THE ESTIMATION OF STOMACH SECRETORY FUNCTION FOR CHILDREN IN CONDITIONS OF THE NORTH

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While studying human population in extreme conditions the problems of data interpretation, the determination of bounds of the norm and pathology have some difficulties, as far as what should be considered the norm for an organism in the course of adaptation may differ greatly from the for an adaptive state.

While studying stomach secretory function in children in different ethnic groups in conditions of the North, the indications of disadaptation of digestive system (dissociated type of a secretion, high basal acidity, disorder of acid excretion regulation) were established. For more precise definition of a character of adaptive changes of stomach secretory function the method of correlating adaptometry was used [1]. In search of differences of the norm for adaptive populations from the norm for adapting ones not only the meanings of separate parameters were being investigated, but different correlations between them. On this way the following effect was revealed [2, 3].

Correlation between physiological parameters in course of adaptation process is higher, then in adapted and disadapted states.

The existence of this effect is being confirmed by the results of data processing, obtained in the Institute of Medical Problems of the North, Sib. Dept. Acad. of Med. Sci. of Russia and also by other investigations [4].

The characteristics observed under the action of ecologo-evolution law on selection and succession and ones observed

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at adaptation of populations were compared to explain the above discussed effect. The selection, successional reconstructions and adaptation lead from monofactoriality to polifactoriality, i.e. from limiting by one factor or by a small number of factors to equivalence of a great number of factors [3]. While considering the adaptation process a high level of correlations corresponds to monofactoriality, and low correlations correspond to polyfactoriality. Hence, the adaptation process is being represented as a motion from a high correlation level of physiological parameters to a lower one.

Materials and Methods of Investigation

Three groups of children living in the regions of the Far North (Khatanga and Dudinka regions) between 8 and 16 years of age were examined in different time of the year - in spring and in autumn and also the children of alien population, arrived from different regions of the country, that have been living in the North for 1-5 years. More than 500 people were examined in all.

In every examined child the stomach content was investigated at the following stages: the first portion (on an empty stomach), basal (hour-long) and a stimulated one (after ghistomin introduction, also hour-long).

From these portions the following analyses were being picked out:

KOL - the overall secretion quantity,

OBV - the overall quantity of hydrochloric acid,

SVOB - the quantity of free hydrochloric acid,

D1OB, D2OB - the output of overall hydrochloric acid in basal and stimulated phase (here and there the numeral 1 is used for basal phase, 2 - for stimulated one),

NK1, NK2 - hour-long tension,

P1, P2 - index of pepsin,

ZKK1, ZKK2 - alkaline-acid index.

The obtained data were calculated by standard statistic methods to have mean, dispersion and mean error (M, σ, m). Then the analysis of pair correlation for all parameters was carried out. The correlation coefficient was being calculated by the formula:

$$\rho = \frac{\mathrm{cov}(X, Y)}{\sigma_x \cdot \sigma_y}$$

where $\mathrm{cov}(X, Y)=\sum_{i=0}\sum_{j=0}(i-M_x)(j-M_y)P_{ij}$;

M_x – average meaning of casual value (of analysis) Y;

M_y – average meaning of casual value (of analysis) X;

P_{ij} – probability $P(X=i,\ Y=j)$;

σ_x – standard deviation X;

σ_y – standard deviation Y.

The data correlation degree was being estimated with the aid of correlation graph, being calculated as a sum of weights of its ribs (the sum of corresponding coefficients of pair correlation)

$$G=\sum_{|r_{ij}|\geqslant\alpha}|r_{ij}|$$

were r_{ij} – coefficient between i^{th} and j^{th} indices. Significant coefficients of correlation $r_{ij}\geqslant 0.5$ were taken into account [5]. A matrix R(10×10) was used in calculations. The parameters of hour-long tension, the parameters of output of total and free hydrochloric acid, pepsin and alkaline-and-acidic parameters in basal phase are the part of the matrix.

Fig. 1 represents the results of correlation investigation for physiological parameters of stomach secretion of basal phase in children of different regions of living in spring and in autumn. Children from Khatanga region were fed with traditional products (meats, fish, mushrooms, berries), that contributed to more favourable acid formation. Mathematical investigations also confirm this (the higher correlation indices).

