# PHENOMENOLOGY, PRINCIPLES AND MATHEMATICAL CRITERIA FOR ASSESSMENT OF MEAT RAW MATERIALS TECHNOLOGICAL ADEQUACY

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The practice of the assesment of technological adequacy of meat raw materials and prediction their functional and technological properties according to experimentally determined parameters corresponding to their composition and state began to form about 50 years ago. Physical, biochemical, sanitary-hygiene, medical and biological parameters are the most common ones that are used for this purpose. The authors have proposed an original methodology of quantitative interpretation and computer processing of an apriori and experimental information about these indices, allowing to quantitatively assess the technological adequacy of meat raw materials. The concept of technological adequacy so far has not had the analogues in the existing publications. Its phenomenology makes it possible to identify this concept with quantitative measure of compliance of the complex of the properties of initial raw materials with the purposes of ensuring the stable quality of finished products at different tolerable levels of fluctuations of the parameters of technological processes as used for this purpose. The quintessence of the proposed methodology is a multiplicative mathematical criterion.

By its structure this criterion is similar to that of "cumulative quality of technological processes" suggested by N.N.Lipatov and Z.M.Tskitishvili and meaning that the more stability to a negative change of dominant factors the technological process possesses, the higher its "cumulative quality is".

Analysing the suggested mathematical formula meeting this definition one can readily be convinced that it is oriented to quantitative determination of the measure of conformity of the technological process to the purposes of ensuring stable quality of finished products at different levels of instability of the indices of the used raw materials.

The above definition of "technological adequacy" allows to suggest the following mathematical dependence of the criteria of relative techonological adequacy of meat raw materials:

$$A_T = \left[ \prod_{\alpha} \left( \frac{\Delta T_{\alpha x}}{\Delta T_{\alpha 0}} \right) \prod_{\beta} \left( \frac{\tau_{\min\beta 0}}{\tau_{\min\beta x}} \right) \prod_{\gamma} \left( \frac{\Delta W_{\gamma x}}{\Delta W_{\gamma 0}} \right) \prod_{\delta} \left( \frac{\Delta d_{\delta x}}{\Delta d_{\delta 0}} \right) \prod_{\varepsilon} \left( \frac{\Delta C_{\varepsilon x}}{\Delta C_{\varepsilon 0}} \right) \prod_{\varphi} \left( \frac{\Delta P_{\varphi x}}{\Delta P_{\varphi 0}} \right) \cdot \right.$$

$$\left. \cdot \frac{\Delta p_0}{\Delta p_x} \cdot \frac{\Delta L_0}{\Delta L_x} \cdot \left( \frac{\Delta W_0}{\Delta W_x} \right)^{\mathrm{sign}(1{,}5-j)} \frac{\Delta \pi_x}{\Delta \pi_0} \prod_{\vartheta} \lg \frac{M_{\vartheta 0}}{M_{\vartheta x}} \cdot \frac{A_{nx}}{A_{n0}} \right]^{\frac{1}{\alpha+\ldots+5}} \quad (1)$$

fract. unit.

where $\Delta T_{\alpha x}$, $\Delta T_{\alpha 0}$ - maximum permissible deviations of temperature conditions of the a-th step of technological treatment of the compared and basic types of raw materials, K ($^0$C);

$\tau_{\min\beta x}$, $\tau_{\min\beta 0}$ - minimum needed length of $\beta$-th step of technological treatment for compared types of raw materials, s;

$\Delta W_{\gamma x}$, $\Delta W_{\gamma 0}$ - maximum allowable deviations of humudities of $\gamma$-th step of technological treatment for compared kinds of raw materials, %;

$\Delta d_{\delta x}$, $\Delta d_{\delta 0}$ - maximum allowable deviations of dispersity of compared types of raw materials at the $\delta$-th steps of its technological treatment, m;

