EXPRESS—METHOD AND DEVICE FOR MEAT AND MEAT PRODUCTS QUALITY EVALUATION

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At the present time the known methods of guality evaluation of meat and meat products by their colour are evaluation by experts and the instrumental ones.
The advantage of instrumental methods consists in objectivity of measurements and possibility of obtaining quick information about quality of the object. Methods of meat sorting based on measurements of different colour characteristics of carcasses gained wide use in the meat industry. The device "Colormet" and its modification "Colormet Fibre Optic" make it possible to differentiate between PSE pork and normal pork during 1 sec; a reflectometer "Retrolux" (France) is used for colour measurements of veal at production lines of meat processing plants.
The objective of the present work was to develop a rapid method of quality evaluation of meat raw materials based on measurements of the spectrum of reflection of cattle muscle tissue. Spectral characteristics of muscles of different quality groups - PSE, N and DFD were studied. For this purpose the meat of young bulls (up to 2 years) of black and white breed was selected. pH was determined directly in m. long. dorsi at the level of 9 - 12 ribs. From the same muscle the samples were taken, investigated on spectrocolorimeter "Spectrofoton": coefficient of reflection in the range 380-720 nm was measured and coordinates of colour and chromaticity - in system XYZ, L, a, b.
Analysis of the obtained reflectance spectra of meat of different quality groups has shown that in the range 380-450 nm an insignificant change of coefficient of reflection occurred as compared to a change in the region of spectra with longer waves.
Statistical treatment of the experimental data made it possible to determine the boundaries in the reflectance spectra which corresponded to meat of different quality groups. It was found that the overall coefficient of reflection depended mainly on the quality group of raw materials.
The larger is the wavelength, the higher is the value of coefficient of reflection, which agrees with the evaluation by the experts. Thus, in order to differentiate between different quality groups of meat, it is not necessary to register the whole spectrum of reflectance: measurements in the wavelength range 500-720 nm are sufficient. Based on the investigations a device for rapid evaluation of meat raw materials quality by colour was developed. A physical model of the instrument were eye analyzers of live organisms.
As is known, the pigments of eye retina, having different absorption spectra act as a photosensitive material. The signals about received colour are treated in several layers of cells and then go to the brains. A device for recognition by colour and revealing the defects of meat materials (PSE and DFD) with the aim of their preliminary sorting and differentiated processing is developed using the optical principle of the eye.
The principle of operation of the device is based upon measurement of diffusively reflected light from muscle fibres of meat materials during then illumination at a particular spectral region (500-720 nm). The device consists of an outside needle with a handle (optical fibre probe) and a recording system, mounted separately in the housing, connected with the handle by a cable. The housing of the needle contains a light emitting diode, a lens, support and measuring photodiodes, diaphragms and a light conduit.
The divice works as follows:
After introducing the needle into the object being analyzed, the device is switched on a light emitting diode is lit and the light of the latter is focused by the lens on the upper end of the light conduit. A part of light is reflected by the surface of the light conduit and falls onto the support photodetector. The light as entered into the light conduit is spread over it up to an outgoing end of the needle and goes out into the object being analyzed. A part of light is reflected from the object, comes back into the light conduit, goes through it, reflects from its end surface and goes to measuring photodetector. To reduce the number of focusings the signals from the photodetectors are amplified by pre-amplifiers, located directly in the handle and go to the main amplifiers and then to the dividing block, where their ratio is found. Then a signal proportional to the fraction of the reflected light, goes to the analog-digital converter and is lit at a digital panel of the indicator. These readings are read out by operator.
Testing of the prototype was carried out at a meat processing plant. Young animals with the consideration of their breed, sex, age, fattness were selected from the same farm and transported at simiral conditions. These were young bulls, up to 2 years old, of black and white breed, reared under the same conditions of fattening and handling.
Taking into account that the degree of animals bleeding has an essential influence on meat colour, and the process of bleeding itself directly depended upon the conditions and regimes of stunning, special attention was given to the observation of these parameters during slaughter. Reception, pre-slaughter handling and processing were carried out according to the requirements of regulations in force. Conditions of stunning, process of bleeding and carcasses processing were similar for all the test stock.
The animals were stunned in special boxes by electrical current of commercial frequency (50Hz), voltage 90-100 v, lenght 8-10 s, by a single application of electrical stick to back of head with sticking the hide to the depth not more than 5 mm. The animals were bled not later than i min and a half after stunning: total length of bleeding the carcasses - 8-10 min.
45-60 min after stunning,pH was determined with the help of portable pH meter (TMB ULTRA

X type 3002, BRD) directly in the carcass m. long. dorsi at the level of 9-10 rib. After 24 hours of cold storage at 0-4°C, pH24 was determined again at the same part of the muscle. M. long. dorsi was selected as an object of investigations. This selection was due to the fact that it was uniform in composition, and the reliable results can be obtained, which can be compared. From the point of view of growth of the animal this muscle shows in a most objective way the development and state of musculature. The papers of Gronn R. , Damon R. (1960), Gravent H. (1963) have shown that a high correlation exists between quality features of this part of the back and whole carcass. Measurement of colour intensity or the reflected light was carried out after chilling the carcasses during 24 hours; the measurement were not carried out in hot carcasses, because by this time the glycolysis process of the normal meat has practically finished and the pigment myoglobin turned into MBO (oxymyoglobin, and the colour has changed from purple to bright red. As the intensity of meat colour is in direct relation with the beginning and completing rigor mortis, and the rate and depth of meat glycolysis of PSE and DFD meat significantly differs from normal meat, so the colour of this meat will respectively differ. This factor, other things being equal, allows to consider the index of intensity of meat colour as a determining one in sorting the carcasses. Meat colour measurement were evaluated with the use of fibre optic probe, by means of sticking the muscle tissue with a "penetrating probe' directly in the muscle l. dorsi at the level of 9-10 rib to the depth of 50-70 mm. 30-40 s later on a digital panel of the registrating block readings were registered which were compared with the reference scale. Simultaneously in m. l. dorsi pH was measured in hot meat and after 24 hours of chilling (pH24). The correlations of carcasses sorted out into quality groups according to pH value and colour, are shown in the Table.

Table. Correlations of carcasses of different quality

Sorting by value:	Quantity of carcasses in the group, %		
	PSE	N	DFD
pH	16	10	74
Intensity of colur	15	9	76

The experiments carried out and the data obtained suggest that the proposed express method and a device for its accomplishment permit to determine the quality of meat quickly and with high degree of accuracy. Wide testing of the device under commercial conditions allowed to develop a reference scale for sorting of cattle meat by colour, showed high reliability of the device, its convenience in operation, portability and good convergence of measurements.