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ЕВРОПЕЙСКИЙ КОНГРЕСС РАБОТНИКОВ
Н И И МЯСНОЙ ПРОМЫШЛЕННОСТИ

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OBJECTIVE DETERMINATION OF MEAT QUALITY BY ITS "MARBLENESS"

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OBJECTIVE DETERMINATION OF MEAT QUALITY
BY ITS "MARBLENESS"

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The main quality data of meat, namely: the colour, taste, flavour, tenderness, biological value and general nutritiousness depend greatly on the fatness of the meat.

When estimating the quality of the meat, the percent, as well as the distribution of the fat are of importance. The complex sense of taste is bound with one of the most important features of the quality of the carcass, namely: the quantitative correlation of fat and meat proper. The taste of beef improves with an increase of the fatness to 38% (in dry matter) on condition of uniform distribution of fat in the meat (H.R. Davidson, 1956). Meat with intramuscular fatty layers is considered to be of the highest grade. This meat looks like marble with red-white crosses, so-called "marbleness". Very fat meat, in which the fat is located in the form of mass layers or between the muscles is not a product of highest food value (A.I. Anfimov et al, 1959; A.A.Manerberger et al, 1960), while intramuscular fat makes the meat more juicy and tender.

It is important to note that with an increase of the fattiness, the distributuon of fat in different animals is effected variously: in some animals the main store of fat deposits in the omentum in the form of a "mass" while the intramuscular depositions of fat do not increase. In other animals the intramuscular depositions of fat increase simultaneously with an increase of the general fattiness. It is of interest to draw an example of different types of fat distribution in meat.

Figures I and 2 provide photographs of cross sections of the fillet parts (over the 12th rib) of two carcasses of 18 month old horned cattle. The content of fat in the meat test from the carcasses of these animals was practically similar and equalled 13.98 and 13.06% (respectively) in the 1st and 2nd animals, but the distribution of fat was different. A considerable percent of the fat in the second animal was located in the muscles; the quality of this meat greatly surpassed the quality of the meat of the first animal in which the main percent of the fat is deposited in the form of "masses".

Researchers, dealing with the selection and fattening of animals, are attempting lately to attain intramuscular distribution of fat in the carcasses (A.V.Cherekayev, 1961 and others). The urgency of this phenomenon will increase with the continuously expanding introduction of most effective methods of intensive fattening of stock in which case, as is known, the process of fat formation is effected more rapidly. It is important to know the reason for the specific character of fat distribution in the animal: whether it is the peculiarity of the breed or it depends on the feeding of the animal. The solution of this problem would advance the production of "marble" meat.

Owing to the latter, an objective estimation of the "marbleness" of meat becomes especially urgent. The degree of meat "marbleness" has been estimated up to late by the eye with the following definitions:"marbleness not expressed", "marbleness expressed moderately" or "marbleness expressed well".

The subjective character of such estimations is hardly acceptable in scientific research.

The need of an objective estimation of the "marbleness" of meat has been stressed at the International Conference on the Control of Meat Productivity in 1959 in Budgoszcz and at the V International Conference of Animal Breeders in 1961 in Hamburg. Attempts have been made to estimate objectively the "marbleness" of meat by calculating the correlation of the fat content and the dry substance of meat free from fat (M.Y.Yanistky, 1959), but this method provides only an idea of the quantitative correlation of the fatty and muscular tissues and cannot determine the "marbleness" proper because the estimation of the latter requires not only the knowledge of the total percent of fat in the meat but , first of all, the character of its distribution in the muscles. It stands to reason that the accumulation of fat in two or three points inside the muscles does not creat the look of "marbleness" and cannot improve the quality of the meat considerably.

For the purpose of illustration we provide an example of the different distribution of fat in the longest muscle of the back. Figures 3 and 4 provide photographs of the cross section of the given muscles of two carcasses at the level of the 12th rib. The total percent of fat is similar but it is seen in Fig.3 that the fat is concentrated in four main points, and in Fig.4 -

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- in many spots which provides "marblehess" of the meat. When ripening, it is necessary to distinguish the fat between the muscles (marked in the figures with number I, fatty inclusions between m.long. dorsi, m.spinalis, etc.), fat in the form of "mass" (marked in figures with number 2) and intramuscular fat, creating "marbleness". It is clear that only one figure, i.e. the percent of fat in the muscle is far from being sufficient in order to determine the "marbleness" of the meat. It is necessary also to have data making it possible to judge on the degree of the break of the fat fraction in the meat.

A method is described herein, making it possible to estimate more objectively and precisely the quality of the meat according to its "marbleness".

Principle of method. The method is based on calculating the area of the fat fraction and quantity of fatty inclusions, located on the cross section of the investigated muscle by the 10 cm long central line.

a) Estimation of "marbleness" directly in the muscle cut.

