The relationship between acidification (pH) and meat quality traits of polish white breed pigs

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Received: 11 May 2021 / Revised: 21 July 2021 / Accepted: 24 July 2021 / Published online: 31 July 2021
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Abstract

The paper presents the results of a study on the relationship between acidification (pH) and standard quality characteristics of the meat of Polish Large White × Polish Landrace pig crossbreds. The meat for the study was obtained from 184 F₁ Polish Large White × Polish Landrace fatteners from a herd free of the stress-sensitivity gene. The obtained results were analysed in groups formed according to the meat's measured pH₄₅ values (≤ 6.3 ; 6.3–6.7; > 6.7) and pH_u values (≤ 5.3 ; 5.3–5.6; > 5.6). Increasing measured pH₄₅ values were paralleled by greater water-holding capacity and plasticity, lower drip loss, darker colour L* as assessed visually and with equipment, and greater content of muscle pigments ($P < 0.01$) of the evaluated meat. Higher pH_u values had a more pronounced impact on WHC, free drip loss, tenderness, water content, and colour parameters: a*, b*, chroma C* ($P < 0.01$), and hue angle h° ($P < 0.05$). The obtained simple correlations between pH₄₅ and pH_u acidity and meat-quality characteristics indicate that the measured pH₄₅ value was correlated more closely than ultimate acidification ($P < 0.01$) with visually assessed colour intensity, tactilely assessed meat hardness, colour lightness L* ($P < 0.01$), hue angle h° ($P < 0.05$), and muscle pigment content. On the other hand, pH_u was more strongly correlated with water-holding capacity, drip loss, meat tenderness as well as water and protein content ($P < 0.01$).

Keywords Pigs · Acidity pH · Meat quality · Pork

Introduction

The quality of obtained pork has a great importance to both the meat industry and consumers. The world population of people is steadily increasing, especially in developing countries. Therefore, the demand for high-quality protein is increasing, which can be supplemented by meat and its products, which are an important food element in the human diet [1]. It is worth noting that the quality of obtained meat, especially pork, is influenced by many factors. Pork quality is defined as a sum of many significant quality characteristics, i.e., pH, water-holding capacity, colour, tenderness, taste, and shelf life, all of which are determined by genetic and environmental factors [2–5]. However, intensive selection of livestock animals has resulted in variety negative

side effects, including poorer meat quality and lower disease resistance to pigs [6]. Since 2008, to ensure high meat quality, modern pig production technologies employ marker-assisted selection (MAS), which facilitates reproductive exclusion of animals burdened with the stress-sensitivity gene (*RYRI*) that affects the incidence of PSE meat [7].

When an animal is still alive, the muscle tissue has neutral pH from 7.0 to 7.2. Muscles begin to transform into meat upon exsanguination. The oxygen deficit stops oxidation processes, and anaerobic processes of glycolytic transformations intensify until all glycogen supplies in the muscles are used up. The intensity of glycolytic transformations leads to accumulation of lactic acid and rapid acidification of muscle tissue, assayed by measuring the concentration of hydrogen ions (pH) [8].

Muscle acidification 45 min after slaughter (pH₁) and ultimate acidification (pH_u) are key factors that determine the quality of pork [2, 9–12]. Muscle pH measurements 45 min after slaughter (pH₁) are used to predict meat quality and its classification in respect to PSE (pale, soft, exudative), normal, and DFD (dark, firm, dry) types [13]. The values of meat acidification measured 45 min after slaughter

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lower than 5.8 as typical of PSE meat, values from 5.8 to 6.0 as characteristic of semi-PSE meat, and values above 6.0 as characteristic of normal meat. Limit values of pH_i measurements are used by most researchers as meat quality classification criteria [8, 10, 12–16].

Ultimate pH (pH_u) is an equally relevant determinant of meat quality that affects meat water-holding capacity, colour, tenderness, and shelf life [17, 18]. The correlation between pH_u and meat colour indicates that the colour gets darker with increasing pH_u values [5, 19–23]. Acidification of meat (pH_u) measurements exceeding 5.7 ensure homogeneous pork quality with proper water-holding capacity and colour, pH_u limit values in the range 5.6–5.9 are desirable for normal meat, whereas those exceeding 6.0 are typical of DFD meat, which is excessively dark, firm, and dry. In turn, the low pH_u values indicate more profuse free drip loss during meat storage [14, 15, 17]. According to Bidner et al. [19], the best quality of tenderloin is achieved with moderate acidification (5.4–6.0), while the American National Pork Producers Council recommends that the ideal pH_{48} exceeds 5.7 for good quality tenderloin [14].

