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THE EFFECT OF TIME GAINING ON CHEMICAL COMPOSITION AND TECHNOLOGICAL CHARACTERISTICS OF MECHANICALLY SEPARATED TURKEY MEAT (MSM)

WPŁYW CZASU POZYSKIWANIA NA SKŁAD CHEMICZNY I WŁAŚCIWOŚCI TECHNOLOGICZNE MIĘSA ODDZIELONEGO MECHANICZNIE (MOM) Z INDYKA

Summary
Mechanically separated meat (MSM) of poultry is a raw material widely used in the meat industry in Poland and most European Union countries. The manner and conditions for the production of this raw material cause, however, that it has limited technological usefulness. In this study the effect of time of obtaining turkey MSM produced by pressure separation on selected quality characteristics of this raw material: basic chemical composition, pH, thermal loss, water binding capacity and colour was determined. The experimental material consisted of MSM, which was collected directly from the machine after 1, 2 and 3 h of operation. The content of water, protein and fat in MSM was determined using a near infrared spectrometer. The instrumental measurement of colour parameters was performed in the CIE *L*a*b** (1976) system. Determination of ash content in MSM and pH measurement were performed according to the requirements of Polish standards, and to determine other technological quality characteristics the methods described in the literature were used. It was found that the extension of working time of the pressure separator from 1 to 3 h resulted in a significant increase in the water content in turkey MSM. Furthermore, the MSM sample obtained after 3 h of operation of the device was characterized by a significantly lower thermal loss and higher water binding capacity than a similar material, but obtained after 1 and 2 h of operation of the device. Time of obtaining of turkey MOM had no significant effect on the content of protein, fat and ash, pH value and colour parameters (*L**, *a**, *b**) of the raw material.

Key words: mechanically separated meat, turkeys, chemical composition, quality characteristics

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Introduction

The production of poultry meat has been increasing in Poland for several years. National Poultry Council – Chamber of Commerce in Warsaw reports that poultry meat production reached 2 mln 199 thous. t in 2014, and Poland took the first place among the EU producers of the raw material as far as the production size is concerned (KRD – IG, 2015).

Paralel with an increase of the poultry meat meant for meat products, there is an increase in the share of poultry skeletons and bones, left after the separation of the biggest muscles (breast and thigh), but still containing a significant share of muscle tissue. A meaningful part of the tissue can be gained using mechanical separators of various construction. The raw material obtained in this way is called mechanically separated meat (MSM). The poultry industry has been producing it since 1960's (Makała, 2012; Stangierski et al., 2011). Regulation (EC) No 853/2004 (Regulation..., 2004) defines the conditions of MSM production.

Paying attention to both safety and quality of meat products with MSM participation, and also the future demand for the material, EC has issued a communique informing they have no objections to further utilization of swine and poultry origin MSM (EFSA, 2013).

Its accessibility, satisfactory technological properties, and first of all the low cost make the poultry MSM an attractive material for meat processed products. However, its utilization is of a limited range: exclusively for the thermally processed meat products, made in certified meat plants (Bełkot et al., 2013).

Both Polish and European poultry industry most frequently apply bone structure destroying high-pressure technologies to produce poultry MSM. Thus the obtained raw material is comminuted to a very meaningful degree and is characterized by a significant fat participation and high amounts of bone marrow coming from the comminuted bones. Comparing it with the manually or machine deboned meat MSM presents worse technological properties, as well as lower storage life (Botka-Petrak et al., 2011; Grabowski and Kijowski, 2004; Makała, 2012; Nagy et al., 2007).

Chemical composition, chemical-physical properties and storage life of the high-pressure obtained meat in focus have been the issue described in numerous literature positions (Botka-Petrak et al., 2011; Henckel et al., 2004; Michalski, 2006; Nagy et al., 2007; Pietrzak et al., 2011; Stangierski et al., 2011). However, majority of them concentrated on chicken meat, whereas less numerous have been the articles discussing the problem of MSM coming from other poultry species (Bełkot et al., 2013; Michalski, 2007; Mielnik et al., 2003). Moreover, no information has been found in the accessible literature concerning the influence of the deboning machine operation time on MSM's quality. The research presented in the paper was carried out on commission of a turkey MSM producer. The purpose of it was defining the effect of time gaining on technological characteristics of the raw material produced with an application of the high-pressure technology.