The living conditions in summer period for children of alien population and native population of Dudinka region are the same (pioneer camp, living in town conditions or outside Taymyr). The "european" type of nutrition predominates, that leads to digestive system disadaptation, expressed in high basal acidity, in regulation disorder of acid secretion in medical investigations and to lower weight of correlation graph in comparison with the children of Khatanga region.

Returning to the North in autumn they are to adapt themselves to a great number of abiotic factors, to the changing character of nutrition. All these changes lead to disbalance of functional systems, including a digestive one. In autumn the weight of correlation graph is much higher, then in spring.

The same conditions of living in winter period (in boarding

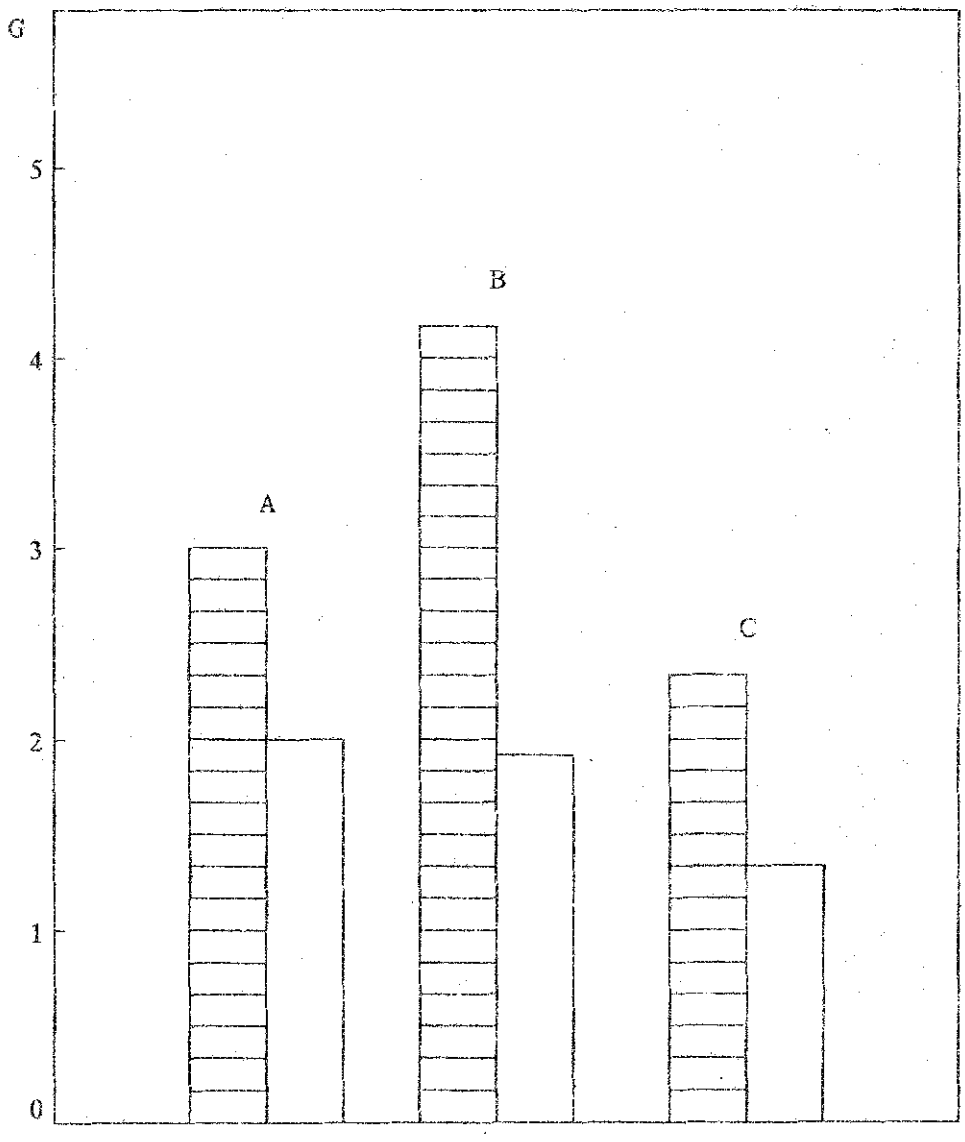

Fig. 1. Degree of correlatedness of indices of physiological parameters for children of Dudinka region (A), Khatanga region (B), alien population (C) in autumn (▤), in spring (□).

schools with "european" type of nutrition) lead to the equalizing of correlation parameters for children of all groups in spring.