The objective of this paper was to evaluate correlations between meat acidification measured as pH_{45} and pH_u and other quality characteristics of the meat of Polish Large White x Polish Landrace pigs.

Materials and methods

The studies were part of a routine production cycle in the swine production sector therefore no individual approval of an ethics committee was required for carried out this study. The experimental animals were slaughtered in a registered meat processing plant. The major research subject was to analyze the meat quality (Directive No. 2010/63/EU).

Animals and sampling

Meat for the study was obtained from 184 F₁ Polish Large White × Polish Landrace (PLW × PL) fatteners crossbreds: 50% gilts and 50% barrows. The fatteners originated from a herd free of the stress-sensitivity gene (*RYR1*). The animals were kept at the same farm, in identical environmental conditions, in compliance with animal welfare regulations. They were fed ad libitum with identical complete feeds in line with standard requirements. Upon completion of fattening, the animals were individually weighed and subsequently transported to an abattoir over a distance of approximately 100 km. The animals were slaughtered according to the applicable procedures after a 2-h pre-slaughter rest. The average body weight of the slaughtered fatteners was 103 ± 7.3 kg (SD).

Meat analysis

Meat acidity was determined in the lumbar section of *m. longissimus dorsi* 45 min after slaughter (pH_{45}) and 48 h after slaughter (pH_u) with an Elmetron CP-401 pH meter with a knife blade electrode. The device had been calibrated using a pH 7.0 and pH 4.0 buffer by Elmetron.

Meat quality assessment was conducted 48 h after slaughter on *m. longissimus lumborum* (LL) muscle specimens collected during carcass cutting 24 h after slaughter and stored in a cold room at 4–6 °C. Determination of water-holding capacity (WHC) was performed using the method given by Grau and Hamm [24], as modified by Pohja and Niinivaara [25]. Samples of comminuted meat weighing 300 mg were put onto Whatman 1 paper, locked between two glass plates, and subjected to an even 2 kg load for 5 min. The area of the resultant stain was used to calculate the percentage of free water in the meat, with 1 cm² of stain assumed to correspond to 10 mg of water. The area of the meat juice stain was determined using a LUCIA computer analysis system (System for Image Processing and Analysis, version 4.82.2004). Meat plasticity was evaluated based on areas of flattened 300 mg meat samples that had been used to measure WHC [26].

Free meat drip loss within 48 h of storage was assayed pursuant to Honikel [27] on ca. 2.5-cm thick slices that included perimysium. The samples were placed into plastic bags and weighed. Several cuts were made in the bottoms of the bags to allow the meat juice to drain out. The contents of each bag were then placed in a second bag and hung so that the dripping juice could not come into contact with the meat samples. The samples were hung for 48 h in a cold room at a temperature of 2–4 °C. After that period, the samples were weighed again. The differences in weights before storage vs. after 48 h of storage were used to calculate the percentage of free meat drip loss.

Shear force measurements were performed with the aid of an INSTRON 3342 strength tester with a Warner–Bratzler shear fixture (WBSF), following methods provided by Szalata et al. [28]. Meat samples with an approximate mass of 120 g were heated up in a water bath to achieve internal temperatures equal to 70 °C. The heat treatment was conducted in a 0.85% NaCl solution. Ten columns with a diameter of 10 cm each were then cut out of the meat along the muscle fibres and subsequently sheared perpendicularly to fibre orientation. The results were expressed as maximum shear force in newtons (N).

The chemical composition of the meat (water, total protein, and intramuscular fat content) was determined according to the Polish Standard PN-A-82109:2010 [29] by means of near-infrared transmission (NIT) spectrometry using artificial neural network (ANN) calibration with the FoodScan device manufactured by FOSS.

Visual and tactile evaluation was conducted 48 h after slaughter on slices of raw meat weighing 120 g. Visual and tactile evaluation of the meat was conducted by a team of ten trained individuals with 4 years of experience in pork evaluation. The raw meat was visually assessed for visual colour intensity on a 6-point scale [30]: 1 point – very pale meat, 6 points—dark purple meat. Marbling was assessed using Canadian and U.S. models on a 10-point scale [31, 32]: 1—meat without flecks, 10—very high marbling. The meat was also tactilely assessed for firmness on a 7-point scale [30]: 1—very hard, —very soft.

