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# ON SOME PROBLEMS OF VETERINARY ONTOGENETICS

The development of veterinary genetics is necessary from the point of view of a further advance of both veterinary and experimental medicine. At the same time, veterinary genetics provides general biology with new facts, since it also makes use of the comparative research method.

At the given stage of development of veterinary medicine, the determination of the degree of the non-specific resistance of the organism is acquiring great importance.

Selection of animals only for high productivity is inevitably accompanied by the distribution of the genotypes susceptible to various diseases. Susceptibility to the surrounding microflora will insrease, which will lead to a greater frequency of occurrence of such diseases as mastitis and other diseases of the organs. Thus the study of resistance must take into account not only research into infective agents but also the investigation of the banal microflora.

The values of the majority of immunological (as well as physiologico-biochemical) characters of the organism depend on the age of an animal, its physical state, the season and the feeding level. When characterizing the individual development of an organism, it is necessary to present the age dynamics of the respective parameters as well as the seasonal variability of a character. When dealing with great age and seasonal variations of characters, it is necessary also to determine the degree of the stability of a character in ontogenesis.

The study of the variability of immunological and other characters is of great practical value only in case when the variational series of characters are subordinated to typification (grouping). This means that the variational series of a character in definite seasons must be presented on a relative scale (in this way it will be possible to ascertain if a certain character has the same value both in autumn and in winter). Such a comparison makes it possible to investigate the genotypic reaction to environmental factors and to evaluate the degree of the reactivity of an animal.

If the number of the characters under consideration is larger than one, it is desirable to calculate the index of the respective animal (Pavel, 1975). Having selected 6 to 8 descendants for one male, it is possible to determine the genotypic index of that animal.

By the method of Kolesnik and his collaborators (Колесник et al., 1967) the ontogenetic recurrence of a character (P) is determined with regard to a definite moment of time. For illustration, see the example presented below (Table 1).

*Table 1*

**Values of a character in ontogenesis**

| Moment of time | Value of character | Deviation from the first moment (in per cent) | Deviation from the third moment (in per cent) |
|---|---|---|---|
| 1 | 5 | 0 | 72−100=−28 |
| 2 | 6 | 120−100=20 | 86−100=−14 |
| 3 | 7 | 140−100=40 | 0 |
| 4 | 8 | 160−100=60 | 114−100= 14 |

If the maximum deviation from the first moment of time amounts to 60 per cent, the maximum deviation from the third moment amounts only to 28.

Consequently, in the latter case the character proves to be less variable, although the values of the character in both cases are equal.

Taking the above into consideration, we recommend to determine the degree of the ontogenetic recurrence of a character relative to the arithmetic mean of a character ($\bar{y}$). We have compiled a table (Table 2) to help to find that index.

*Table 2*

**Ontogenetic deviations of a character**

| Moment of time $i$ | Value of character $y_i$ | Deviation from mean $d=y_i-\bar{y}$ | Deviation (in per cent) $p$ | Error of deviation $m_d$ | Value of t-statistic $t_d$ |
|---|---|---|---|---|---|
| 1 | 5 | −1.5 | 23 | 4.2 | 5.5 |
| 2 | 6 | −0.5 | 8 | 2.7 | 3.0 |
| 3 | 7 | 0.5 | 8 | 2.7 | 3.0 |
| 4 | 8 | 1.5 | 23 | 4.2 | 5.5 |

$\bar{y}=6.5$

The error of deviation ($m_d$) is calculated according to the formula

$$m_d=\sqrt{\frac{p(100-p)}{100}},$$

where p denotes deviation from the arithmetic mean in per cent.

The value of the t-statistic is calculated from the formula

$$t_d=\frac{p}{m_d}.$$

The values of $t_d$ obtained are compared with the critical values of the t-distribution in the table. When the factual value of $t_d$ is smaller than the critical value given in the table, the respective deviation d may be considered negligible (or accidental). The critical value $t_{cr}$ depends on the number of experiments (n) and on the probability of the error $\alpha$ (as a rule, $\alpha$ is taken to be equal to 0.05). In the given example let $n=10$, then $t_{cr}=t_{10;\,0.05}=2.23$, and thus all deviations are significant. In other words, no value of $y_i$ can be considered recurrent.

The coefficients of ontogenetic recurrence P are determined as follows:

$$P=\frac{\text{number of recurrent values}}{\text{number of all values}}.$$

In our example P=0 : 4=0.

Further, the error $m_P$ of the coefficient of ontogenetic recurrence P can be calculated from the formula

$$m_P=\sqrt{\frac{P(1-P)}{N}},$$

where N is the number of all values of the character under the study. In the given example N=4.

In our opinion, the degree of stability of the character (S) can be calculated similarly. When performing the calculation, one again starts from the arithmetic mean of the values of the given character and the deviations are calculated in per cent.