The further investigations of physiological parameters of stomach secretion function for children were made by the method of main components. With the aid of this method the task of diagonalization of correlation matrix R_{nn} is being solved: $R*C=C*\Lambda$, $Y=Z*C$.

The proper numbers and the proper vectors were calculated by correlation matrix R_{nn}. An orthogonal matrix is being used for direct linear transformation of main components' matrix (new variables): $Y=Z*C$.

Each proper number λ_j represents a contribution of j^{th} factor Y_j (matris's column Y_{mn}) into common dispersion, equal to

$$V=\sum_{r=1}^{N} V_r=tr(R)=tr(\lambda)=n$$

The contribution of each component is calculated by the formula:

$$V=\sum_{r=1}^{N} \lambda_r,$$

where r - index of main component.

A relative contribution of a factor is also received

$$Y_j-\Delta_j=\lambda_j/n,$$

expressed in per cents and equal to $\delta_j=\Delta_j \cdot 100\%$, witch is called its weight.

In practical investigations the factors giving the biggest contribution into common dispersion have the greatest interest.

In the given work the main components of matrix R(13×13) are received for 3 groups of children in autumn and spring periods in basal and stimulated phase; dispersions λ_j of all factors, the contribution of each component into common dispersion: λ_j/n, $j=1,\ldots n$ are calculated, and also accumulation of parts (quots) or total contribution of the first components

$$\gamma=f_4(\Lambda)=\frac{1}{n}\sum_{l=1} \lambda_j$$

of correlation matrix R_{nn} of a type $f_s(\Lambda)$, were s=1, 2, 3, 4, 5, 6:

$f_1(\Lambda)=n=\sum_{j=1}^{k} \lambda_j$ - a number of characteristics.

$f_2(\Lambda)=tr(\Lambda^2)=\sum_{j=1}^{k} \lambda_j^2$ - the surplusage value of characteristics'

system. In our case k=n=5. The bigger $f_2(\Lambda)$, the more the degree of expression of initial parameters correlation .

$f_3(\Lambda)=\lambda_1/\lambda_k$ – the determinant of correlation matrix.

$f_4(\Lambda)=(\sum_{j=1}^{I}\lambda_j)/n$ – a part (quota) of the first main components where $\lambda_1 \geq \lambda_2 \geq \ldots \geq \lambda_k$ – are the eigen-values of correlation matrix.

In our case we take into account the components which total contribution into common dispersion is 98% ($I=4$).

$$f_5(\Lambda)=\lambda_1 \ldots \lambda_k$$

$$f_6(\Lambda)=\sum_{j=2}^{k}(\lambda_{j-1}/\lambda_j)$$

A number of conditionality $f_3>1$ is a quantitative measure of "independence" of factors. In our case $f_3 \cong 0.5$, that is evidence of the dependence of factors.

Parameter $f_6(\Lambda)$ characterizes the intercommunications between variables of initial extract.

The received meanings of functional parameters f_2, f_3, represented in Figs 2, 3, confirm the investigations, described above.

The parameter increase of basal phase of secretion reflects exacerbation of gastritis as a rule and pepsin (P1) plays a "compensating" role in such cases, i.e. for preservation of stability of secretion function at acidity decrease it increases and its decrease is observed at acidity increase [6].

Thus , when estimating the correlation level of physiological parameters a number of appropriatenesses was revealed.

1. A high level of correlation is being observed in autumn for children of alien population of Khatanga and Dudinka regions. It corresponds to anthropoecological tension in examined groups. After summer vacations their digestive system is forced to adapt itself to other rhythm and ration of nutrition (Fig. 1).

2 The correlation level of physiological parameters for children of Khatanga region is higher than for children of Dudinka region. It corresponds to higher anthropoecological tension because the children of Khatanga region in summer months lived mainly in tundra and fed on traditional products (Fig. 1).

