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ABERRANT KARYOTYPE OF AN EXPERIMENTAL RABBIT (ORYCTOLAGUS CUNICULUS, LINNAEUS, 1758) WITH A HETEROZYGOUS FIRST AUTOSOMAL PAIR

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Histological and cytogenetic analysis was applied to a male from a breeding stock of experimental rabbits (Oryctolagus cuniculus). The rabbit originated from the breeding farm of experimental animals at the Faculty of Veterinary Sciences in Ljubljana. It was 6 months old, and weighed 2.5 to 3 kg. Reduced fertility was evident from the small number of mated females which, conceived frequent premature termination of gravidity, and reduced vitality of offspiring.

The karyotype analysis showed an unusually large chromosome in the first pair of autosomes. It was assumed to arise as a consequence of the amplification of some chromosomal segments, possibly due to an increase in the concentration of food additives in the food consumed.

Reduced fertility was interpreted to be the consequence of impaired spermatogenesis, irregular chromosomal segregation during meiosis, and the production of imbalanced gametes.

Key words: karyotype, cytogenetic, chromosome, gamet

INTRODUCTION

Ever increasing pollution of the environment imposes the requirement for permanent monitoring, both in controlled and uncontrolled settings, aimed at timely detection of structural and numerical chromosomal aberrations that may potentially impair domestic animal reproduction.

The examination of animals from the breeding stock of a farm of experimental animals originating from the Faculty of Veterinary Sciences in Ljubljana revealed abnormalities in reproduction of a male laboratory rabbit with avital offspring and reduced conception in mated females.

The normal karyotype of the experimental rabbit contains 2n = 44 chromosomes and NF values of 80. Out of the diploid number of chromosomes, 34 autosomes are metacentric of submetacentric, 8 of them are acrocentric of telocentric, while the X and Y chromosomes are submetacentric (Melander 1956, Sarkar et al., 1962; Ray and Williams 1966).

A review of the literature shows the appearance of aberrations in the chromosomal complement of mamals (Dave et al., 1965; Ray and Williams 1966; Grop et al., 1971; Matthey 1972, 1973; White 1973 a, b,; Orlov 1974; Capanna et al., 1973, 1977; Capanna 1981; Gropp and Winking 1981; Gropp et al., 1982; Brooker 1982; Said 1986; Tichy and Vučak 1987; Winking et al., 1980; Stanimirović 1992).

These aberrations are primarily of the Robertson in type, predominantly in Rodentia. References that would indicate the existence of chromosomal aberrations such as inversion, deletion, etc., are scarce.

In this context, especially interesting are the findings of Bostock et al., (1979), Traut et al., (1984), Agulnik et al., (1988 and 1990), and Stanimirović (1992). They all demonstrate alterations in chromosome structure caused by insertions.

MATERIAL AND METHODS

The investigation included rabbits originating from a farm of experimental animals at the Faculty of Veterinary Sciences in Ljubljana. They were 6 months old and weighed from 2.5 to 3 kg.

Amogn the examined rabbits a male specimen was observed that, yielded a significantly lower number of offspring than other male rabbits the result as reduced conception in mated females and avitality of embryos of offspring. This was the reason for histological and cytogenetic analysis as an approach to clarify the basis for the observed abnormalities.

Material for the cytogenetic analysis was obtained according to the procedure of Hsu and Patton (1969). Chromosomes were stained in 596 Giemsa in phosphate buffered saline, at pH = 6.8, for 5 to 10 minutes.

RESULTS AND DISCUSSION

Histologic analysis demonstrated that the testicles were permeated with excessive connective and fat tissue with impaired spermatogenesis.

Cytogenetic analysis revealed a significant number of cells with abnormal structure, notably in the chromatid domain, rarely with isochromatid breakage. Chromatid breaks were always on different chromosomes at different sites. They were particularly frequent in larger autosomes and the X chromosome.

In 97.01% of the cytogenetically analyzed cells we detected the chromosomal set of 2n = 44, where the first set of autosomes exhibited heterozygosity in terms of chromosome size (Figure 1). One of the chromosomes from the first pair of autosomes was unusual dimensions (Figure 2). Based on literature data, we propose that the observed phenome-

non may be the consequence of DNA amplification caused by food additives in the diet consumed. This is in agreement with the findings of Bostock et al., (1979), Aglunik et al., (1988. 1990), and Stanimirović (1992).

Out of the total of 150 cells examined we detected 2 to 3 chromatid breaks in 12% of cases and isochromatid breaks in 4% of cases.

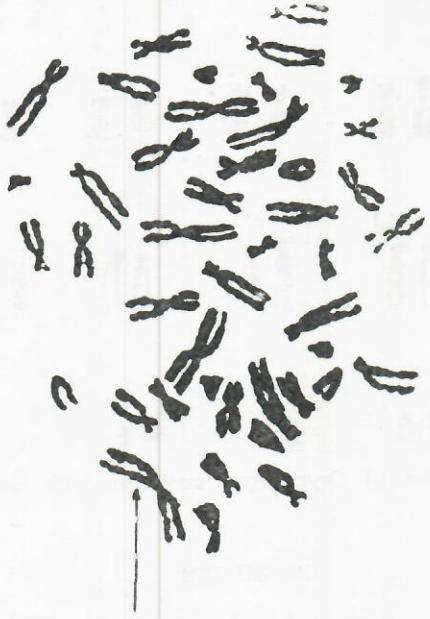

Figure 1. Aberrant karyotype of Oryctolagus cuniculus

Bostock et al., (1979) examined the influence of pesticides and some food additives on cultured cells and concluded that these chemical agents induce amplification of chromosome segments and even the appearance of out-of-chromosome structures.