Required devices and equipment:

1)plexiglass plate with millimetre grid; length of plate - 0 mm, width - 150 mm, thickness - 5 mm;

2) polar planimeter;

3) tracing paper.

b) Estimation of "marbleness" by photograph.

Required devices and equipment:

1) camera (we used camera type "Zenith", allowing for shooting small objects with the entire frame and providing a clear photograph);

2) projector, type EPD-452;

3) screen for projector with dimensions 1100 x 750 mm with grid with intervals of 7.3 mm; a sheet of drawing paper may be used in the capacity of the screen;

4) polar planimeter.

Technique of determination.

a) Estimation of "marbleness" directly in the muscle cut. A plexiglass plate is fitted on the surface of the cross section of the meat. The surface of the cross section has been preliminarily dried with filtering paper. The number of points is counted up(intersections of the millimetre grid) aligning with the fat fraction (T). Then the number of fatty inclusions is counted up (no matter their size) which are crossed by the line which is located within the boarders of the muscle being investigated. It is sufficient to count up the number of fatty inclusions on the lines per 0.5 cm in the horizontal and vertical directions. The counting up by the vertical and horizontal lines is effected in succession and independently of each other. The number of inclusions (b) and the length of the lines (g) is recorded in centimetres; the first (Cb) and the second (Cg) data are summed up separately in both directions; then the number of fatty inclusions is determined per one central 10 cm long line according to the following formula:

$$P = \frac{Cb}{0.1\ Cg}$$

where P - break of fat fraction, i.e. the number of fatty inclusions per 10 cm long line;

When photographing an object, it is possible for this purpose to set on it a square of a certain size and made of wire (Fig. 5). When printing, this square is aligned with the projection of the magnifier.

The photograph is projected at a screen sat at a distance of 3 m (at this distance the projection of the millimetre grid aligns with the grid of the screen). The number of points and inclusions is counted up in the same way as in the first case. A polar planimeter is used for determining in the photograph the total area of the muscle cross section being investigated. Calculation and estimation of "marbleness" is effected to the formula given earlier.

Example of calculation according to photographs given in figures 3 and 4;

$$\Pi_3 = 73.2; \quad \Pi_4 = 70.9; \quad Cb_3 = 71; \quad Cb_4 = 160;$$

$$T_3 = 318; \quad T = 270; \quad Ж_3 = \frac{T_3}{\Pi_3} = \frac{318}{73.2} = 4.4\% ;$$

$$Ж_4 = \frac{T_4}{\Pi_4} = \frac{270}{70.9} = 3.8\% \qquad Cd_3 = 164; \quad Cd_4 = 284 \text{ cm}$$

$$P_3 = \frac{Cb_3}{0.1\ Cd_3} = \frac{71}{16.4} = 4.3; \quad P_4 = \frac{Cb_4}{0.1\ Cd_4} = \frac{160}{28.4} = 5.6$$

The area of the fat fraction (Ж) in Fig.3 is somewhat larger than in Fig.4 but the distribution (P) of the fatty inclusions is considerably different, i.e. it is better in Fig.4. As is seen, these data make it possible to estimate

Cb - total sum of fatty inclusions that are crossed by lines according to which the counting up is effected;

Cg - total length of lines according to which the counting up is effected.

The contours of the muscle being studied is drawn on the tracing paper (the area of the muscle cut).

The polar planimeter is used for determining the area (П) of the muscle being investigated according to the contours drawn on the tracing paper.

The area, occupied by the fat fraction, is determined in percent from the total area of the cross section of the muscle cut being investigated according to the following formula:

$$Ж = \frac{T \cdot 100}{П \cdot 100} = \frac{T}{П}$$

where Ж - area of fat fraction (%),

T - number of points (intersections on millimetre grid), aligning with the fatty inclusions when counting up,

П - total area of cross section of muscle cut being investigated,

100 - in the numerator - conversion to percent, and in the denominator - total number of points (intersections on millimetre grid) on the entire area of the muscle cut being investigated (1 cm^2 has 100 points).

b) Estimation of "marbleness" by photograph.

Photographing of the surface of a muscle cross section, preliminarily dried with filtering paper, is effected with measuring of the height and width of the object so as to provide a photograph of natural size.

