STUDY ON THE HETEROZIS EFFECT IN EARLY EMBRYOGENESIS OF THE COMMERCIAL CHICKEN BROILER HYBRIDS

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Abstract

In the literature, there is less discussed in what extent the methods that modify the genetic structure of a population for a certain character has an impact on the hyperplasia of the tissues during the embryogenesis. The aim of this paper was to study in what extent the different genetic structure, meaning the heterozygosis status in the first and second hybrid generation, is influencing the breadth development of the chicken embryos at the optic and auditory vesicles level between the 30th and 50th hour of incubation. Experiments were carried out on two representative groups of simple bilinear hybrids NH and double tetra-linear hybrids Cy_1Cy_2NH. The results sustain the idea that cephalic processes, and optic and auditory vesicles become visible earlier, and the differentiation and cell replication processes are more vigorous in hybrids with higher heterozygosis than in those with lower heterozygosis.

Key words: hybrid, heterozygosis, genetic structure

INTRODUCTION

The heterozis effect shown up in the heterozygote (hybrid) animals, and obtained by crossbreeding of the parents having different and complementary genetic structure in the non-additive loci could be made evident and even measured. Genetists consider that the plus the hybrid showed over their parents' of the average is due to the heterozis effect or hybrid vigor. On this basis we can think that the plus of a quantitative trait in hybrids over one of the parental forms that is less heterozygote is determined by the heterozis effect, also.

The aim of this paper was to study in what extent the different genetic structure is influencing the dynamics and evolution of the breadth of the optic and auditory vesicles in early embryogenesis of the commercial chicken broilers.

MATERIALS AND METHODS

"Robro 69" hybrid is made up of Cornish lines Cy_1 and Cy_2 and Plymouth Rock lines N and H that were imported in 1969 from "Studler" (France), and was homologated in 1987.

Experiments were carried out on two representative groups of embryos having different genetic structure. One group was highly heterozygous being a simple hybrid F_1 between lines N and H belonging to Plymouth Rock breed. The other group comprised a double hybrid F_2, obtained from crossbreeding of the simple hybrid NH of Plymouth Rock breed with the simple hybrid Cy_1Cy_2 of Cornish breed.

In order to make evident the heterozis effect during the early embryogenesis of broilers, the average of the trait measured in double tetra-linear hybrid embryos "Robro 69", having the formula Cy_1Cy_2 NH, was taken as the reference point.

The area where the morphogenetic differentiation processes were the most active was the cephalic end of the embryo. In this area is taking place differentiations of the cells that make up the future segments of the encephalon, eyes, ears and skull. After the neural canal begins to transform into a neural

tube starting with the cephalic end of the embryo, the optic vesicles start to develop, too. In the stage when the embryo has already about 20 somatic cells, the auditory vesicle and its ganglion could be observed in the cephalic part.

Using a special technique, measurements of the breadth of embryos at the level of optic and auditory vesicles were carried out every 10 hours, during 30th and 50th hour of incubation.

The data was statistically processed in order to quantify the influence of the genetic structure of each embryo group (simple and double hybrids).

RESULTS AND DISCUSSIONS

The measurements performed at the level of optic and auditory vesicles on 35 double hybrid embryos, less heterozygous, which were sacrificed at the ages of 30, 40 and 50 hours of incubation made possible to analyze the standard of embryo development in breadth during this developmental period. We did not performed measurements at the age of 60 hours of incubation because at this age the cephalic end of the embryo suffers a big inflection so the results would be less precise and biased. The results are shown in Table 1.