Agulnik et al., (1990) examined a specimen of naturally occuring representatives of the species Mus musculus. They discovered one unusually large chromosome from the first pair of autosomes with two insertions, one in the 1C5 and one in the 1E region. These mice, also, had reduced reproductive capability as documented by increased mortality of offspring and reduced conception in mated females.

Reduced fertility of the examined animal was notable through frequent termination of gravidity and reduced viability of the offspring which can be interpreted as the consequences of irregular chromosomal segregation causing generation of imbalanced gamates. This is in agreement with the findings of Gropp at al., (1982); Adolph (1984); Nash et al., (1983); Ruvishij et al., (1986 a, b); Agulnik et al., (1990). The cited authors state that heterozygous individuals carry not only insertions but also other types of structural aberration and that in 85% of cases transmit their aberrant chromosome to their offspring.

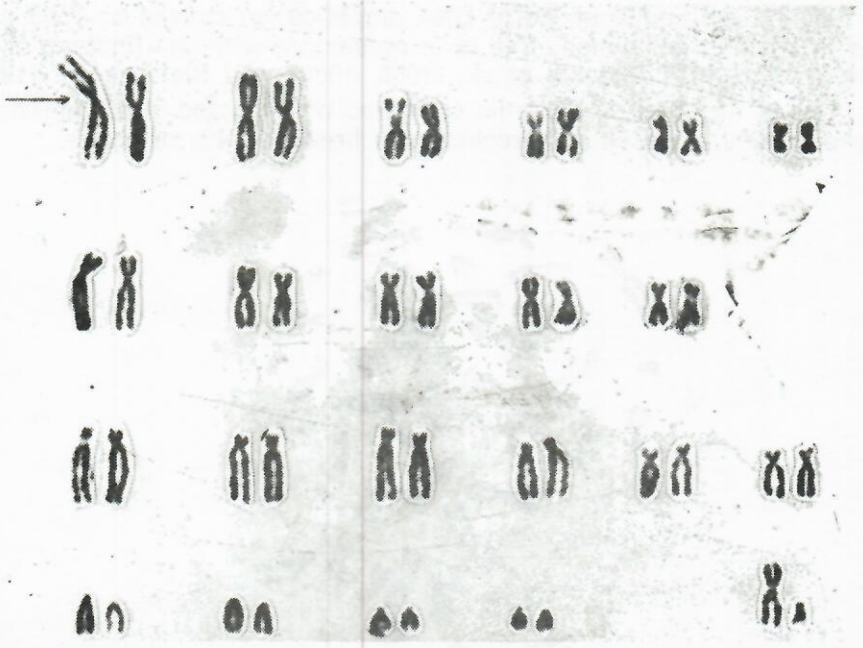

Figure 2. Aberrant karyogram of Oryctolagus cuniculus with heterozygous first autosomal pair

CONCLUSION

We examined the causes of reduced fertility of a male from a breeding stock of experimental rabbits (Oryctolagus cuniculus).

Cytogenetic analysis of the karyotype of the experimental individual indicated heterozygosity in the first pair of autosomes that was reflected in the presence of an unusually large chromosome. Based on literature data we assumed that such a karyotype structure is one of the possible determinants of the impaired fertility that was clinically observed.

The reduced fertility of the examined individual was interpreted to be a consequence of impaired spermatogenesis, irregular chromosomal segregation of the first pair of autosomes, and the production of imbalanced gametes.

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ABERANTNI KARIOTIP LABORATORIJSKOG KUNIĆA (ORYCTOLAGUS CUNICULUS, LINNAEUS, 1758) SA HETEROZIGOTNIM PRVIM PAROM AUTOZOMA

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SADRŽAJ

Histolcškim i citogenetičkim ispitivanjima bio je podvrgnut priplodni mužjak laboratorijskog kunića, (Oryctolagus cuniculus) poreklom sa farme eksperimentalnih životinja Veterinarskog fakulteta u Ljubljani starosti oko 6 meseci i telesne mase 2,5—3 kg, zbog smanjene plodnosti, koja se ogledala u smanjenoj koncepciji parenih ženki, učestalom prevremenom prekidu graviditeta i smanjenoj vitalnosti potomstva.

Analizom kariotipa uočeno je prisustvo jednog neoubičajenog velikog hromozoma iz prvog para autozoma, za koji smo predpostavili da je nastao kao posledica amplifikacija pojedinih delova hromozoma, zbog verovatno povećane koncentracije prehrambenih aditiva u konzumnoj hrani.

Smanjenu plodnost smo tumačili kao posledicu narušene spermatogeneze, neregularne segregacije hromozoma tokom mejoze i produkcije nebalansiranih gameta.