*Table 3*

**Mortality of piglets in individual rounds**

| No. of male | No. of piglets | Mortality in individual rounds | Mean mortality | d | d (in per cent) | Stability | S | $m_s$ | $t_s$ |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 7673 | 356 | 4.4 | | − 7.5 | 63 | − | | | |
| | | 6.9 | | − 5.0 | 42 | − | | | |
| | | 22.5 | | +10.6 | 89 | − | | | |
| | | 13.7 | 11,9 | + 1.8 | 15 | + | 0.25 | 0.22 | 1.2 |
| 8177 | 230 | 5.7 | | − 0.4 | 7 | + | | | |
| | | 10.0 | | + 3.9 | 64 | − | | | |
| | | 8.6 | | + 2.5 | 41 | − | | | |
| | | 0 | 6.1 | − 6.1 | 100 | − | 0.25 | 0.22 | 1.2 |
| 7927 | 129 | 0 | | − 6.1 | 100 | − | | | |
| | | 13.5 | | + 7.4 | 121 | − | | | |
| | | 11.1 | | + 5.0 | 82 | − | | | |
| | | 0 | 6.1 | − 6.1 | 100 | − | 0 | 0 | 0 |
| 7675 | 314 | 10.8 | | + 2.2 | 26 | + | | | |
| | | 7.6 | | − 1.0 | 12 | + | | | |
| | | 7.9 | | − 0.7 | 8 | + | | | |
| | | 8.2 | 8.6 | − 0.4 | 5 | + | 1.0 | 0 | ∞ |
| 7837 | 259 | 12.0 | | + 2.5 | 26 | + | | | |
| | | 3.5 | | − 6.0 | 63 | − | | | |
| | | 10.7 | | + 1.2 | 13 | + | | | |
| | | 11.8 | 9.5 | + 2.3 | 24 | + | 0.75 | 0.22 | 3.5 |
| 6673 | 196 | 24.0 | | + 7.6 | 46 | − | | | |
| | | 3.8 | | −12.6 | 77 | − | | | |
| | | 8.2 | | − 8.2 | 50 | − | | | |
| | | 29.6 | 16.4 | +13.2 | 80 | − | 0 | 0 | 0 |
| 8075 | 447 | 12.3 | | − 1.1 | 8 | + | | | |
| | | 12.3 | | − 1.1 | 8 | + | | | |
| | | 14.9 | | + 1.5 | 11 | + | | | |
| | | 14.0 | 13.4 | + 0.6 | 4 | + | 1.0 | 0 | ∞ |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| 6683 | 222 | 23.2 | | + 7.7 | 50 | — | | | |
| | | 12.4 | | − 3.1 | 20 | + | | | |
| | | 7.3 | | − 8.2 | 53 | — | | | |
| | | 19 | 15.5 | + 3.5 | 23 | + | 0.5 | 0.25 | 2.0 |
| 7709 | 197 | 0 | | −15.5 | 100 | — | | | |
| | | 24.4 | | + 8.9 | 57 | — | | | |
| | | 11.3 | | − 4.2 | 27 | + | | | |
| | | 26.4 | 15.5 | +10.9 | 70 | — | 0.25 | 0.22 | 1.2 |
| 7899 | 243 | 16.7 | | 0 | 0 | + | | | |
| | | 10.3 | | − 6.4 | 38 | — | | | |
| | | 19.5 | | + 2.8 | 17 | + | | | |
| | | 20.2 | 16.7 | + 3.5 | 21 | + | 0.75 | 0.22 | 3.5 |
| 2651 | 310 | 1.9 | | − 5.6 | 75 | — | | | |
| | | 13.1 | | + 5.6 | 76 | — | | | |
| | | 10.7 | | + 3.2 | 43 | — | | | |
| | | 5.1 | 7.5 | − 2.4 | 32 | — | 0 | 0 | 0 |
| 2669 | 272 | 7.9 | | − 4.4 | 36 | — | | | |
| | | 10.3 | | − 2.0 | 16 | + | | | |
| | | 6.0 | | − 6.3 | 51 | — | | | |
| | | 25.0 | 12.3 | +12.7 | 103 | — | 0.25 | 0.22 | 1.2 |
| 2925 | 217 | 11.1 | | + 3.6 | 48 | — | | | |
| | | 7.0 | | − 0.5 | 7 | + | | | |
| | | 10.0 | | + 2.5 | 33 | — | | | |
| | | 2.4 | 7.5 | − 5.1 | 68 | — | 0.25 | 0.22 | 1.2 |
| 2545 | 291 | 2.7 | | −10.4 | 79 | — | | | |
| | | 10.2 | | − 2.9 | 22 | + | | | |
| | | 10.7 | | − 2.4 | 18 | + | | | |
| | | 28.9 | 13.1 | +15.8 | 172 | — | 0.5 | 0.25 | 2.0 |
| 2831 | 317 | 4.7 | | − 4.5 | 49 | — | | | |
| | | 13.2 | | + 4.0 | 43 | — | | | |
| | | 1.0 | | − 8.2 | 89 | — | | | |
| | | 17.7 | 9.2 | + 8.5 | 92 | — | 0 | 0 | 0 |
| 2347 | 272 | 10.0 | | − 2.6 | 21 | + | | | |
| | | 15.6 | | + 3.0 | 24 | + | | | |
| | | 14.0 | | + 1.4 | 11 | + | | | |
| | | 10.9 | 12.6 | − 1.7 | 13 | + | 1.0 | 0 | ∞ |
| 2713 | 230 | 4.5 | | − 6.9 | 61 | — | | | |
| | | 4.7 | | − 6.7 | 59 | — | | | |
| | | 28.1 | | +16.7 | 146 | — | | | |
| | | 8.2 | 11.4 | − 3.2 | 28 | + | 0.25 | 0.22 | 1.2 |
| 2575 | 225 | 14.9 | | − 0.5 | 3 | + | | | |
| | | 14.5 | | − 0.9 | 6 | + | | | |
| | | 11.5 | | − 3.9 | 25 | + | | | |
| | | 20.6 | 15.4 | + 5.2 | 34 | — | 0.75 | 0.22 | 3.5 |
| 2565 | 200 | 4.3 | | −12.1 | 74 | — | | | |
| | | 15.7 | | − 0.7 | 4 | + | | | |
| | | 28.5 | | +12.1 | 74 | — | | | |
| | | 17.0 | 16.4 | + 0.6 | 4 | + | 0.5 | 0.25 | 2.0 |
| 2919 | 308 | 20.7 | | + 4.8 | 30 | + | | | |
| | | 7.9 | | − 8.0 | 50 | — | | | |
| | | 17.4 | | + 1.5 | 9 | + | | | |
| | | 17.7 | 15.9 | + 1.8 | 11 | + | 0.75 | 0.22 | 3.5 |

