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POPULATION IMMUNOLOGY AND VETERINARY MEDICINE

According to O. T. and D. J. Solbrig (1979) population biology deals with evolutionary processes within a population. Its main components are population genetics and population ecology. We are of the opinion that it would be reasonable to add also the population immunology which deals with the immunological structure of populations (its variability in space and time).

The population immunology and phenetics are closely related subjects (Яблоков, 1980) but the first is dealing instead of monogenic traits mainly with polygenic ones.

From the point of view of animal husbandry and especially the veterinary medicine, it is very important to determine the immunologic status (or immunologic potentials) of animals to the potential (facultative) pathogenic microbes as *Escherichia coli*, staphylo- and streptococci, *Proteus mirabilis*, *P. vulgaris* and other *Proteus* species, *Klebsiella pneumoniae*, *Enterobacter*, *Citrobacter*, *Hafnia alvei*, *Serratia marcescens*, *Pseudomonas aeruginosa*, *Acinebacter* and others. For this purpose we have in our previous works determined the immunological status of hens and the population's immunological structure on the basis of 4—5 nonspecific resistance factors of the blood serum (Pavel, 1975; Павел et al., 1979, 1980 *a*, *б*, *в*, 1985). But in the course of time it became evident that one must limit oneself to four main immuno-physiological traits which reflect not only the immunological status of animals but also their vitality or endurance and the productivity (Вальдман et al., 1981, 1984). Therefore from the practical point of view it is important to represent each immunological trait only in two gradations: — weak (1 point) and + strong (2 points). Using the three-gradation system (— weak, ± intermediate and + strong) of four traits (Bae — bactericidal activity of the blood serum to *Escherichia coli*, Lam — lysozyme activity to *Micrococcus lysodeikticus*, Hb — hemoglobin content of the blood and Prn — the serum protein content), one gets 81 phenotypes ($3^4=81$), but the resulting fine distribution of animals has more theoretical than practical value. Therefore we decided to use only two gradations: strong (+) and weak (—) according to Bae, Lam, Hb and Prn (Павел et al., 1986), which resulted only in 16 different phenotypes and 5 phenoclasses. The last term was acquired from the book by V. N. Rostovtsev (Ростовцев, 1986). The method is based on the comparison of birds of the so-called comparison groups (at least 60—64 birds are investigated immunologically on the same day and the values of traits are expressed in gradations), which allows to compare the birds investigated in different seasons.

Different methods of assessing the human's immunological status have been described by several authors (Макшанов, Томащик, 1985; Петров, Лебедев, 1984; Петров et al., 1985). Our methods of assessing the degree of nonspecific resistance and endurance are discussed by T. Almlid (1981), A. J. van der Zijpp (1983), J. S. Gavora and J. L. Spencer (1978). In previous years we used the elements of genealogical analysis for determining the immunological status of individuals and the immunological structure of populations (Вальдман et al., 1984) but now we propose a more convenient method which is reduced to phenotypic level. We have to add that several authors have expressed the polygenic traits as "monogenic" ones (Гинзбург, 1980; Гинзбург, Аксенович, 1986; Гинзбург, Федотов, 1986).

Using our last method (four traits in two gradations (Павел et al., 1987)) the distribution of phenotypes and phenoclasses is presented in Table 1. As can be seen in the case of four traits with two gradations (+ and −) there are 16 different phenotypes and 5 phenoclasses (despite the fact which trait is strong or weak).

Table 1

Phenotypes and the corresponding phenoclasses

Phenotypes		Phenoclasses
Bae+ Lam+ Hb+ Prn+	1	4+
Bae+ Lam+ Hb+ Prn− Bae+ Lam+ Hb− Prn+ Bae+ Lam− Hb+ Prn+ Bae− Lam+ Hb+ Prn+	4	3+1−
Bae+ Lam+ Hb− Prn− Bae− Lam+ Hb+ Prn− Bae− Lam− Hb+ Prn+ Bae+ Lam− Hb+ Prn− Bae+ Lam− Hb− Prn+ Bae− Lam+ Hb− Prn+	6	2+2−
Bae+ Lam− Hb− Prn− Bae− Lam+ Hb− Prn− Bae− Lam− Hb+ Prn− Bae− Lam− Hb− Prn+	4	1+3−
Bae− Lam− Hb− Prn−	1	4−
	16	5

In Table 2 we have presented (Павел et al., 1986) the correlation between the immunological phenoclasses and egg production per basic hen (counting the egg productivity in survived as well as in dead hens). It should be noted that the population immunological analysis method is quite simple as compared to the genealogical analysis. In Table 2 we can see that in 1983 the correlation between the immuno-physiologic status (phenoclasses) of the hen and its egg productivity is peculiar only to the line *B*. The line *C* reveals also this type of correlation if the extreme phenoclasses (4+ and 4−) are not taken into account. In 1984 the correlations are obvious already in two lines — in the lines *B* and *C*, respectively. Therefore the reaction norm of the line *B* is more stable as compared to the line *C*. Obviously in the line *B* the genes that control the immunologic traits, and those determining the productivity, have a higher degree of linkage.

