IMPEDANCE MODULE AND PH-VALUE IN THE QUALITY EVALUATION OF BREAST MUSCLES OF BROILERS

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Background

The velocity of glycolytic processes after slaughtering influences the technological meat quality of broilers. With the normal glycolysis rhythm, the pH-value in pectoral muscles is between 5.9 and 6.0. More rapid glycolysis, higher than usual, produces a quantity of lactic acid (pH 5.6-5.7), releases more heat, cellular proteins are denaturated, cellular membranes are injured and the meat loses water more intensively. Retarded glycolytic processes (pH 6.4-6.7) also lead to undesirable meat conditions. The appearances measured are described as PSE and DFD syndrome respectively (Niewiarowicz, 1971).

The chemical processes in the meat also influence the bioelectrical characteristics of muscle. The change in concentration of dissociated ions in meat leads to the change of impedance module and phase angle (Tonković et al. 1990; Kralik et al. 1991, 1992). In the research performed by Petričević and Kralik (1993), under application of a Meat-Checker Device, a significant relationship (r = 0.416**) between pH-values and impedance module in the m.pectoralis thoracicus 15-20' p.m. has been determined. This work examined the frequency of pH-values and impedance module, their variability and the mutual relationship in the m.pectoralis thoracicus of broilers 80' p.m. The purpose of this work was to determine the course of the glycolytic processes and the frequency of possibly undesirable appearances in the meat. Performing the measurement on a great number of samples, the intention was to determine and practise application of the device on the slaughtering line of broilers.

Methods

The research on the physical and bioelectrical characteristics of muscles was performed on the carcasses of Ross-208 broilers at the age of 45 days. The measurement was performed 80' p.m. after the carcasses had passed through the cooling chamber. The meat temperature at the measuring time was kept between 2 and 4°C. The Meat-Checker Device was used to measure the impedance module, working on the frequency of 1 kHz and constructed at the Faculty of Animal Science in Kaposvár, Hungary. It is intended for the detection of exudative appearances in meat which appear as a result of changes in the concentraion of ions in the intercellular liquor. The measurement of mass of broilers' carcasses and pH-values and impedance module was performed on 500 meat samples. The prick-point was always m.pectoralis thoracicus (left side) and the sound prick was directed from the vertical side transversal to the direction of muscle fibres.

The pH-value of meat was meaured with the pH-meter MA 5722 "Iskra" Kranj, Slovenia in the same inlet. The research results were prepared on a PC using normal statistical methods (SPSS programme).

Results and discussion

The measuring results of pH-values and impedance module in m.pectoralis thoracicus 80' p.m. are shown in Tables 1 and 2 .

The pH-values measured on 500 samples of breast muscles of Ross broilers show that the meat possesses satisfying technological characteristics. The concentration of hydrogen ions, as an indicator of glycolytic processes in the meat, indicated that these processes developed by a normal course. Taking into consideration the fact that the measurements were performed 80' p.m., according to the assertion of Stewart et al.(1984) and Fletcher (1992), a more significant decrease in pH-values in meat could occur. The authors cited point out that glycolysis in breast muscles develops very fast, so that during the first hour p.m. the pH can decrease to 5.75 (post rigor) value. By analysing the frequency of appearance of pH-values (Table 1) it can be seen that only 0.4% of samples had pH<5.8, in 69.6% of samples of meat pH-values were <6.4 and 30% of samples had pH≥ 6.4. The variability and the mean value pH of meat, evidenced in this work, are identical, considering the measuring time, to those formerly documented in the research with the same broiler hybrids (Kralik and Petričević,1993). The exception represents a higher frequency of samples with pH≥ 6.4. The data on impedance module of breast muscles, measured by Meat-Checker Device, show that electricity conduction by the analysed meat significantly varies (V = 39.65%). Most samples (58.4%) show a resistance in muscles of 200 to 360 Ω. The mean value of impedance module (Table 2) was 263.34±4.67. Concerning the connection between pH 80' and impedance module, the measurements on 500 meat samples showed the presence of a high, positive and very significant connection (from r = 0.639** to r = 0.648**). In our previous research (Petričević and Kralik, 1993), when the measurement was performed 15-20' p.m., we observed a moderately strong, positive connection between pH-values and the impedance module (r = 0.42**). The research by Kunst and Pingel (1992) has also proved that the connection between pH-values and the impedance module increased if the measurement was done 80' p.m., but also because of work practicality in the slaughter house it is recommended that the bioelectrical characteristics be measured in combination with the determination of meat pH-values immediately after cooling of the broilers' carcasses and before normal quality classification.

Since Klosowska et al.(1979) classify poultry meat according to the pH_1-values as 5.6-5.7=PSE meat; 5.9-6.2=normal meat and 6.4-6.7=DFD meat, it is necessary to point out that in our research, by samples with pH=6.4 - through an organoleptic test, we classed only 0.5% of samples as DFD meat type. This cognition speaks in favour of the results obtained through research done by Bingwang and Zhongyang (1992), who have also found out that pH_1-values are quite high in the samples of broilers' breast muscles ($\bar{x}$= 6.32) but they did not mention the appearance of DFD meat.

Table 1. Frequency of pH-values and impedance module

pH-value	n	%	Impedance module (Ω)	n	%
5.60 - 5.79	2	0.4	40 - 119	46	9.2
5.80 - 5.99	18	3.6	120 - 199	103	20.6
6.00 - 6.19	127	25.4	200 - 279	122	24.4
6.20 - 6.39	203	40.6	280 - 359	140	28.0
6.40 - 6.59	134	26.8	360 - 439	66	13.2
6.60 - 6.79	14	2.8	440 - 519	20	4.0
6.80 - 6.99	2	0.4	520 - 599	3	0.6
Total:	500	100.0	Total:	500	100.0

Table 2. Mean value, variability and relation among pH-value and impedance module

Indicator	$\bar{x}$	s	$s_{\bar{x}}$	V	x_{min}	x_{max}
pH-value	6.29	0.17	0.01	2.70	5.62	6.80
Impedance module, Ω	263.34	104.44	4.67	39.65	40	590

Correlation coefficient:		Regression equation:
Linear	r = 0.639**	$y' = -2142.899 + 382.365x$
Exponential	r = 0.646**	$y' = 5.606 \cdot 10^{-3} \cdot e^{1.694x}$
Logarithmic	r = 0.640**	$y' = -4156.947 + 2403.559 \cdot \ln x$
Potential	r = 0.648**	$y' = 7.175 \cdot 10^{-7} \cdot x^{10.673}$
Square	r = 0.642**	$y' = -7909.607 + 2219.591x - 146.218x^2$

Conclusion

The research results reffering to the relation between pH (80' p.m.) and the impedance module in breast muscles of Ross-208 broilers (n=500) showed the following:

1. The mean value pH 80' of breast muscles was 6.29±0.01. The variation expanse of the indicator ranged from 5.62 to 6.80.
2. The mean value of impedance module, measured at the same time and at the same prick point, was 263.34±4.67 Ω and the variation expanse ranged from 40 to 590 Ω.
3. The connection between pH 80' and the impedance module is positive and strong (r = 0.648**) and for the description of the appearance corresponds to the regression eqaution: $y' = 7.175 \cdot 10^{-7} \cdot x^{10.673}$.
4. The research has shown that the Meat-Checker Device is suitable for quick detection of quality in breast muscles of broilers.

Pertinent literature

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