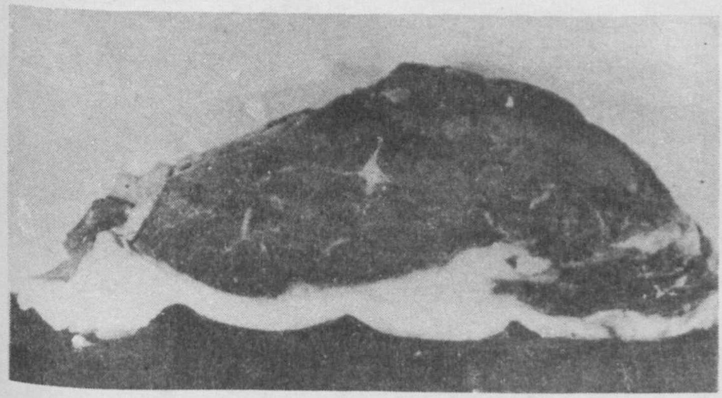

Fig.1

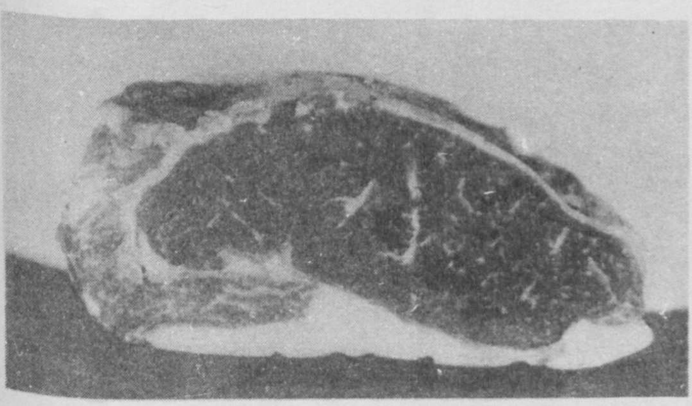

Fig.2

objectively the degree of "marbleness".

We have correlated the areas of fatty inclusions (X) with the chemical analysis of the preparation of the longest muscle in the back according to 38 controls. The material has been treated statistically and we have obtained a very high coefficient of correlation between these data. B = 0.91 at a coefficient of partial regression of the area of the fat fraction according to the data of chemical analysis Γ= 0.42. The degree of significance of these coefficients is 0.01. It is clear from the coefficient that the figure, determined by the area of the fatty inclusions, surpasses the data of chemical analysis. This is understandable because different data of fat are compared in this case: volumetric and weight.

Both methods do not eliminate each other. The applicability of the methods depends on the definite conditions under which the researcher works, but the second method is distinguished by higher precision and documentary character that are required in scientific research. Beside that, it can be used to success when treating the curves of the morphological structure of the cross section of a carcass, obtained by means of ultrasound (I!R!Stoffer, 1961), and when estimating the "marbleness" of a live animal according to these curves.

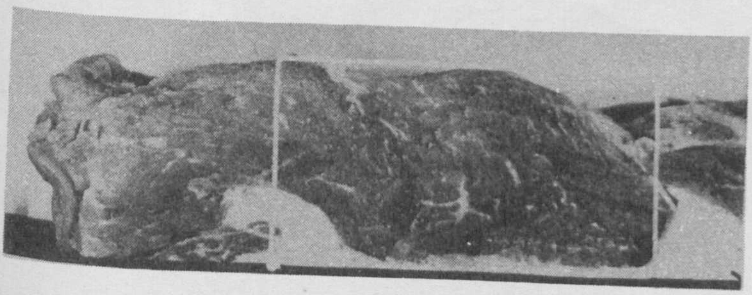

Fig.5

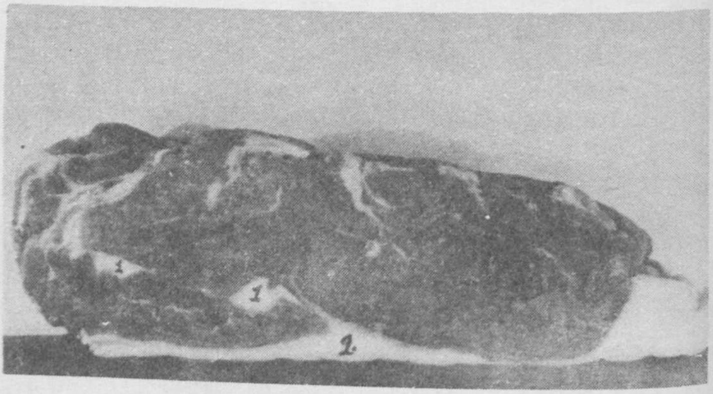

Fig.3

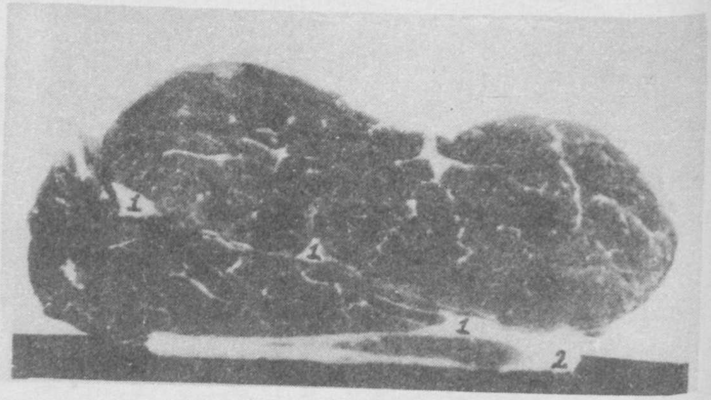

Fig.4

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