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Material and methods

The tested material was mechanically separated cooled turkey meat obtained from non-frozen turkey broilers' necks and backs left over after hand-removal of breast and thigh muscles, with an application of the high-pressure technology. The raw material provided to the separator on a given production day came directly from the production line and was close both to the birds' age and pre-slaughter mass. Though the participation of goblers and turkey-hens, subjected to slaughter at successive production line operation hours and days, was changeable. Samples of MSM (2 kg each) were collected at the production plant (north-eastern part of Poland), after 1, 2 and 3 h of the deboning device operation, marking them: P1, P2 and P3.

The samples collected on a given day and cooled down to 2°C were taken to Meat Technology Unit, Warsaw University of Life Sciences – SGGW, Warsaw, observing the cooling conditions (foam polystyrene containers with cooling liners) and all tests and markings were then conducted.

The experiment was repeated four times, MSM coming from four different production parts was evaluated. The accepted arrangement of the test aimed at obtaining the information whether turkey MSM from different production parts i.e. collected 1, 2 and 3 h after the deboning device's operation and on different production days, would be of an equal quality.

Determining the water, protein and fat content in MSM was carried out by help of a near infrared spectrometer (NIT) FoodScan™ Lab (Foss Analytical A/S, Denmark) according to Polish norm PN-A-82109:2010 (2010), whereas ash according to Polish norm PN-ISO 939:2000 (2000). The pH measurement in MSM samples was carried out using a pH-meter (CP-31; Elmetron, Poland) equipped with an electrode Ag/AgCl (Metron, Poland), according to Polish norm PN-ISO 2917:2001 (2001). Water loss and thermal water binding capacity in the samples were marked according to Tyburcy and Florowski (2014), respectively applying the gravimetric and centrifugal methods. The colour measurement of MSM samples surface was carried out in the CIE $L^*a^*b^*$ (1976) colour system using the Chroma Meter CM 2600d (Konica Minolta Inc., Japan), colorimeter with an 8 mm measuring head, source of light D65, standard observer 10°. The obtained results were subjected to a statistical analysis, applying Statistica 12.0 (StatSoft Inc., USA). The single-variance analysis and Tukey's HSDW ($\alpha = 0.05$) were applied. Chemical markings, technological properties markings, and colour measurements for each of the test series and each of the sample were carried out respectively: in one ($n = 4$), two ($n = 8$) and three ($n = 16$) repetitions.

Results and discussion

It was found out, while analysing the results concerning the basic chemical composition of turkey MSM (Table 1), that the changes consisting in a gradual decrease of the protein and fat content and increase of the ash content in MSM samples along with the deboning device operation time extension were statistically insignificant ($p > 0.05$). On the other hand, a slight but statistically significant ($p \leq 0.05$) increase of the water

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Table 1. Chemical composition of MSM from turkey depending on the time operation of deboning machine ($x_{śr}$ ±SD)
Tabela 1. Skład chemiczny MOM indyczego w zależności od czasu pracy urządzenia do odkostniania ($x_{śr}$ ±SD)

MSM sample Próbka MOM	Content of water Zawartość wody (%)	Content of protein Zawartość białka (%)	Content of fat Zawartość tłuszczu (%)	Content of ash Zawartość popiołu (%)
P1	59.31^{a} ±0.79	16.72^{a} ±0.47	21.93^{a} ±0.13	0.89^{a} ±0.06
P2	60.90^{ab} ±1.00	16.26^{a} ±0.68	20.99^{a} ±0.16	0.90^{a} ±0.06
P3	61.44^{b} ±1.06	15.80^{a} ±0.72	20.58^{a} ±0.60	0.90^{a} ±0.06

