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# The effect of rations containing hulled or hull-less barley on the slaughter parameters and the quality of broiler chicken meat

# Wpływ mieszanek zawierających jęczmień oplewiony lub nagoziarnisty na wyniki poubojowe i jakość mięsa kurcząt brojlerów

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## ABSTRACT

The studies aimed to determine the effect of feed rations containing hulled or hull- less barley meal on the slaughter parameters and the quality of muscles in broiler chickens. The experiment involved 120 broiler chickens of Ross 308 split into 3 groups (K, DI, DII), each consisting of 40 birds. Until the 21st day of life the birds were fed *ad libitum* with ground starter rations, and from day 22 to day 42 they received grower rations based on wheat, soybean meal, and soya oil with an admixture of minerals and vitamins. In the control rations the second cereal was corn, and the experimental rations contained 30% hulled barley (DI) or hull-less barley (DII). The best slaughter parameters were recorded for chickens from group DI. They had the largest share of total muscles including thigh and drumsticks as well as the smallest share of abdominal fat and skin with subcutaneous fat compared to others. The intramuscular fat of experimental birds contained significantly less PUFA than that of the control birds. In terms of taste, the best note the muscles of chickens fed mixtures containing husked barley were rated. The mean of the traits of breast muscle of chickens in this group was higher ($P \le 0.05$) compared to others. The slaughter parameters obtained in the study provide grounds for recommending the use of hulled barley in rations for broiler chickens accounting for 30% of the ration weight.

**Keywords:** barley, broiler chickens, dressing percentage, meat quality, nutrition

## STRESZCZENIE

Celem badań było określenie wpływu mieszanek zawierających śrutę z jęczmienia oplewionego lub nagoziarnistego na wyniki poubojowe i jakość mięśni kurcząt brojlerów. Doświadczenie wykonano na 120 kurczętach brojlerach Ross 308 podzielonych na 3 grupy (K, DI, DII) liczące po 40 ptaków Do 21. dnia życia ptaki żywiono systemem *ad libitum* sypkimi mieszankami Starter, a od 22. do 42. dnia mieszankami Grower wyprodukowanymi na bazie pszenicy, poekstrakcyjnej śruty sojowej, oleju sojowego oraz dodatków mineralno – witaminowych. W mieszankach kontrolnych jako drugie zboże zastosowano kukurydzę, a do mieszanek doświadczalnych wprowadzono jęczmień oplewiony (DI) lub nagoziarnisty (DII) w ilości 30%. Najlepsze wskaźniki poubojowe uzyskały kurczęta z grupy DI. Miały one największy udział mięśni ogółem, udowych i podudzi oraz najmniejszy udział tłuszczu sadełkowego i skóry z tłuszczem podskórnym w porównaniu do pozostałych grup.W tłuszczu śródmięśniowym ptaków doświadczalnych stwierdzono istotnie mniej PUFA w porównaniu do ptaków kontrolnych. Pod względem walorów smakowych najlepiej oceniono mięśnie kurcząt żywionych mieszankami zawierającymi jęczmień oplewiony. Średnia ocen mięśnia piersiowego kurcząt tej grupy była wyższa ($P \le 0{,}05$) w porównaniu do pozostałych grup. Uzyskane wyniki poubojowe dają podstawę do zalecania stosowania jęczmienia oplewionego w udziale 30% w mieszankach dla brojlerów.

**Słowa kluczowe:** jakość mięsa, jęczmień, kurczęta brojlery, wydajność rzeźna, żywienie

## INTRODUCTION

Cereal grains are the main concentrate feed in poultry feeding. The feed usability of respective species of cereals is varied and depends on the content of nutrients and anti-nutrients (Osek et al., 2010; Janocha, 2011). Corn and wheat are used without limitations in the production of feed rations for slaughter chickens, but the feed range is more and more often extended by other cereal meals (Kwiecień and Winiarska- Mieczan, 2010; Osek et al., 2010; Perera et al., 2019). The emerging new varieties of (hull-less) barley and (naked) oats must be evaluated in terms of nutritional value and suitability for poultry feeding (Osek et al., 2003; Sharifi et al., 2012; Krajewski et al., 2013).

Knowing their effect on the slaughter value and quality of poultry meat is an important element of such an evaluation. According to Pietrzak et al. (2013) the values of poultry meat may vary depending on the method of nutrition, origin of birds, rearing scheme (intensive, semi-intensive, ecological), age, sex and the slaughtering procedure. Its quality is a product of many properties such as texture, colour, juiciness, water absorption and nutritional value that is primarily determined by the whole protein content. This characteristic, in combination with a high content of unsaturated fatty acids, a lower content of connective tissues and collagen in poultry meat can testify to its high dietary quality (Zdanowska-Sąsiadek et al., 2013).