Meat colour was also measured on raw meat slices 48 h after slaughter using a Minolta CR 310 photoelectric colourimeter (Konica Minolta, Japan) with a 50-mm measuring port diameter. The device was calibrated against a white CR310 reference plate with the following coordinates: $Y=92.80$, $x=0.3175$, and $y=0.3333$. Colour parameters were established in the CIE $L^*a^*b^*$ system (L^* – lightness, a^* – value representing redness, b^* – representing yellowness) [33] with the use of illuminant D65 and a standard 2° observer. Chroma (C^*) and hue angle (h°) were calculated according to the formula provided by Beattie et al. [34] and Brewer et al. [35]: $C^*=(a^{*2}+b^{*2})^{1/2}$, $h^\circ=(\tan^{-1}(b/a))$.

Muscle pigments were colourimetrically determined using the method of Hornsey [36]. Forty millilitres of acetone/water/concentrated HCl mixture with a ratio of 40:2:1 were poured over the comminuted meat samples (10 g) and extracted for 1 h. After filtration, absorbance of the investigated solutions was measured using a Marcel Media spectrophotometer at a wavelength of 640 nm. The optical density (E) value was multiplied by a factor of 680 to obtain the correct hematin concentration, expressed in micrograms of hematin per 1 g of meat.

Statistical analysis

The obtained results of the study were aggregated into and analysed in groups formed according to the pH_{45} value of meat (≤ 6.3 ; 6.3–6.7; > 6.7) and according to pH_u values (≤ 5.3 ; 5.3–5.6; > 5.6) as per normal distribution of the characteristics (Gaussian curve).

Classification into groups by pH_{45} and pH_u values of the *longissimus lumborum* muscle was conducted in order to verify the impact of pH values on meat quality 45 min and 48 h after pig slaughter.

The results were processed statistically as follows: arithmetic mean, standard deviation (SD), and standard error of the mean (SEM) were calculated. The data were verified for variance homogeneity by a Levene's test; in cases of absent variance homogeneity, statistical significances occurring between the groups were calculated by means of a non-parametric Kruskal–Wallis test. The probability value $P < 0.05$ was considered statistically significant.

Pearson coefficients of simple correlation between pH_{45} and pH_u post-slaughter values and the other meat quality characteristics were calculated. All calculations were performed using Statistica PL.13.3 data analysis software [37].

Results

Table 1 shows the technological properties of the meat, its chemical composition, its visual and tactile evaluation, as well as colour and muscle pigment content in relation to initial pH_{45} . The 184 meat samples were evaluated in three pH_{45} ranges as follows: below 6.3 ($n=27$), 6.3 through 6.7 ($n=123$), and above 6.7 ($n=34$). Average pH_{45} values in the respective groups were 6.07, 6.45, and 6.86; these were typical of meat with proper initial acidification ($P < 0.01$). Higher pH_{45} values were paralleled by higher pH_u values ($P < 0.01$). Meat with the lowest pH_{45} values ≤ 6.3 (group I) was characterised by lower water-holding capacity (WHC) and poorer plasticity compared to meat with high pH_{45} values obtained from animals of group III ($P < 0.01$). The noted free drip loss in meat storage was higher in group I than in groups II and III ($P < 0.01$). Visual evaluation of raw meat colour revealed lighter meat in the low pH_{45} group and darker meat in the high pH_{45} group, as was confirmed by colourimetry with the Minolta device (colour parameter L^*). The differences between all of the groups were statistically significant ($P < 0.01$). Yellowness b^* was significantly different in groups I and II ($P < 0.05$), while hue angle h° varied across the assessed groups depending on pH_{45} values ($P < 0.01$). The highest muscle pigment content was shown in the meat from group III compared to groups I and II ($P < 0.01$).

Results of raw pork quality assessment parameters in relation to ultimate meat pH determined 48 h after slaughter are presented in Table 2 in three pH_u groups: I ≤ 5.3 ($n=10$); II 5.3–5.6 ($n=164$); III > 5.6 ($n=10$). The ultimate meat pH (pH_u) significantly varied across groups I, II, and III ($P < 0.01$). In contrast, initial pH_{45} showed that there was a highly significant statistical difference between groups I and III ($P < 0.01$) and a significant difference between groups II and III ($P < 0.05$). Meat water-holding capacity (WHC) was significantly greater in group III than in group II ($P < 0.01$). The highest drip loss during the 48 h of storage and simultaneously the best tenderness was achieved in groups I and II compared to group III ($P < 0.01$). The highest water content in the meat was found in the group in which the ultimate pH was the highest (group III), in comparison to groups I and II ($P < 0.01$). Visually evaluated meat colour was darkest in group III compared to group II ($P < 0.01$). No significant variation in colour lightness L^* measured with the relevant equipment was found between the meat groups; however, there were some statistically significant differences in colour