$x_{śr}$ – mean value, SD – standard deviation.
Values in a column marked by different letters differ statistically significantly at a level of $\alpha \leq 0.05$.
$x_{śr}$ – wartość średnia, SD – odchylenie standardowe.
Wartości w kolumnie oznaczone różnymi literami różnią się istotnie statystycznie na poziomie $\alpha \leq 0{,}05$.

content was found in the MSM sample collected 3 h after the separator's operation (P3) comparing it with the sample collected after 1 h of the operation (P1). Samples P2 and P3 were in agreement with the requirements contained in the non-obligatory Polish norm PN-A-86522:1992 (1992) for MSM obtained from domestic fowl in which water and fat should not be higher than 75% and 20%, respectively, whereas the protein content not lower than 12%. A slightly higher fat content, compared to the normative requirements, was observed in P1.

The results of the work are close to those reported by other authors. According to Michalski (2006) the mean water, protein, fat and ash content in turkey MSM oscillated within the range of: 59.0–62.7%, 13.0–15.6%, 21.4–26.1% and 1.01%, respectively. Earlier investigations conducted by Mroczek and Słowiński (1981) proved that turkey MSM contained, on the average, 64.4–68.8% of water, 15.3% of protein, 12.0–16.0% of fat and 1.0% of ash. Thus, the below results prove the fact that the chemical composition of poultry MSM is, to a high degree, dependent on the initial raw material type and the deboning process parameters. Pełczyńska (1982) reports that poultry MSM fat content can be affected by the amount of skin left on the elements of carcasses prior to deboning. The presence of bone marrow in MSM via application of the high-pressure technology increases the amount of ash compared to the raw material from the same poultry species but received via the low-pressure technology (Michalski, 2010).

The mean value of pH of the turkey MSM samples subjected to an evaluation in the work was not significantly ($p > 0.05$) diversified by the separator's operation time (Table 2). Słowiński et al. (1984) measured the mean pH (6.23) value in chicken MSM stored at cooling temperature for 48 h.

The lowest thermal loss, as well as the highest water binding capacity were found in the case of turkey MSM collected after 3 h of the high-pressure device's operation (P3; Table 2). The differences both in the thermal loss size and water binding capacity between P3 and P1, as well as P2 samples were statistically significant ($p \leq 0.05$).

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Table 2. Technological characteristics of MSM from turkey depending on the time operation of deboning machine ($x_{śr}$ ±SD)
Tabela 2. Właściwości technologiczne MOM indyczego w zależności od czasu pracy urządzenia do odkostniania ($x_{śr}$ ±SD)

MSM sample Próbka MOM	pH	Thermal loss Wyciek termiczny (%)	Water binding capacity Wodochłonność (%)
P1	6.21^{a} ±0.02	32.7^{b} ±1.50	53.2^{a} ±2.62
P2	6.20^{a} ±0.03	31.7^{b} ±1.04	55.8^{a} ±1.06
P3	6.21^{a} ±0.03	28.9^{a} ±1.27	59.4^{b} ±1.49

$x_{śr}$ – mean value, SD – standard deviation.
Values in a column marked by different letters differ statistically significantly at a level of $\alpha \leq 0.05$.
$x_{śr}$ – wartość średnia, SD – odchylenie standardowe.
Wartości w kolumnie oznaczone różnymi literami różnią się istotnie statystycznie na poziomie $\alpha \leq 0,05$.

The available literature presents a high span of results relating to the already-mentioned MSM technological characteristics. It can be assumed it results from the manner of the sample preparation (e.g. earlier storage of the material), as well as the applied heating parameters. According to Słowiński et al. (1983, 1984) the mean size of chicken MSM thermal loss equalled 14.7–17.1%. The fowls' age, as well as the type of carcass elements meant for deboning can be a decisive factor in the thermal loss size in the turkey MSM. Niewiarowicz et al. (1991) report that the water binding capacity of turkey MSM from the high pressure separation reached 62.9%. The quality factor was found (Słowiński et al., 1983) to have significantly lower values, i.e. 24.0–35.4%, in chicken MSM.

