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THE INFLUENCE OR DAMS' EGG-WHITE MUCIN-GLOBULINS ON THE RESISTANCE OF OFFSPRING IN THE PERINATAL PERIOD

Recently the effect of the egg reserve proteins on the development of embryo has been observed (Morton et al., 1965; Buvanendran, 1967). We found that in New Hampshire Breed the mortality of the offspring of dams of different genotype depends on the stage of development (Павел, Петерсон, 1967).

The present report concerns the association of egg-white globulins with the resistance of the offspring in the perinatal period.

Experimental

The subject of the study was a New Hampshire population of Kurtna Poultry Breeding Experimental Station. Egg-white globulins were fractionated by using O. Smithies' (1955) slightly modified starch gel electrophoresic method (Пыдер, Павел, 1966). In this report the genotypes of mucin-globulins are signed according to C. M. A. Baker and C. Manwell (1962). For simplification the symbol of locus is omitted, for example $G_3^A G_3^B G_2^C G_2^D$ is written simply ABCD.*

The chicks were experimentally infected by injecting the live culture of *Salm. gallinarum* in a dosage of $1—3.1 \times 10^7$ bacterial cells subcutaneously on the first to the third day after hatching. The mortality was registered during 21 days after the experimental infection. For statistical analysis, the percentage data were transformed to the arcsin percent scale and subjected to dispersion analysis.

Results and discussion

The pooled data of 5 experiments are presented in Tab. 1. Out of the 6 characters studied (fertilization, embryonic mortality, post-embryonic mortality in the first 9 days after infection, post-embryonic mortality in 21 days after infection, perinatal mortality up to the 9th post-infection day incl., and perinatal mortality up to the 21st post-infection day), a statistically significant effect of mother genotypes was found in embryonic mortality only. The dams' genotypes align according to their positive influence as follows: BBDD-ABDD-AADD-ABCD. Thus the embryonic mortality is highest in diheterozygous birds, which is in accordance with our preliminary results (Павел, Петерсон, 1967).

* This notation corresponds to Lush's symbol II^A II^B III^A III^B.

Table 1

The offspring mortality of hens of different genotypes

Stage	Mother genotype			
	ABDD	BBDD	ABCD	AADD
Fertilization:				
Hens	371	131	76	175
Eggs	2081	657	404	931
Fertilized eggs	1585	479	324	651
Fertilization	0.7617	0.7291	0.8020	0.6992
Embryonic mortality:				
Fertilized eggs	1585	479	324	651
Dead embryos	586	162	158	283
Mortality	0.3697	0.3382	0.4877	0.4347
Post-embryonic mortality in 9 days after injection:				
Hatched chicks	999	317	166	368
Dead chicks	740	242	129	276
Mortality	0.7407	0.7634	0.7771	0.7500
Post-embryonic mortality in 21 days after infection:				
Dead chicks	898	286	149	328
Mortality	0.8989	0.9022	0.8976	0.8913
Perinatal mortality up to the 9th post-infection day incl.:				
Fertilized eggs	1585	479	324	651
Deaths	1326	404	287	559
Mortality	0.8366	0.8434	0.8858	0.8587
Perinatal mortality up to the 21st post-infection day incl.				
Deaths	1484	448	307	611
Mortality	0.9363	0.9353	0.9475	0.9386

Table 2

The effect of dam's genotype on the survival of offspring

Survival rate of offspring, %	Dam's genotype			
	ABDD	BBDD	ABCD	AADD
From the number of:				
Eggs	4.85	4.72	4.21	4.30
Fertilized eggs	6.37	6.47	5.25	6.14
Hatched chicks	10.11	9.78	10.24	10.90

After the experimental infection of newly-hatched chicks with *Salm. gallinarum*, the differences between dams' genotype effects gradually diminish. If a slight, but non-significant difference between the influence of dams' genotypes is still observable during the first 9 days after injection, it will practically disappear by the end of the observation period, i. e. by the 21st day after infection (incl.).

The survival rates of the offspring of different dams are presented in Tab. 2. It can be seen that the survival percentages in different dams are in the same order, especially in the case when fertilization is excluded, i. e.

Table 3

Comparison of homozygous and heterozygous dams

Stage	Locus	Expression of character		d*	p
		homozygotes	hetero-zygotes		
Fertilization	G_3	0.7199	0.7683	4.84	<0.05
	G_2	0.7400	0.7137	1.47	>0.05
Embryonic mortality	G_3	0.4060	0.3897	0.97	>0.05
	G_2	0.3797	0.4784	4.31	<0.05
Post-embryonic mortality (up to the 9th post-infection day incl.)	G_3	0.7515	0.7459	0.28	>0.05
	G_2	0.7470	0.7552	0.30	>0.05
Post-embryonic mortality (up to the 21st post-infection day incl.)	G_3	0.8962	0.8987	0.18	>0.05
	G_2	0.8979	0.8966	0.07	>0.05
Perinatal mortality (up to the 9th post-infection day incl.)	G_3	0.8524	0.8449	0.60	>0.05
	G_2	0.8431	0.8723	1.74	~0.08
Perinatal mortality (up to the 21st post-infection day incl.)	G_3	0.9383	0.9582	0.01	>0.05
	G_2	0.9366	0.9460	0.83	>0.05

* Бейли Н., 1962. Статистические методы в биологии. М. : 58.