Table 1 Results of the technological properties, visual and tactile evaluation of meat colour and muscle pigment content of pork (mean value and standard error) in relation to pH₄₅ acidity

	Group—pH ₄₅			SEM	<i>P</i>
	I ≤ 6.3	II 6.3–6.7	III > 6.7		
Number (<i>n</i>)	27	123	34		
pH ₄₅	6.07 ^A	6.45 ^B	6.86 ^C	0.020	0.001
pH _u	5.40 ^{Aa}	5.45 ^b	5.49 ^B	0.007	0.002
WHC (% of free water)	21.34 ^A	20.19	19.14 ^B	0.216	0.009
Plasticity (cm ²)	2.35 ^a	2.41	2.65 ^b	0.033	0.029
Drip loss (%)	5.53 ^A	3.74 ^B	3.04 ^B	0.154	0.001
WBSF (N)	40.44	44.29	49.05	1.071	0.095
Water content (%)	73.72	73.84	73.96	0.081	0.767
Total protein content (%)	23.30	23.10	23.02	0.056	0.658
IMF (%)	1.61	1.81	1.60	0.061	0.322
Visual colour intensity (1–6 scale)	2.5 ^A	3.5 ^B	4.0 ^C	0.055	0.001
Marbling (1–10 scale)	2.1	2.3	1.9	0.076	0.147
Firmness (1–7 scale)	4.4	4.2	4.0	0.038	0.138
L* ₄₈	57.02 ^A	53.62 ^B	51.84 ^C	0.176	0.001
a* ₄₈	14.64	14.91	15.39	0.109	0.134
b* ₄₈	4.95 ^a	3.92 ^b	4.16	0.150	0.029
C* ₄₈	15.52	15.52	16.04	0.135	0.233
h° ₄₈	18.22 ^{Aa}	14.24 ^B	14.52 ^b	0.469	0.007
Muscle pigment (micrograms of hematin per 1 g of meat)	30.16 ^{Aa}	33.91 ^{Ab}	38.55 ^B	0.509	0.001

(A–C) Row means with different superscripts differ significantly at $P < 0.01$ (a–b) Row means with different superscripts differ significantly at $P < 0.05$ pH₄₅: pH at 45 min post slaughter; Group pH₄₅ I: ≤ 6.3; II: 6.3–6.7; III: > 6.7 $n = 184$ meat test, pH_u—pH at 48 h' post slaughter, IMF – Intramuscular fat content; WHC – Water-holding capacity; WBSF – Warner Bratzler shear force (N—Newton); L* value represents lightness; a* proportion of red; b* proportion of yellow; C* saturation; h° hue angle

parameters a*, b*, chroma C* ($P < 0.01$), and in hue angle h° ($P < 0.05$) between groups II and III.

Correlation coefficients of initial pH₄₅, ultimate pH_u, and meat quality characteristics are shown in Table 3. A significant positive correlation between pH₄₅ and pH_u ($P < 0.01$) was found. Both pH₄₅ and pH_u values were highly significantly and positively correlated with tenderness (WBSF) and water content and were negatively correlated with qualities such as WHC, drip loss, and meat protein content ($P < 0.01$). The measured pH₄₅ had a greater effect than the ultimate pH on visually evaluated colour intensity, tactilely evaluated meat hardness, colour lightness L*, hue angle h° ($P < 0.05$), and muscle pigment content ($P < 0.01$).