The turkey MSM samples collecting time from the high pressure separator had no significant effect on pH and colour parameters (L^*, a^* and b^*) of the obtained raw material (Table 3). Pietrzak et al. (2011) report that approximately three times higher quantity

Table 3. Colour parameters of MSM from turkey depending on the time operation of deboning machine ($x_{śr}$ ±SD)
Tabela 3. Parametry barwy MOM indyczego w zależności od czasu pracy urządzenia do odkostniania ($x_{śr}$ ±SD)

MSM sample Próbka MOM	L^*	a^*	b^*
P1	50.34^{a} ±2.65	23.27^{a} ±3.39	4.31^{a} ±2.08
P2	48.87^{a} ±2.46	23.45^{a} ±5.90	4.03^{a} ±2.62
P3	48.51^{a} ±2.35	24.45^{a} ±4.07	4.09^{a} ±3.01

$x_{śr}$ – mean value, SD – standard deviation.
Values in a column marked by different letters differ statistically significantly at a level of $\alpha \leq 0.05$.
$x_{śr}$ – wartość średnia, SD – odchylenie standardowe.
Wartości w kolumnie oznaczone różnymi literami różnią się istotnie statystycznie na poziomie $\alpha \leq 0,05$.

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of hem pigments, present in chicken MSM, compared to manually deboned meat makes MSM darker. According to Golonko (2002) mean values of colour parameters *L**, *a** and *b** measured at the cross-section of turkey breast muscles, manually cut out 48 h after the slaughter, were respectively: 51.48, 5.10 and 3.25. The results discussed in the paper indicate that the colour of turkey MSM – independently of the sample collecting time – significantly differed from the colour of the fresh breast muscles, exclusively in respect of the *a** colour value parameter.

Conclusions

Extension of the high-pressure separator's operation time from 1 h to 3 h caused a significant increase in the water content in turkey MSM. It did not meaningfully increase the content of protein, fat and ash, though. MSM obtained after 3 h of the device's work showed a significantly lower thermal loss and higher water binding capacity than a similar raw material obtained after 1 and 2 h. The moment of turkey MSM collecting from the device had no important effect on the pH value and colour parameters (*L**, *a** and *b**) of the obtained material.

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Streszczenie

Mięso drobiowe oddzielone mechanicznie (MOM) jest surowcem powszechnie wykorzystywanym w przemyśle mięsnym w Polsce oraz w większości krajów Unii Europejskiej. Sposób i warunki produkcji tego surowca powodują jednak, że cechuje się on ograniczoną przydatnością

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technologiczną. W pracy badano wpływ czasu pozyskania MOM z indyka wytwarzanego metodą wysokociśnieniową na wybrane wyróżniki jakości tego surowca: podstawowy skład chemiczny, pH, ilość wycieku termicznego, wodochłonność i barwę. Materiał do badań stanowiły próby MOM pobierane bezpośrednio z urządzenia do odkostniania po 1, 2 i 3 h jego pracy. Zawartość wody, białka i tłuszczu w MOM oznaczano z użyciem spektrometru bliskiej podczerwieni. Instrumentalnego pomiaru parametrów barwy dokonywano w układzie CIE *L*a*b** (1976). Oznaczenie zawartości popiołu oraz pomiar pH w MOM wykonywano zgodnie z wymaganiami Polskiej Normy, do oznaczenia zaś pozostałych wyróżników jakości technologicznej stosowano metody opisane w literaturze. Stwierdzono, że wydłużenie czasu pracy separatora wysokociśnieniowego z 1 do 3 h spowodowało istotny wzrost zawartości wody w MOM. Ponadto MOM pozyskane po 3 h pracy urządzenia cechowało się istotnie mniejszym wyciekiem termicznym i większą wodochłonnością niż podobny surowiec, ale pozyskany po 1 oraz po 2 h. Czas pozyskania MOM indyczego nie miał istotnego wpływu na zawartość w nim białka, tłuszczu i popiołu, wartość pH, a także parametry barwy (*L**, *a**, *b**) tego surowca.

Słowa kluczowe: mięso oddzielone mechanicznie, indyki, skład chemiczny, wyróżniki jakości

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