3. The correlation level of functional parameters is lower in spring than in autumn period for all examined groups. The percentage of children having gastroenterological complains is

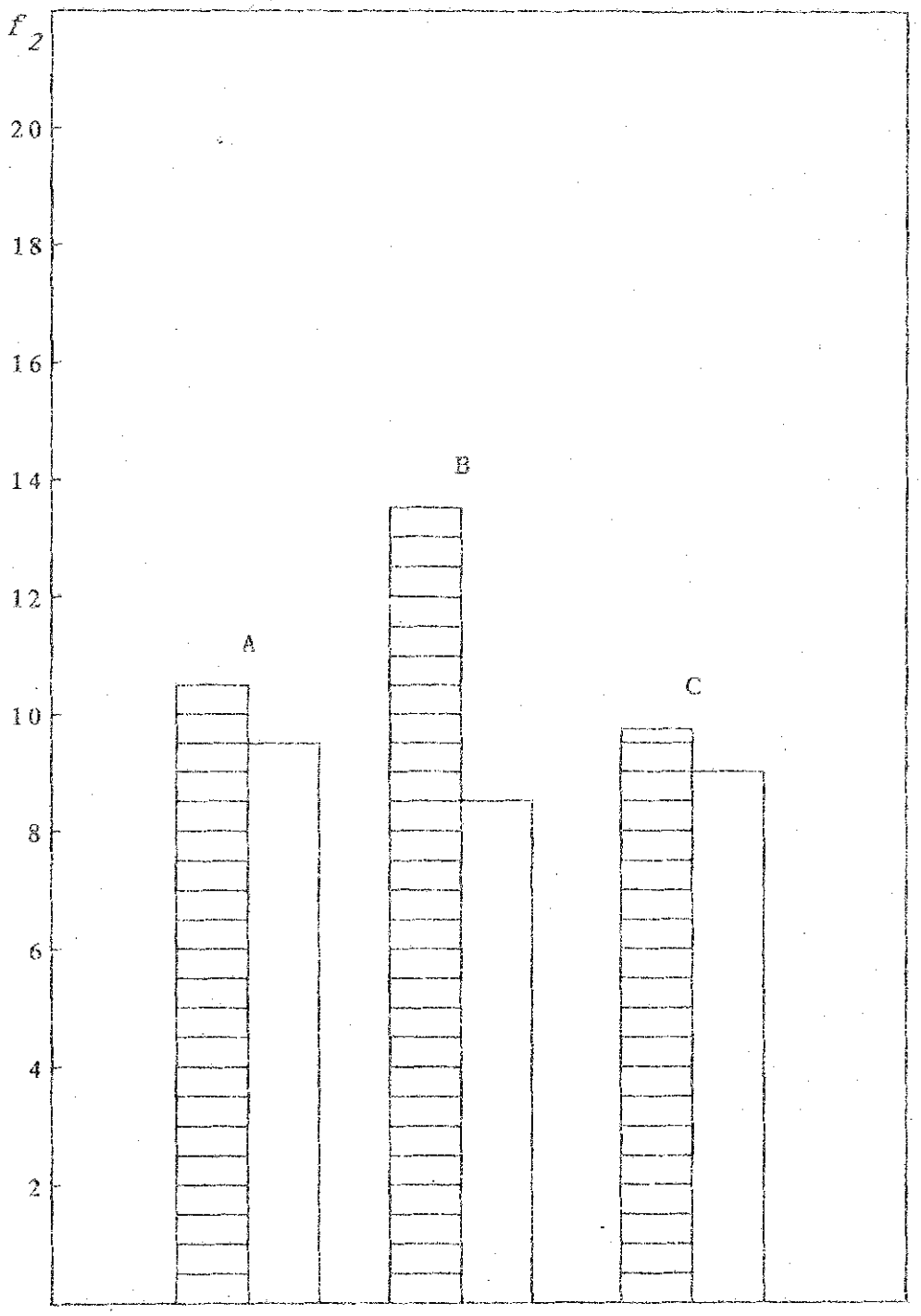

Fig. 2. The value of physiological parameter f_2 of stomach content undices (basal portion) for children of Dudinka region (A), Khatanga region (B), alien population (C) in autumn (▤), in spring (□).

