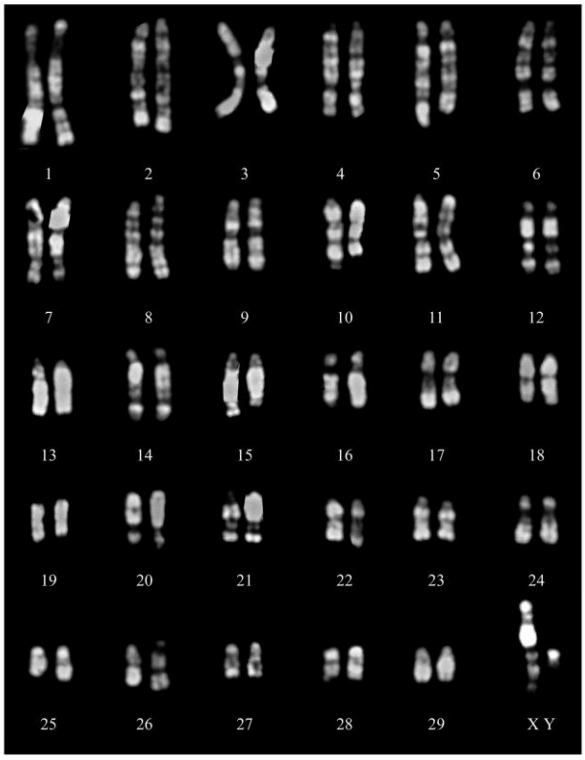

Figure 2 RBA-banded prometaphase karyotype of a male Angora goat

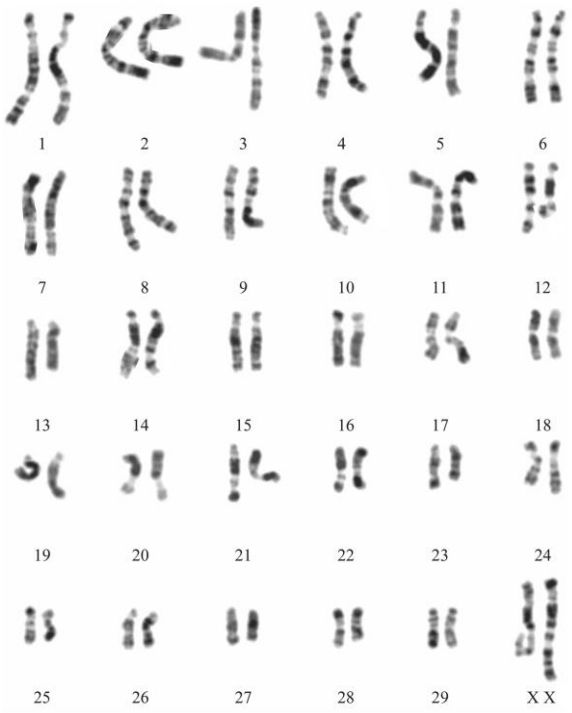

Figure 3. RBG-banded prometaphase karyotype of a female Angora goat. Active (right) and inactive (left) X-chromosomes are clearly shown in the karyotype.

Discussion

Chromosomal abnormalities, either numerical or structural, are known to have a negative impact upon fertility and reproductive efficiency in livestock. Since the discovery of the Robertsonian translocation 1/29 in the Swedish Red and White cattle (Gustavsson and Rockborn, 1964) and its deleterios effects on fertility (Gustavsson, 1979), chromosomal abnormalities have been recognized as one of the major sources of embrionic mortality, giving rise to genetically unbalanced embryos (monosomic or trisomic) which do not survive implantation, thus increasing the abortivity rate, increasing the number of inseminations per conception, lengthening the calving interval, reducing the number of live borns per female per year (fertility).

While numerical abnormalities usually have a visible effect and can be readily eliminated from the herd, the structural abnormalities do not have visible effects, the carriers are phenotypically normal, escape observation and spread into the population, by establishing polymorphic systems and compromising the genetic improvement programs.

To avoid these negative effects, it is necessary to perform a 'genetic prophilaxy', by screening the population for identification of animals carriers of chromosomal abnormalities which, consequently, have to be eliminated..

In the present study we characterized -for the first time in this scale- the basic chromosomal make-up of the Angora breed of goat (*Capra hircus* L.) reared in Turkiye.

Although the chromosomal profile usually doesn't change among different breeds of the same species, some authors report the existence of 'interbreed chromosomal polymorphism' (Bhatia and Shanker, 1994; Stranzinger et al., 2007), especially for the sex chromosomes. Since the consequences of these chromosomal polymorphisms are detrimental for the reproductive and productive efficiency (fertility trait), it becomes fundamental to characterize the genetic resources of a given region, in order to avoid possible intermating with other breeds or genetic types that could lead to a reduction in fertility or to a loss of the ancient genetic combination.

Cytogenetic screening in the Angora breed of goat should be started and expanded upon a larger number of animals in order to identify animals' carriers of chromosomal abnormalities, to be eliminated from the herd, and to correctly plan future breeding strategies for conservation and implementation of this important genetic resource.

Table 1. Mean relative lenght for Angora goat chromosomes and centromeric index for sexual chromosomes.

Chrom.N.	R.L.	C.I.	Chrom.N.	R.L.	C.I.	Chrom.N.	R.L.	C.I.
1	6.18	-	12	3.60	-	23	2.21	-
2	4.97	-	13	3.23	-	24	2.06	-
3	4.80	-	14	3.07	-	25	2.04	-
4	4.61	-	15	2.94	-	26	2.02	-
5	4.88	-	16	2.86	-	27	1.85	-
6	4.44	-	17	2.81	-	28	1.81	-
7	4.33	-	18	2.76	-	29	1.74	-
8	4.06	-	19	2.56	-	X	5.30	0.10
9	3.86	-	20	2.52	-	Y	1.08	0.45
10	3.70	-	21	2.47	-			
11	3.71	-	22	2.40	-			

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