Discussion

In recent years, consumers and the meat industry have emphasized the declining quality of pork. They indicated that offered meat was characterized as pale, soft, and exudative (PSE), also faulty because of too low water-holding capacity and high drip loss. That traits are unacceptable and

influence on taste of pig meat [18]. All meat properties are directly or indirectly determined by the metabolic processes that occur in muscle tissue while the animal is alive, after slaughter, and in the meat maturation period. Their course is largely regulated by environmental pH. The impact of acidification variations, which are defined by the measured pH value, is associated with changes in muscular protein hydration and changes in water binding and retention in meat; this is referred to as water-holding capacity (WHC) [38, 39]. Measurements of pH₄₅ values were utilised to identify PSE meat [40, 41]. The effect of the course of pH value changes within the first hour after slaughter clearly affects meat water-holding capacity. Lower pH values contribute to lower water-holding capacity and more muscle juice dripping (drip loss) in storage [10]. The results achieved in this paper clearly confirm these correlations. Both greater pH reduction in the muscles within the first hour after slaughter (lower pH₄₅) and higher ultimate acidification are very closely associated with increased drip loss during meat storage ($P < 0.01$). This suggests that acidity plays a major part in tissue hydration and meat water-holding capacity. A similarly significant effect of pH on the amount of drip loss

Table 2 Results of the technological properties, visual and tactile evaluation of meat colour and muscle pigment content of pork (mean value and standard error) in relation to ultimate pH_u acidity

	Group – pH _u			SEM	P
	I ≤ 5.3	II 5.3–5.6	III > 5.6		
Number (n)	10	164	10		
pH _u	5.27 ^A	5.45 ^B	5.66 ^C	0.007	0.001
pH ₄₅	6.31 ^A	6.46 ^a	6.68 ^{Bb}	0.020	0.003
WHC (% of free water)	19.80	20.36 ^A	17.43 ^B	0.216	0.005
Plasticity (cm ²)	2.51	2.44	2.42	0.033	0.788
Drip loss (%)	5.08 ^A	3.96 ^A	1.30 ^B	0.154	0.001
WBSF (N)	40.12 ^A	43.43 ^A	59.61 ^B	1.071	0.001
Water content (%)	72.90 ^{Aa}	73.83 ^{Ab}	75.00 ^B	0.081	0.001
Total protein content (%)	23.79	23.08	22.99	0.056	0.111
IMF (%)	1.31	1.78	1.51	0.061	0.094
Visual colour intensity (1–6 scale)	3.2	3.4 ^A	4.3 ^B	0.055	0.006
Marbling (1–10 scale)	1.9	2.2	1.9	0.076	0.277
Firmness (1–7 scale)	4.0	4.2	4.1	0.039	0.189
L* ₄₈	54.74	53.85	51.95	0.176	0.144
a* ₄₈	15.57	14.83 ^A	16.55 ^B	0.109	0.001
b* ₄₈	4.76	3.95 ^A	6.21 ^B	0.150	0.003
C* ₄₈	16.38	15.44 ^A	17.73 ^B	0.135	0.001
h° ₄₈	16.63	14.43 ^a	20.41 ^b	0.469	0.019
Muscle pigment (micrograms of hema- tin per 1 g of meat)	33.12	34.16	36.38	0.509	0.270

(A–C) Row means with different superscripts differ significantly at $P < 0.01$ (a–b) Row means with different superscripts differ significantly at $P < 0.05$ pH_u – pH at 48 h post slaughter: Group pH_u I: ≤ 5.3; II: 5.3–5.6; III: > 5.6**Table 3** Correlation coefficients between meat acidity pH₄₅ and pH_u and other variables in meat

	pH ₄₅	pH _u
pH ₄₅	–	0.329**
pH _u	0.329**	–
WHC	–0.133	–0.211**
Plasticity	0.144	–0.005
Drip loss	–0.354**	–0.468**
WBSF	0.253**	0.517**
Water content	0.196**	0.547**
Total protein content	–0.221**	–0.403**
IMF	–0.032	0.048
Visual colour intensity	0.527**	0.363**
Marbling	–0.109	–0.081
Firmness	–0.244**	–0.104
L* ₄₈ —value represents lightness	–0.566**	–0.338**
a* ₄₈ —proportion of red	0.038	0.089
b* ₄₈ —proportion of yellow	–0.107	0.154*
C* ₄₈ —saturation	–0.001	0.118
h° ₄₈ —hue angle	–0.146*	0.134
Muscle pigment	0.398**	0.158*

(*) Statistical significance at $P < 0.05$, (**) Statistical significance at $P < 0.01$

was observed by Nevrlka et al. [42], when assessing the meat quality of Prestice Black-Pied pigs and hybrid pigs with the participation of white, Duroc and Pietrain pigs. According to Bocian et al. [43] the meat obtained from native breed Zlotnicka Spotted pigs compared to that of hybrid pigs (PLW x PL) was characterized by a higher pH_u value ($P < 0.05$) and lower values for drip loss ($P < 0.05$) and WHC ($P < 0.05$).