$\Delta C_{\varepsilon x}$, $\Delta C_{\varepsilon 0}$ - maximum allowable deviations in concentration ratios of components of recipe mixtures, containing compared kinds of raw materials at the $\varepsilon$ -th step of technological treatment, %;

$\Delta P_{\varphi x}$, $\Delta P_{\varphi 0}$ - maximum allowable deviations of baric conditions of the implementation of $\varphi$ -th step of technological treatment of compared kinds of raw materials, Pa;

$\Delta p_0$, $\Delta p_x$ - relative losses of protein during technological treatment of compared kinds of raw materials, kg/kg raw materials;

$\Delta L_x$, $\Delta L_0$ - relative losses of fat during technological treatment of the assumed identity element of compared types of raw materials kg/kg raw materials;

$\Delta W_x$, $\Delta W_0$ - absolute losses of moisture during technological treatment of compared types of raw materils, kg (or %);

$M_{\vartheta x}$, $M_{\vartheta 0}$ - $\vartheta$ -th microbiogical index of compared types of raw materials (ready product) after termination their technological treatment, corresponding units of measurement;

$A_{nx}$, $A_{no}$ - numerical values of the criterion of food adequacy of compared types of raw materials and ready products, fract. units;

$\Delta\pi_x$, $\Delta\pi_o$ - gain of digestibility of compared types of raw materials during technological treatment, % to the initial tyrosine;

j = 1; 2 - arguments of the function of the sign(j), corresponding to the technological processes of the production of produce, providing for the preservation of moisture in the recipe (j=1), or providing for a decrease in the mass fraction of moisture (j=2).

Data about numerical values of the most of the arguments entering the formula (1), as applicable to real processes in the meat industry are practically absent in literature and reference books.

Despite this, Figs 1a and 1b show the graphs, plotted by the computer on the formula (1) on the basis of experimental investigations at the Sloutsk and Zhlobin meat-packing plants.

During plotting of graphs the following values of arguments entering the formula (1) are used.

For sausage meat of the cooked sausages: $\Delta T_{\alpha 0}=3^0C$; $\tau_{\min\beta 0}=\tau_{\min\beta x}=2$ hours, $\Delta W_{\gamma x}=4\%$; $\Delta W_{\gamma 0}=3\%$; $\Delta d_{\delta 0}=\Delta d_{\delta x}=0{,}5*10^{-3}$ m; $\Delta C_{\varepsilon 0}=2\%$; $\Delta C_{\varepsilon x}=4\%$; $\Delta P\varphi 0=\Delta P\varphi x=10^2$ Pa; $\Delta p_0=10^{-2}$; $\Delta p_x=1{,}2*10^{-2}$; $\Delta L_0=10^{-2}$; $\Delta L_x=2{,}1*10^{-2}$; $\Delta W_0=9\%$; $\Delta\pi_o=15\%$; $\Delta\pi_x=13\%$; $M_{\vartheta 0}=6*10^2$; $M_{\vartheta x}=10^3$; $A_{no}=0{,}634$; $A_{nx}=0{,}625$.

For sausage meat of raw-dried sausages: $\Delta T_0=4^0C$; $\tau_{\min 0}=28$ days; $\Delta W_{\gamma x}=2\%$; $\Delta W_{\gamma 0}=4\%$; $\Delta d_{\delta 0}=3*10^{-3}$ m ; $\Delta d_{\delta x}=3*10^{-3}$ m; $\Delta C_{\varepsilon 0}=3\%$; $\Delta C_{\varepsilon x}=5\%$; $\Delta P\varphi 0=\Delta P\varphi x=10^1$ Pa; $\Delta p_0=2*10^{-3}$; $\Delta p_x=1{,}7*10^{-3}$; $\Delta L_0=\Delta L_x=10^{-3}$; $\Delta W_0=52\%$; $\Delta W_x=47$; $\Delta\pi_o=17\%$; $\Delta\pi_x=15\%$; $M_{\vartheta 0}=M_{\vartheta x}=$Const; $A_{no}=0{,}653$; $A_{nx}=0{,}641$.

