

A note on cytogenetic monitoring of geese in native conservative flocks*

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ABSTRACT

The studies conducted aimed at evaluating the frequency of chromosome abnormalities in early embryos of 8 breeds/varieties of geese originating from the Southern and Northern parts of Poland, since the seventies of the XX century, without selection, avoiding interrelations.

In total 1927 eggs were evaluated, of which 485 were not fertile. The karyotypic survey was performed on 1442 embryos and showed that 65 of them (4.5%) had an abnormal karyotype. Among the chromosome abnormalities the principal were: 1AZ haploidy; haploid-diploid chimerism 1AZ/2AZZ, 1AZ/2AZW; mosaic 2AZZ/3AZZZ. One embryo proved to be a pure tetraploid 4A/ZZZZ. The translocation or inversion type of structural chromosome abnormalities were not observed.

A considerable variability was observed in the frequency of chromosome abnormalities between the geese varieties examined: from 2.99% in the Pomeranian variety to 7.58% in the case of the Hunched Breed. In the remaining six breeds/varieties the per cent of karyotype changes ranged from 3.38 to 4.73.

KEY WORDS: embryos, chromosome abnormalities, conservative flock, geese

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INTRODUCTION

Reserve and conservative geese flocks constitute a unique material for investigations and render possible the evaluation of breeds and varieties already not used for commercial production but included in conservation programmes. Small, isolated populations, such as reserve and conservative geese flocks, must be genetically controlled, as in such closed populations there is a risk of an increased frequency of chromosome aberrations and a decreased genetic variability. This could lead, among much else, to an inbreeding depression, i.e. decreased production and lowered resistance to diseases.

The conservation of endangered species refers not only to wild living animals, but also to breeds, lines and varieties of farm animals, created by humans. Among the numerous reasons for protecting endangered species one may find economic, biological, scientific and cultural (Crawford, 1990; Wężyk et al., 1994; Cywa-Benko et al., 2006).

The level of spontaneous chromosome aberrations in different poultry species changes depending on breed, line, family and selection type (Reddy and Siegel, 1977; Snyder et al., 1979). Karyotype changes are responsible, among much else, for an increased embryo mortality during incubation and a lower hatchability. This makes cytogenetic surveys, determining the level of chromosome aberrations in poultry, especially advisable in conservative flocks.

The examinations performed aimed at evaluating the frequency of chromosome aberrations in early embryos of 8 breeds/lines of geese, originating from the Southern and Northern parts of Poland and maintained at the Institute of Animal Production, Department of Breeding Water Fowl, Dworzyska, since the seventies of the XX century, without selection, avoiding interrelations. Biological traits of geese from conservative flocks: resistance to illness, good quality of eggs (thick, strong shell), high reproductivity, longevity, adaptability to environmental conditions and ability to use less valuable feeds (Książkiewicz, 2007). The majority of native goose flocks have been included in the world's genetic resources (World Watch List for Domestic Animal Diversity; Scherf, 2000).

MATERIAL AND METHODS

The experimental material for the karyotype survey of early (48 h) geese embryos was collected during two subsequent laying periods and comprised a 100 eggs per breed/line: Lubelska (Lu), Kielecka (Ki), Sub-Carpathian (SC), Hunched Beak (HB), Kartuska (Ka), Rypinska (Ry), Suwalska (Su) and Pomeranian (Po). The size of flocks ranged from 45 to 55 males and from 135 to 156 females at

2-3 years of age (Książkiewicz, 2007). Eggs were collected in April for three days, pedigreed and stored at 12°C for two weeks and then placed in an incubator at 38°C. After 48 h incubation the eggs were opened and examined macroscopically. The blastodisks from fertile eggs were removed and a cell suspension was made from each in a 2 ml culture medium with an addition of colchicine. Further processing with short culture (2 h), hypotonic, fixation and slide preparation followed the method described by Zartman and Jaszczak (1979).

Fifty to one hundred metaphase spreads were analysed by scoring the presence of the largest 10 pairs of autosomes and sex chromosomes ZZ and ZW. The chi-square test (proc FREQ in SAS, 1999) was used to compare groups of embryos with regard to the incidence of embryos with chromosome abnormalities.

RESULTS AND DISCUSSION

In total 1927 eggs were examined (Table 1), of which 485 were not fertile. The karyotype survey covered 1442 embryos.