Table 2

Correlation between the phenoclasses of nonspecific resistance and the egg productivity (per basic hen)

Phenoclass (Bae Lam Hb Prn)	Year	Line *A*	Line *B*	Line *C*
4+	1983	166,50 (2)*	255,66 (3)	0
3+1−	1983	240,11 (9)	222,95 (23)	212,70 (17)
2+2−	1983	220,16 (37)	228,94 (54)	197,66 (48)
1+3−	1983	211,16 (59)	214,32 (31)	198,81 (48)
4−	1983	220,00 (14)	200,10 (10)	211,50 (12)
4+	1984	143,50 (4)	230,57 (7)	251,00 (2)
3+1−	1984	186,04 (22)	210,69 (13)	230,07 (27)
2+2−	1984	203,63 (41)	203,90 (32)	226,75 (40)
1+3−	1984	203,97 (45)	199,47 (21)	223,48 (41)
4−	1984	205,41 (12)	199,60 (5)	207,36 (11)

* The number of hens is given in brackets. Bae — bactericidal activity of the blood serum to *Escherichia coli*; Lam — lysozyme activity of the blood serum to *Micrococcus lysodeikticus*; Hb — haemaoglobin content of the blood and Prn — the protein content of the blood serum.

In 1982 (see Павел et al., 1986) we could not observe any correlation between the degree of the immunologic status of hens and their egg productivity in the line *A*. But after eliminating the extreme phenoclasses (i. e. 4+ and 4−), the correlation exists (in the line *C*).

The specific "weight" of a concrete immuno-physiological trait has been calculated (Петров et al., 1984; 1985; Павел et al., 1985).

It must be pointed out that the egg productivity of the observed hen groups was registered during their 68 weeks of age while the immunologic traits were measured beginning from their 35 weeks of age. We suppose that already younger chickens can be subjected to immunologic research. We can see that the lines *B* and *C* (especially the line *B*) are "prognosticables" on the basis of the degree of immunological strength (phenoclass) in a sense of the endurance (viability) of the hens. If one eliminates the extreme phenoclasses, the line *C* is also "prognostic".

G. Biozzi (1979, cit. A. J. van der Zijpp, 1983) and L. B. Crittenden (1983) suggest that it is reasonable to eliminate the extreme (in immunological sense) animals from the flock, i. e. to get stabilizing selection.

So the lines *B* and *C* can be subjected to the "veterinary selection" (Эйснер, 1981), which means the elimination of immunologically extreme phenoclasses, while the line *A* has to be replaced by a prognosticable line.

We are of the opinion that in the near future it will be necessary to start the analogical research work also with cattle and pigs, investigating the correlation between the immunological potentials and life span of cattle, while in pigs the immunological potentials and fertility can be compared. We think that the endurance is influenced by T-lymphocytes of the immune system (Weksler, 1980).

Thus the population immunological method is relatively simple. At the same time it is an express method. It enables to prognosticate the endurance (viability) of chickens. The method is valid in assessing the phenoclass of the birds, i. e. the number of strong immuno-physiological traits without the succession of traits (for example, Bae^{+} Lam^{-} Hb^{-} Prn^{+} is expressed as the phenoclass 2+2−, as Bae^{-} Lam^{-} Hb^{+} Prn^{+}).

One of the main tasks of preventive veterinary medicine is to raise the endurance of an animal organism (i. e. nonspecific resistance and productivity) in respect to potential pathogenic microbes on the population level. We suppose that this can be achieved by using the population immunological method.

If our efforts are confirmed also in other species of animals, the veterinary medicine will arise from the service level to the production level.

In conclusion we put forward the hypothesis that the immunological potential of an organism, i. e. the immune system controls also some peculiarities of the individual development of an animal organism and therefore one can use this phenomenon in veterinary genetics and selection as a valuable factor.

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POPULATSIOONIIMMUNOLOOGIA JA VETERINAARMEDITSIIN

Artiklis on esitatud uus, suhteliselt lihtne populatsiooniimmunoloogiline meetod kanade eluvõime (mittespetsiifilise resistentsuse ja munatoodangu) prognoosimiseks.

Юло ПАВЕЛ, Анатолий ФЕДОТОВСКИЙ

ПОПУЛЯЦИОННАЯ ИММУНОЛОГИЯ И ВЕТЕРИНАРНАЯ МЕДИЦИНА

Представляется новый относительно простой популяционно-иммунологический метод для прогнозирования жизнеспособности кур (неспецифическая резистентность и яйценоскость на начальную курицу).