Table 1.
Evolution of the average breadth of the double embryos (Robro 69) at the level of optical and auditory vesicles (mm)

Item	Age of embryos (hours of incubation)		
	30	40	50
Embryo breadth at the optic vesicles level	0.40±0.040	0.58±0.059	0.86±0.027
Embryo breadth at the auditory vesicles level	0.39±0.080	0.62±0.070	0.65±0.086

The data shown in Table 1 suggests that the breadth of the chicken embryos increase only up to 40th hour of incubation. From the 40th to the 50th hour of incubation the double hybrid (standard) embryos remain at the same size they achieved at 40 hours of incubation. This phenomenon is true for both optic and auditory vesicles. This not means that the embryos' breadth is not growing further 40 hours of incubation. They stay at the same size for 10 hours then they begin to grow more vigorously. Our calculations lead to the conclusion that from the 30th to the 40th hour of incubation the average growth speed of the breadth of optic vesicles is 0.045 mm/hour and that of auditory vesicles is 0.023 mm/hour.

If we compare the data obtained from double hybrids to those obtained from simple hybrids, we obtain information regarding the influence of the genetic structure on the breadth development of embryos. The data are shown in Table 2.

Table 2.
Dynamics of differences regarding the breadth development of the double and simple hybrid embryos

Item	Age of embryos (hours of incubation)		
	30	40	50
At the level of optic vesicles			
Simple hybrid embryos	0.25±0.05	0.78±0.06	1.146±0.031
Double hybrid embryos	0.40±0.04	0.85±0.059	0.86±0.027
Difference	+0.12	-0.10	+0.286
At the level of auditory vesicles			
Simple hybrid embryos	0.40±0.05	0.526±0.06	0.814±0.07
Double hybrid embryos	0.39±0.08	0.62±0.07	0.65±0.086
Difference	+0.01	-0.094	+0.164

Analyzing the data in Table 2, one can observe that at the age of 30 hours of incubation the first generation simple hybrids had a superior development than double hybrids both at the level of optic (+0.12 mm) and auditory (+0.01 mm) levels. The situation is inversed at 40 hours of incubation, the double hybrids having a more vigorous growth during this period. At the age of 50 hours of incubation the simple hybrids overcome the "handicap" encountered earlier, so at the level of optic vesicles they are 0.286 mm bigger and at the level of auditory vesicles they are 0.164 mm bigger than the double hybrids.

By applying the statistical methods for the growth speed calculated over the whole studied interval, we have to accept the null hypothesis. If we analyze the average development speed over short time periods, it was concluded that this is net following a continue line with a constant rate, but it displays undulatory according to the incubation period.

CONCLUSIONS

All the above-mentioned data suggest that the embryos that have more frequent heterozygosis are developing in breadth following another pattern than those who are less heterozygote. The higher heterozygosis determines an earlier and faster development of the embryos at the level of optic and auditory vesicles. Our data sustain the idea that the occurrence of the cephalic processes, and optic and auditory vesicles take place earlier, and the differentiation and cell replication processes are more vigorous in hybrids with higher heterozygosis.

REFERENCES

Journal articles

[1] BARLOW R. - Experimental evidence for interaction between heterozis and environment in animals. Anim.Breed Abstr.49, 715-737, [1981]

[3] ELIAS St. - O metodă pentru măsurarea precisă a creşterii în stadii tinere de dezvoltare embrionare. Stud. şi Cercet. Embr. şi Citol., Seria Embr. Tom IV, nr.2, Bucureşti, [1967]

[4] NEELY J.D. et al. - Heterozis estimate for measures of reproductive traits in crossbred boars. J. Anim. Sci. 51, 1150, [1980]

[5] ŞANDOR Şt., ELIAS Şt. - Acţiunea alcoolului etilic asupra dezvoltării embrionului de găină. Stud. şi Cercet. Embr. şi Citol. 32, [1966]

[6] VINTILĂ I. - Manifestarea fenomenului heterozis în dezvoltarea embrionului de găină de la 20-60 ore de incubaţie. Lucr. şt. IAT, seria Med. Vet. voi. XI, [1968]

Book

[2] DRONCA D. – Ameliorarea genetică a populaţiilor de animale, Editura Mirton, Timişoara, [2007]