The studies aimed to determine the effect of feed rations containing hulled or hull- less barley meal on the slaughter parameters and the quality of thigh and breast muscles in Ross 308 broiler chickens.

## MATERIAL AND METHODS

The experiment involved 120 broiler chickens of Ross 308 split into 3 groups (K, DI, DII), each consisting of 40 birds of both sexes. Each group was split into 5subgroups of 8 chickens each. The birds were reared for 42 days in metal cages with dimensions of 0,56m x 1m each. All cages were in the same room in the same environmental conditions, and chickens had continuous access to feed andwater.

Electric lighting was used throughout the rearing period (24 h/day). During the first week of the experiment, the birds were kept at 32 °C. The temperature was reduced by 1–2 °C every week until the final temperature of 21–23 °C was reached.

Until the 21st day of life the birds were fed ground starter rations, and from day 22 to day 42 with grower rations based on wheat, soybean meal (SBM), soya oil and mineral and vitamin additives. In the control rations (group K) the second cereal was corn, while in the experimental rations corn was replaced with a 30% share of hulled barley Rubinek (group DI) or hull-less barley Rastik (group DII). In both ration types for all groups an enzymatic preparation of 0.6 g/kg with a declared activity of endo-1,3(4)- β-glucanase (50FBG/g) and pectinase (5000 PSU/g), endoxylanase (8250 EXU/g) and the activity of accompanying hemicellulase and pentosanase was used. The hulled and hull-less barley used in the experiment was analysed for the content of fundamental nutrients and minerals and β-glucanes.

Feed rations produced by own means were balanced according to the nutritional recommendations (Nutritional recommendations and nutritional value of feed, Feeding Standards for Poultry, 2005) for the needs of isoprotein and isoenergetic diets (Table 1).

The raw materials and feed rations were subjected to chemical analysis according to AOAC(2005).The content of β-glucanes in the grain of hulled barleyRubinek and hull-less barley Rastik was determined using the enzymatic method according to ICC Standard Method No. 168, and its moisture was evaluated according to ICC Standard Method No. 168, and its moisture was evaluated according to ICC Standard Method No. 110 at the Institute of Food Technology of Plant Originof the University of Natural Sciences in Poznań. On day 42 of life, 10 birds (5 males and 5 females) with a body weight representative of the specific group and sex were selected from each sub-group for dissection analysis (Ziołecki and Doruchowski,1989). Next, the $pH_{15}$ and $pH_{24}$ reactions of breast muscles (*m. pectoralis maior*) and thigh muscles (*m. iliotibialis*) were measured and their colour was determined according to

**Table 1.** Composition (%) and nutritive value of experimental diets

| Components | Starter period | | | Grower period | | |
|---|---|---|---|---|---|---|
| | K | DI | DII | K | DI | DII |
| Maize meal | 24.00 | - | - | 27.00 | - | - |
| Wheat meal | 31.20 | 29.30 | 29.30 | 31.90 | 31.40 | 31.20 |
| Hulled barley meal | - | 30.00 | - | - | 30.00 | - |
| Hull-less barley meal | - | - | 30.00 | - | - | 30.00 |
| Soybean meal | 36.00 | 31.90 | 31.90 | 31.50 | 29.00 | 29.10 |
| Soya oil | 5.00 | 5.00 | 5.00 | 6.00 | 6.00 | 6.00 |
| DL- methionine (99%) | 0.18 | 0.24 | 0.24 | 0.16 | 0.20 | 0.20 |
| L-lysine (99%) | 0.08 | 0.10 | 0.10 | 0.06 | 0.08 | 0..08 |
| Limestone | 0.75 | 0.78 | 0.71 | 0.70 | 0.84 | 0.84 |
| Salt | 0.35 | 0.35 | 0.35 | 0.38 | 0.38 | 0.38 |
| Dicalcium phosphate | 1.94 | 1.83 | 1.90 | 1.80 | 1.60 | 1.70 |
| Mineral-vitamin premix* | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Nutritive value of diets (g/kg) | | | | | | |
| Metabolizable energy (MJ/kg) | 12.50 | 12.49 | 12.51 | 12.91 | 12.81 | 12.84 |
| Crude protein | 215.0 | 216 | 215.0 | 203.0 | 202.0 | 204.0 |
| Crude fibre | 35.0 | 42.0 | 35.0 | 37.9 | 43.0 | 38.0 |
| Lysine | 11.9 | 12.2 | 12.2 | 11.5 | 11.6 | 11.3 |
| Methionina | 5.4 | 5.5 | 5.5 | 5.1 | 5.2 | 5.2 |
| Calcium total | 9.6 | 9.5 | 9.5 | 9.3 | 9.2 | 9.3 |
| Available phosphorus | 4.3 | 4.3 | 4.3 | 4.0 | 4.1 | 4.0 |
| Sodium total | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 | 1.7 |