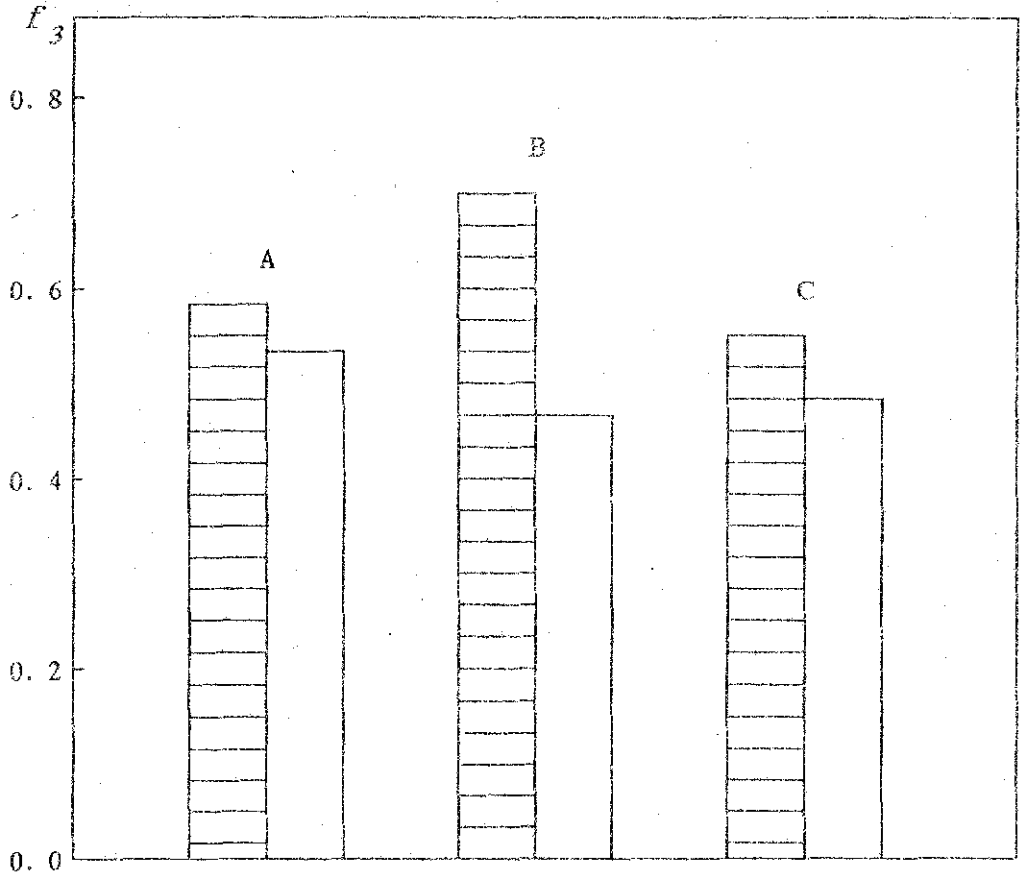

Fig. 3. The value of physiological parameter f_3 of stomach content indices (basal portion) for children of Dudinka region (A), Khatanga region (B), for children alien population (C) in autumn (▤), in spring (□).