Further it is assumed that if the deviation is less than ±30 per cent, the values of the character are stable. The coefficient of the stability of the character (S) is calculated as follows:

$$S = \frac{M}{N},$$

where M is the number of the stable values of the character and N is the total number of the values of the character.

The statistical error $m_s$ of the coefficient S is calculated in the following way:

$$m_s = \sqrt{\frac{S(1-S)}{N}}.$$

The coefficient of stability of the mortality of piglets in individual litters was determined by the same method (Table 3).

From the data presented above it is evident that in three males the coefficient of stability of the mortality of descendants in individual rounds is maximal (S=1.0; descendants of the males Nos. 7675, 8075, 2347), in seven males that coefficient was high (S=0.5...0.75; males Nos. 7837, 6683, 7899, 2545, 2575, 2565, 2919). In ten cases the coefficient of stability of the mortality of descendants was low (S=0...0.25; males Nos. 7673, 8177, 7927, 6673, 7709, 2651, 2669, 2925, 2831, 2713).

It may be concluded that the mortality of descendants in males with a high coefficient of stability of mortality is not so strongly influenced by the environment, as compared with the males which have a low coefficient of stability of mortality.

To sum up, it may be supposed that the methods presented here may succesfully be applied also in medical genetics.

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## MÕNINGATEST VETERINAARSE ONTOGENEESI PROBLEEMIDEST

*Resümee*

Artiklis soovitatakse määrata tunnuse ontogeneetilise korduvuse ja püsivuse astet, milles kajastub tema arengu ja programmeerituse tase, tunnuse aritmeetilisest keskmisest lähtudes. Tunnuse ontogeneetilise püsivuse koefitsienti defineeritakse tunnuse püsivate väärtuste arvu ja kõigi väärtuste arvu suhtena. Järeldatakse, et kõrge suremuse püsivuse koefitsiendiga isasloomade järglased ei allu väliskeskkonna mõjule nii tugevasti kui madala suremuse püsivuse koefitsiendiga isasloomade järglased.

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## О НЕКОТОРЫХ ПРОБЛЕМАХ ВЕТЕРИНАРНОЙ ОНТОГЕНЕТИКИ

*Резюме*

Степень онтогенетической повторяемости и устойчивости признака рекомендуется определять, исходя из арифметического среднего признака. Дефинируется коэффициент онтогенетической устойчивости признака. Поскольку высокая степень устойчивости и повторяемости признака является показателем развития и программирования признака, делается вывод, что смертность потомков у самцов с высоким коэффициентом устойчивости к смертности не столь сильно зависит от влияния окружающей среды как у самцов с низким коэффициентом устойчивости к смертности.

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