Table 1. The number of evaluated and not fertile goose embryos

Variety	Number of eggs examined	Not fertile eggs	
		number	%
Lubelska	234	57	24.3
Kielecka	214	38	17.7
Sub-Carpathian	232	59	25.4
Hunched Beak	272	48	17.6
Kartuska	259	82	31.6
Rypinska	222	53	23.8
Suwalska	252	73	28.9
Pomeranian	242	75	30.9
Total	1927	485	25.1

The frequency of chromosome aberrations was determined for 1442 goose embryos. The karyotype survey showed 65 (4.5%) embryos with an abnormal karyotype. Among the chromosome abnormalities the principal were: haploidy 1AZ; haploid-diploid chimerism 1AZ/2AZZ, 1AZ/2AZW; mosaics 2AZZ/3AZZZ and, in the case of one embryo, a pure tetraploid 4A/ZZZZ (Table 2).

The translocation or inversion type of structural chromosome aberrations was not observed. Similarly as in other poultry species, they are rarely found. A clear majority of this type of irregularities are induced by X rays or chemical mutagens (Wooster et al., 1977).

Haploidy 1AZ was the dominant chromosome aberration as it was observed in 32 embryos (2.21%). The second was the haploid-diploid chimerism 1AZ/2AZZ, 1AZ/2AZW and the last the mosaic 2AZZ/3AZZZ. The haploidy, similarly as monosomy, is a lethal condition. Embryos that are 1AZ haploids are found only in the early stages of embryo development. Studies on the origin of haploidy, performed using gametes with a chromosome marker, have demonstrated that it may be of an androgenic origin. Haploidy cell lines in embryos and chicks being haploidy/poliploidy chimerism/mosaics 1A/2A; 1A/2A/3A are of a similar origin (Fechheimer and Jaap, 1978). In turn, the

Table 2. Number and per cent of embryos with chromosome aberrations in conservative flocks of geese

Variety	Number of embryos examined	Chromosome aberrations number	Aberrations	
			number	%
Lubelska	177	1AZ (4)	8	4.51
		1AZ/2AZZ (2)		
		1AZ/2AZW (2)		
Kielecka	176	1AZ (4)	7	3.97
		1AZW/1AZ		
		1AZ/2AZZ		
Sub-Carpathian	173	2AZZ/3AZZZ	6	3.46
		1AZ (3)		
		1AZ/2AZZ (2)		
Hunched Beak	224	1AZ/2AZW	17	7.58 [†]
		1AZ (7)		
		1AZ/2AZZ (3)		
Kartuska	177	2AZW/ZZ (5)	6	3.38
		2AZZ/3AZZZZ (2)		
		1AZ		
Rypinska	169	1AZ/2AZZ	8	4.73
		2AZZ/ZW		
		2AZZ/4AZZ		
Suwalska	179	2AZZ/2AZ	8	4.46
		4AZZZZ		
		1AZ (5)		
Pomeranian	167	1AZ/2AZZ (2)	5	2.99*
		2AZZ/ZW		
		1AZ (6)		
Total	1442	1AZ/2AZZ	65	4.50
		2AZW/ZZ		
		1AZ (2)		

* P<0.05

diploid/triploid mosaics (2A/3A) appears as result of disturbances in cytokinase during the initial divisions of embryo cells (Reddy et al., 1977)

The overall frequency of chromosome aberrations identified at the level of 4.5% in the embryos of 8 varieties and breeds of geese, maintained in conservation flocks, is comparatively low, when compared with the results reported by other authors. Jaszczak et al. (1999), performing a cytogenetic survey of 411 embryos of the Zatorska goose, maintained in a conservation flock and 486 embryos of the White Italian goose from a commercial flock, observed chromosome irregularities in 6.3 and 5.4% of cases, respectively. In other poultry species the same type of aberrations occur, on a similar or higher level than that observed in geese. Cytogenetic examinations of turkey embryos, representing two commercial lines - medium heavy (Nicholas 300) and heavy (Nicholas 700) - demonstrated 10.5% of embryos with chromosomal aberrations (Jaszczak et al., 2003).

A considerable variability was observed in the frequency of chromosome aberrations between the goose varieties examined: from 2.99% for the Pomeranian variety to 7.58% for the Hunched Beak variety (difference significant at $P < 0.05$). In the remaining six varieties the per cent of karyotype irregularities ranged from 3.38 to 4.73. A high level of chromosome abnormalities is responsible for the higher embryo mortality during incubation and a lower hatchability (Jaszczak and Jaszczak, 1993).

One should emphasise that the overall number of chromosome abnormalities in different bird species is certainly higher, as routine investigations as a rule cover 5-10 pairs of macrochromosomes. As the estimation and identification of the remaining pairs of microsomes is difficult, the information about the actually occurring abnormalities is in fact incomplete.

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