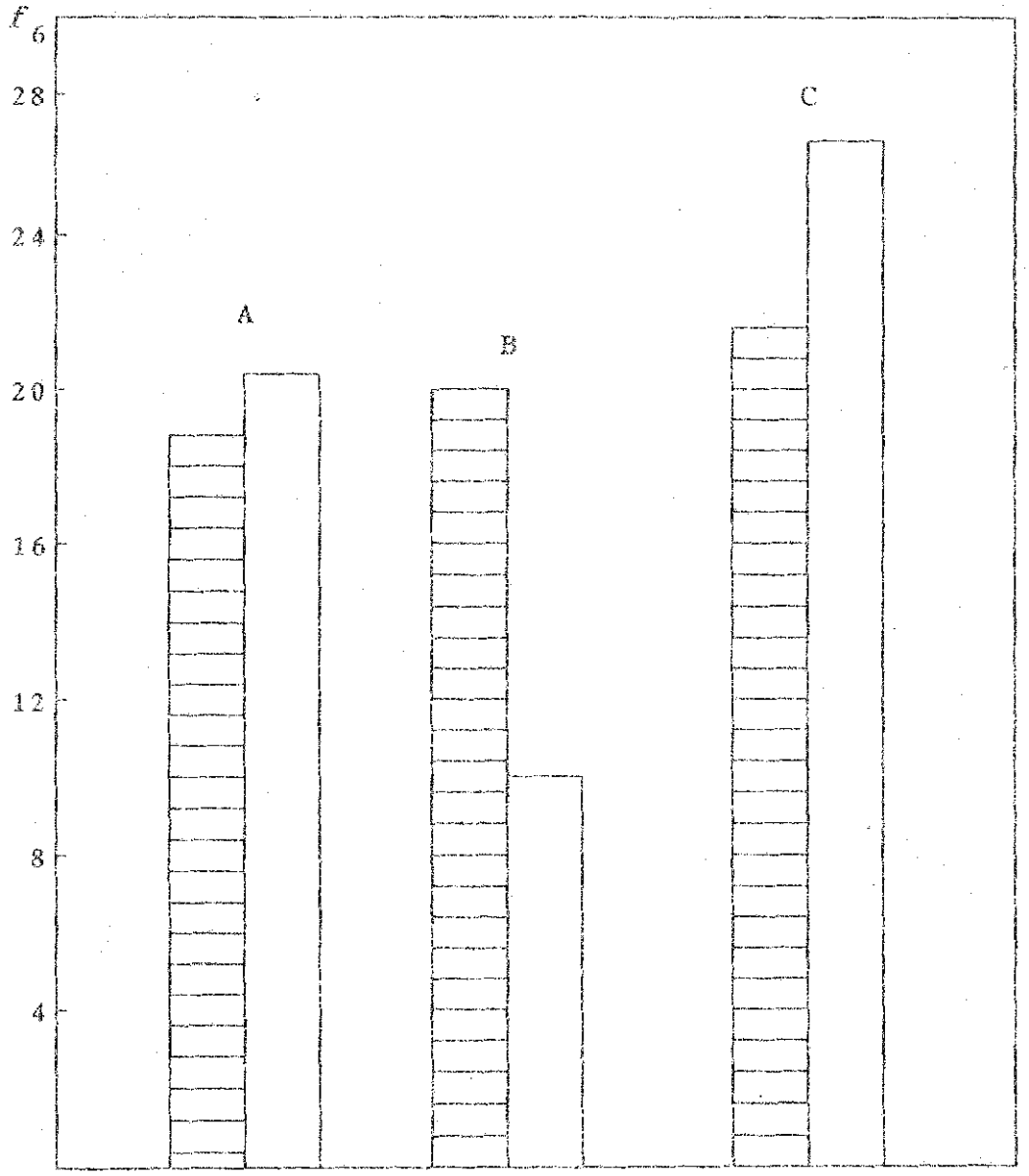

Fig. 4. The value of physiological parameter f_6 of stomach content indices (basal portion) for children of Dudinka region (A), Khatanga region (B), for children of alien population (C) in autumn (▤), in spring (□).

being increased in spring period of the year. The increase of basal acidity and regulation disorder of acid secretion is being observed. A dissociated type of secretion predominates for all children of northern nationalities. It is considered as a disbalance of secretion function of a stomach and a symptom of exacerbation of a chronic gastritis.

During winter the children of nationalities of the North lived in boarding schools with "european" type of nutrition. This led to disadaptation of heir digestive system which was reflected on correlation level of physiological parameters.

4. In spring season the state of disadaptation was observed mainly in children of Khatanga region, as at that time a dissociated type of secretion predominates in them; and in aborigens of Dudinka region and in alien population the frequency of normocyde type of secretion increases . Thus an evidence of proceeding adaptive processes (especially in alien population, Fig. 4).

REFERENCES

1. Anokhin P. K. The main questions of the theory of functional system. –M.: Science, 1980. –197p.

2. Bulygin G. B. Functional state of blood lymphocytes in connection with phases of human adaptation to new ecological conditions. Author's abstract diss. cand. med. sci. – Tomsk, 1984.

3. Gorban A. N., Manchuk V. T., Petushkova E. V. The dynamics of correlation between physiological parameters at adaptation and ecologo-evolutional principle of polifactoriality. // Problems of ecological monitoring and modelling of ecosystems. –L. 1987. p. 187–198.

4. Gorban A. N., Petushkova E. V. Correlating adaptometry as a method of comparative study of adapting population // Mathematical modeling in problems of rational use of nature. Rostov-on-Don, 1987, p. 240–241.

5. Zakharova L. B., Polonskaya M. G., Savchenko A. A., Smirnova E. V. The estimation of anthropoecological tension of alien population of industrial zone of Zapolyarye (biophysical aspect). // Institute of Biophisics Sib. Dept. Acad. USSR. Reprint No 110B, Krasnoyarsk, 1989.

6. Smirnova E. V. The correlation change between physiological parameters at adaptation. // Diss. cand. phys. math. sciences. – Krasnoyarsk, 1980, – 126p.