Table 4

Comparison of homozygous and heterozygous dams

Character	Locus	Expression of character	
		homozygotes	heterozygotes
Fertilization	G_3	−8.3474	+7.9177
	G_2	+3.8801	+10.7808
Embryonic mortality	G_3	−3.5719	+15.6766
	G_2	−2.7417	+32.3944
Post-embryonic mortality (up to the 9th post-infection day incl.)	G_3	−4.6866	+5.5726
	G_2	−2.2969	+8.6626
Post-embryonic mortality (up to the 21st post-infection day incl.)	G_3	−4.7076	−0.0827
	G_2	−1.7726	−4.2828

when the survival rates are calculated from the number of eggs. If one also considers the fertilization process, the diheterozygous birds (ABCD) are also characterized by the lowest survival rate of the offspring. If one excludes the fertilization and embryonic mortality when calculating the survival percentages from the number of hatched chicks, it can be found that the survival rate of the offspring of diheterozygous birds will rise. These data, and those presented in Tab. 1 refer to the fact that dams' effect differs in succeeding ontogenic stages.

As to the severe *Salmonella enzootia*, it seems that none of the 4 mucin-globulin phenotypes has any selective advantage. The fact that the differences between the mother effect are not significant in all the hatches, agrees with the postulation of M. Kimura (1966) that the intensity of selection is not constant but varies under different conditions. One must even presume that in mucin-globulin polymorphism, as well, selection

sometimes prefers one or another phenotype (Haldane, Jayakar, 1963). This opinion is also confirmed by the data of D. O. Schmid and P. Thein (1968) who found that in some lines of chicks embryonic mortality is associated with allele II^A, i. e. G_3^A, and in the others, however, with allele II^B (i. e. G_3^B) respectively.

It is of some interest to determine the role of heterozygosity in the persistance of mucin-globulin polymorphism. Some information can be given by a comparison of homozygous and heterozygous dams (Tabs 3, 4). Tab. 3 characterizes the effect of homozygous and heterozygous dams on the resistance of the offspring. A statistically significant difference between homozygous and heterozygous mothers was noticed in the fertilization and embryonic mortality, only. The fertilization was higher in hens being heterozygous on locus G_3. Concerning embryonic mortality, however, locus G_2 is associated with the resistance of the embryo. Thus the offspring of homozygous dams proved to be more resistant as compared with the offspring of the heterozygous ones. It is of interest that a statistically nearly significant effect, from among the dam's effect, was noticed in postnatal mortality up to the tenth post-infection day on locus G_2. Here, again, the homozygous dams proved to be more efficient. In Tab. 4 the performance of homozygous and heterozygous dams is compared on the basis of calculated deviations. For this purpose, the offspring value of each dam was calculated by subtracting it from the mean value of the experiment. The genotype values were pooled and divided by the number of genotypes.

As will be seen, fertilization is mostly influenced by locus G_3. However, in embryonic mortality, apart from locus G_2, the influence of G_3 is also noticeable. Both embryonic and post-embryonic mortality of the offspring of homozygous mothers are lower than in heterozygous ones until the tenth post-infection day. However, in case of the whole postnatal period examined, there is no remarkable difference between the homozygous and heterozygous mothers. Accordingly, after the tenth post-infection day, some changes take place in the mother's effect, which indicate that maternal effect in various stages of perinatal development is not always unidirectional.

Since the presented data do not indicate the existence of the overdominance of mucin-globulin loci, a further study must elucidate what role is enacted by the genetic-automatic processes (Дубинин, 1966; Дубинин, Глембоцкий, 1967) in the persistance of polymorphism on mucin-globulin loci.

Summary

The effect of the egg-white mucin-globulins on the viability of the offspring in New Hampshire chicks was studied. It was found that the dam's mucin-globulin phenotype influences the development of the embryo. The highest offspring mortality occurred in the case of diheterozygous dams. Since the differences between dams' genotypes appear solely in pooled data and in some experiments, it is concluded that the effect of the natural selection varies under different conditions.

The *Pullorum* disease as a factor of natural selection levels off the differences between the influence of dams' phenotypes.

A difference between the homozygous and heterozygous dams in fertilization and embryonic mortality was found. Fertilization rate was higher in heterozygous hens (locus G_3), while the embryonic mortality was also higher in heterozygous dams (locus G_2).

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MUNAVALGU MUTSIIN-GLOBULIINIDE MÕJUST JÄRGLASTE RESISTENTSUSELE PERINATAALSEL PERIOODIL

Resümee

Uuriti munavalgu mutsiin-globuliinide mõju njuuhämpširi tõugu tibude resistentsusele. Suurim embrüonaalne suremus esines diheterosügootsetel emadel. Kanade genotüüpide mõju erinevusi täheldati ainult mõnedes katsetes. Selgus, et pulloroos kaotab genotüüpide erinevused.

Tartu Riiklik Ülikool
Eesti Põllumajanduse Akadeemia

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ЮЛО ПАВЕЛ, КАРЛ ПЕТЕРСОН

ВЛИЯНИЕ МУЦИН-ГЛОБУЛИНОВ ЯИЧНОГО БЕЛКА НА РЕЗИСТЕНТНОСТЬ ПОТОМСТВА В ПЕРИНАТАЛЬНОМ ПЕРИОДЕ

Резюме

Изучалось влияние муцин-глобулинов яичного белка на резистентность цыплят породы нью-гемпшир. Оказалось, что наивысшая эмбриональная смертность обнаружилась у дигетерозиготных матерей. Различия во влиянии генотипов кур обнаружены только в некоторых опытах. Выяснилось, что пуллороз теряет различия между генотипами.

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