INSTRON-CHARACTERISTICS OF ANATOMICALLY SEPARATED MUSCLES OF MEAT RAW MATERIALS

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As the investigations carried out in VNIIMP have shown, these characteristics as well as the water binding, largely depend on microstructural and histological properties of the raw materials. The interest to their studying and prediction is pre-determined by the necessity to substantiate the effective technological and economically advantageous methods of raw materials processing, ensuring proper quality of products. The generalization of the published data, concerning the results of the investigations of compression-deformation and damaging effects on different muscles belonging to quality groups PSE, NOR and DFD, suggests that independent measurements of conventionally comparable deformation and damaging forces by different devices often give opposite directionality of the pattern of the change of these forces which contradicts the logic of microstructural and histological analysis. To minimize the amount of artefacts in the investigations, the results of which are presented below, the procedure as developed at the Moscow State University of Applied Biotechnology by Lipatov N.N. (jr) and Scherbinin A.A. was used. This procedure has been accomplished with the help of a ten-blade measuring cell "Kramer-Shia-Press" of the universal testing machine "Instron-1122" and makes it possible during one measuring step to obtain an integral result equivalent to the arithmetic mean of 16 measurements of compression-deformation characteristics with the help of the measuring cell "Magnum-Taylor" or compression-damaging effects with the help of the measuring cell "Warner-Bratzler". Table 1 shows the results of the calculation of deformation-damaging stress Q and deformation-damaging work A, as determined on the basis of the results of the measurements* of the corresponding force according to the formula presented below.

$$Q = \frac{P_{max} \cdot \delta}{\pi R^2 h_{cp}\, n} \quad Нм^{-2}, \text{ where} \qquad (1)$$

P_{max} - maximum force, as perceived by a strain gauge in cutting the sample, H;
δ - width of vertical slot (δ = 0.003), m;
R - radius of the product sample, m;

h_{cp} - averaged height of the product sample, m;
n - n of samples charged into the cell.

$$A_{рез} = \frac{S\, V_{тр}\, \delta}{V_{л}\, \pi R^2 h_{cp}\, n} \quad Дж\, м^{-2}, \text{ where} \qquad (2)$$

$V_{тр}$ - traverse movement speed, m/s;
$V_{л}$ - chart strip movement speed, m/s;
S - area under the curve "deformation force" restricted by the vertical from the left, determining the time of coming out of the ten-blade knife through the slots in the bottom of the cell (in our case at the of distance $52 \bullet 10^{-3}$ m from the intersection point of the curve with the line P=0 of chart strip, Nm.

Table 1

Instron-characteristics of main beef muscles of different quality groups

Name of the muscle	PSE		NOR		$P_{ст}/P$	$K_{пр}$	$K_{ст}$	DFD	
	Q x 10^{-5} Pa	A x 10^{-3} kJ/m^2	Q x 10^{-5} Pa	A x 10^{-3} kJ/m^2				Q x 10^{-5} Pa	A x 10^{-3} kJ/m^2
L.dorsi lumb.	1.54	0.97	1.82	1.13	0.11	10.27	1.04	2.09	1.28
L.dorsi	1.59	1.00	1.88	1.18	0.11	10.72	0.99	2.12	1.32
Ad. fem.	2.28	1.39	2.69	1.64	0.16	10.25	1.00	2.95	1.83
Glut. med.	2.31	1.43	2.72	1.70	0.17	10.00	0.97	3.07	1.88
Tric. brachii	2.43	1.51	2.82	1.76	0.15	11.73	1.14	3.21	1.97
Semim.	2.53	1.55	2.98	1.85	0.16	11.56	1.12	3.30	2.05
Pectin.	3.01	1.93	3.59	2.21	0.19	11.63	1.13	4.11	2.46
Biceps fem.	3.10	2.01	3.65	2.27	0.19	11.94	1.16	4.12	2.51
Quadriceps fem.	2.95	1.86	3.48	2.15	0.15	14.33	1.40	3.92	2.43
Supraspin.	3.57	2.21	4.15	2.57	0.18	14.27	1.39	4.63	2.88
Semitendinosus	2.82	2.33	4.31	2.69	0.19	14.15	1.37	4.81	3.01
Subcut. collii	5.16	3.19	6.07	3.75	0.27	13.88	1.35	6.72	4.19
Intraspin.	5.02	3.08	5.91	3.63	0.24	15.12	1.47	6.62	4.05

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* The investigations were carried out jointly with doctor Scherbinin A.A.

The analysis of the data of this table suggests that by numerical values, characterizing the integral structural-mechanical properties, especially, those connected with deformation-damaging work, the anatomically separated muscles, for instance NOR beef, can be divided into 5 groups. The first group includes: longissimus dorsi lumbarum and longissimus dorsi for which the values of integral work are in the range from 1.0 to 1.5 kJ/m^2.

The second group includes four muscles: m. Adductor femoris, m. Gluteus medius, m. Triceps brachii, m. Semimembranosus for which the amount of integral work is in the ranges from 1.5 to 2.0 kJ/m^2

The third group includes: m. Pectineus, m. Biceps femoris, m. Quadriceps femoris for which the amount of integral work is in the range 2.0 - 2.5 kJ/ m^2.

M. supraspinatus and m. semitendinosus are in the fourth group for which the amount of integral work is around 3.0 kJ/m^2.

The fifth group includes m. Subcutaneous colii and m. infraspinatus for which the amount of integral work is in the ranges from 3.5 to 4.0 kJ/m^2

Along with the data about structural and mechanical properties of raw materials, Table 1 shows the numerical values of the ratio of the mass fraction of connective tissue proteins P_{CT} to the total protein in anatomically separated muscles as calculated on the basis of the data of mass fractions of the total, muscle and connective tissue proteins as contained in anatomically separated muscles of different quality groups PSE, NOR and DFD. Simple calculations interrelating the integral work A and the ratio P_{CT} / P make it possible to determine the numerical values of the coefficients of proportionality $K_{пр}$, the ratios K_{CT} of which characterize the influence of revealed under the microscope the structural peculiarities of muscles (including their pre-disposition to autolityc destruction) on their consistency. The calculated values of this coefficient - K_{CT} are also shown in Table 1.