Another very important area in which acidification affects meat quality is its effect on meat colour [2, 9, 10, 20, 40, 44]. As an optical phenomenon, meat colour is dependent on muscle tissue structure and histological arrangement. Notwithstanding the same heme pigment content, meat colour may depend on the depth of light beam penetration and its reflection or dispersion, which is predominantly observed in the variability of colour lightness measurements [22, 44]. When colour was evaluated visually, the darkest meat was found in cases in which pH₄₅ and pH_u values were high. This was also confirmed by meat colourimetry using relevant equipment, as greater acidification, i.e. lower pH₄₅ values, was noted in meat showing higher numerical colour lightness L* values. In their analysis of the active acidity of *longissimus lumborum*, measured 45 min and 24 h after slaughter, Strzyżewski et al. [20] confirmed the effect of pH on the L* colour parameter. Other colourimetric parameters such as a* (redness), b* (yellowness), as well as chroma C*

and hue angle h° did not show any consistent change tendencies related to initial and ultimate acidification. Furthermore, minute differences in these values are not perceivable or distinguishable by the human eye [10]. The negative effect of the reduced pH on the brightness of the color (L^*) was also noted by Cebulska et al. [23], who observed the presence of much brighter meat obtained from four-breed hybrids with the participation of the Pietrain breed compared to native breeds (Złotnicka Spotted and Puławska).

The basic chemical composition of meat, including water, protein, and intramuscular fat content, is affected by metabolic processes in the animal's lifetime but is modified by post-mortem changes in meat pH only to a small extent. In meat with greater ultimate acidification (pH_u below 5.3), water content was significantly lower than in the other groups ($P < 0.05$; $P < 0.01$), probably due to inevitable drip loss during carcass sample collection and storage for 24 h. This is confirmed by the calculated positive correlations of pH_{45} and pH_u values with meat water content ($P < 0.01$). Jankowiak et al. [4] observed relation between level of intramuscular fat content and acidification of meat measured 45 min after slaughter as well as 48 h after slaughter. Higher pH_{45} values were observed in group with the lowest IMF ($P < 0.05$) and the meat pH value measured 48 h post slaughter was the highest in the meat with the lowest IMF content ($P < 0.01$).

The usefulness of muscle (pH_{45}) and meat (pH_u) acidification measurements in drawing conclusions about other meat quality characteristics is also unquestionable in pigs that are not burdened with the genetic stress-sensitivity defect. The presented correlations between acidification measurements and other meat quality characteristics confirmed the adverse effect of the rate of pH_{45} decrease on meat water-holding capacity and visual and equipment-assisted colour evaluation (Table 3). These values were close to the results obtained by Kušec et al. [9], whereas in the study by Strzyżewski et al. [20] pH_{45} was shown to be highly correlated with colour lightness L^* ($r = -0.807^{**}$), while Tomović et al. [2] obtained correlations smaller than those presented herein. In one study, Bocian et al. [21] showed a significant effect of meat acidity (pH_u) on colour parameters L^* , a^* , b^* and hue angle h° , but in a later study by Bocian et al. [22] the effect of meat acidity (pH_{45} and pH_u) on colour lightness L^* was not shown and acidity measured 48 h after slaughter was only shown to be significantly correlated with redness a^* and chroma C^* .

Post-slaughter proteolytic processes that affect meat tenderness have a crucial regulator in the form of the enzymatic calpain-calpastatin system [45]. When proteolysis and tenderisation processes are restricted, meat is characterised by lower tenderness and greater shear force (WBSF). The significant positive correlations between acidity levels and shear force arrived at in this study ($P < 0.01$) suggest lower

meat tenderness in the case of higher pH values. The value of pH_u measurements affects drip loss, meat tenderness, as well as water and protein content in meat to a greater extent than pH_{45} .

Meat acidification measurement is used as early diagnosis method of the obtained raw material quality. Our research was aimed to show the relationship between acidification and standard quality parameters of fatteners meat obtained from the most frequently kept sows in Poland. The results obtained of this study indicate that the change in acidification measured post-slaughter by pH_{45} and pH_{48h} has a significant effect on the technological properties of meat and on visually assessed colour intensity and colour lightness L^* . This information is an important element in the further improvement of the pig stock and the proper destination of the obtained raw material by local meat plants.

Funding This research was financed by the Ministry of Science and Higher Education of the Republic of Poland.

Declarations

Conflicts of interest The authors declare no conflict of interest.

Ethics approval Not applicable.

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