Comparing the character and orientation of graphical dependences in Figs 1a and 1b with the analysis of the structure of the formula (1) one can conclude that other things being equal, the greater technological adequacy is typical for those types of raw materials, that allow to obtain a stable quality one and the same type of produce under large allowable fluctuations of technological parameters of its production.

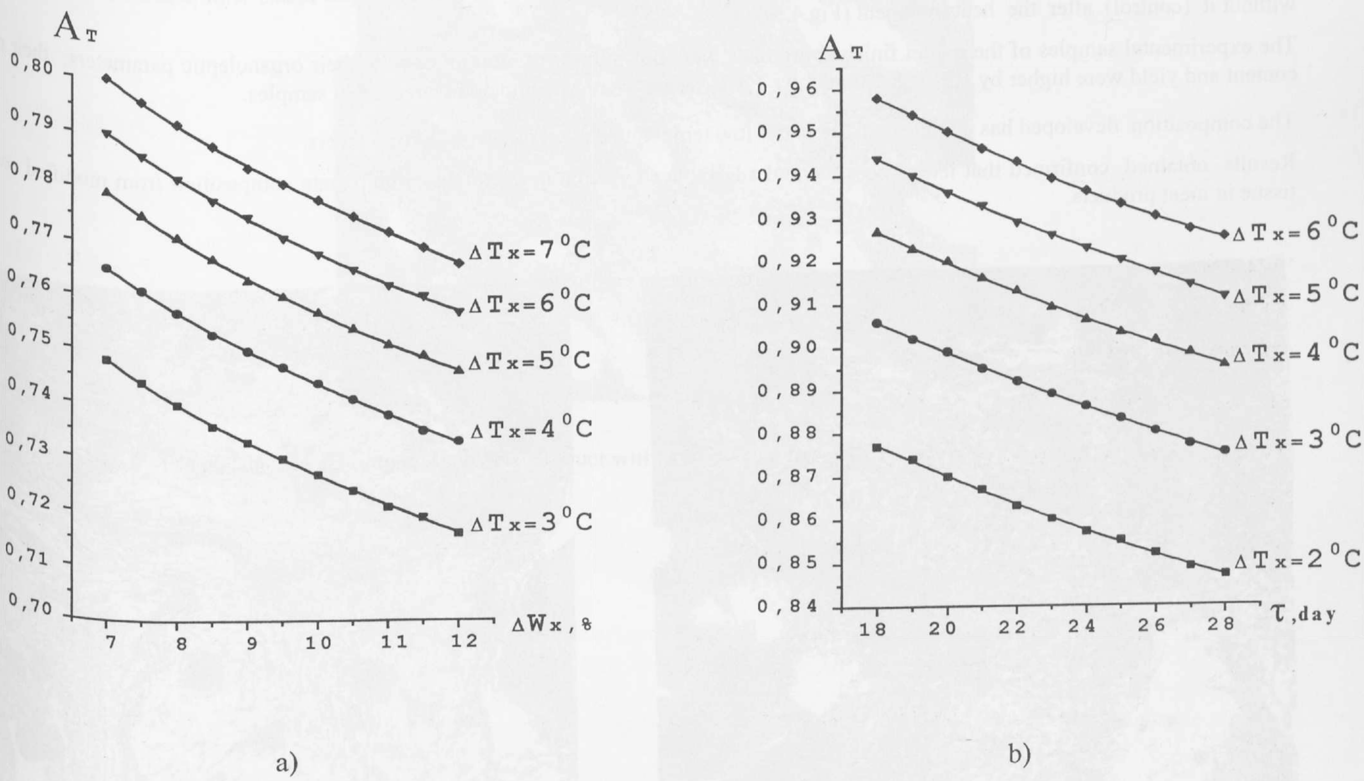


*Fig.1. Dependence of relative technological adequacy from differential indicators of fluctuations of technological process.*