* - Starter premix in Starter period, Grower premix in Grower period
group K –the control group fed standard diet without barley
group DI –the group fed 30% (starter/grower) of hulled barley
group DII –the group fed 30% (starter/grower) of hull-less barley

the L*, a*, b* system. This parameter was estimated using a Minolta Chroma Meter (CR 300) with a Minolta CR/CT – 300 measuring head. Breast, thigh and drumstick muscles were prepared by dissection. The left breast muscle and the left thigh and drumstick were used to determine the levelofbasicnutrients(AOAC,2005)andanalysethefattyacidscomposition-bygas chromatography using a gas chromatograph with a flame ionization detector (Matyka, 1976). On the other hand, right-side (breast and thigh) muscles were used for the evaluationoftheorganoleptic propertiesofmeataccordingtoafive-pointscalecarried out by a team of 8 people. The samples for analysis and the scoring criteria were prepared as indicated in reference literature (Baryłko-Pikielna, 1975; Baryłko-Pikielna and Matuszewska, 2009).The sensory evaluation focused on the flavour, tenderness, palatability and juiciness of meat. Respective scores were the constituents of the total score.

The results of the experiment were elaborated by statistical methods using the STATISTICA software package ver. 12.0, StatSoft Inc. (2014).

## RESULTS AND DISCUSSION

The analysis of the chemical composition of hulled barley Rubinek and hull-less barley Rastik (Table 2) revealed a higher level of protein (121.3 vs. 112.7 g/kg) and β-glucanes (4.33 vs. 3.60% d.m.) and a lower content of raw fibre (20.3 vs. 45.9 g/kg) in hull-less barley meal in comparison to hulled barley.

**Table 2.** Chemical composition of hulled and hull-less barley

| Item | Barley | |
|---|---|---|
| | hulledvar. Rubinek | hull-less var. Rastik |
| Nutrients (g/kg) | | |
| Dry matter | 885.1 | 895.6 |
| Crude ash | 21.8 | 19.7 |
| Crude protein | 112.7 | 121.3 |
| Crude fat | 21.2 | 17.2 |
| Crude fibre | 45.9 | 20.3 |
| Ca | 0.23 | 0.23 |
| P | 3.64 | 4.19 |
| Na | 0.09 | 0.10 |
| K | 2.84 | 2.78 |
| β-glukan total (% s.m.) | 3.60 | 4.33 |

The results were close to those obtained by Banaszkiewicz et al. (2017) and Barczak et al. (2019).

A 30% inclusion of hulled and hull-less barley in the rations had an influence on some slaughter parameters of the birds (Table 3).

A higher (P≤0.05) pre-slaughter body weight (2185 g) and cold carcass weight (1670 g) was characteristic of chickens receiving rations with a 30% share of hulled barley Rubinek in comparison to birds from other groups. The slaughter analysis of the carcasses showed that chickens fed with rations containing hulled barley as the second cereal had a higher dressing percentage (76.43%) than the birds from other groups (75.70 and 75.06%) but the differences were not confirmed by statistics. The dressing percentage of chickens fed with rations containing hulled or hull-less barley was higher than reported by other authors who included from 15 to 65% of hulled barley (Kamińska 2003) and 20 – 60% of hull-less barley (Koreleski et al., 2000; Bekta and Fabijańska, 2004; Sharifi et al., 2012; Banaszkiewicz et al., 2017) in feed rations for broiler chickens. Such a variation could have been a result of differences in the age of the slaughtered chickens, the ingredients of rations and the amount of nutrients in respective species of barley.

Total muscle mass, including breast muscle mass, was analogous to pre-slaughter body weight and cold carcass weight. The highest total muscle mass (789 g) and breast muscle mass (395 g) was characteristic of birds fed with rations containing hulled barley Rubinek as the second cereal. The differences were confirmed by statistics. At the same time, birds from this group showed better muscularity, which documents a significantly (P≤0.05) higher share of total muscle mass in a cold carcass (47.30%), and in particular of breast muscles (23.65%), in comparison to chickens from the control group and chickens receiving hull-less barley Rastik.

Similar to the present author, Pisarski et al. (2006) and Janocha (2011) noted an adverse effect of rations containing from 40% to 50% of hull-less barley on the muscularity of birds. Nevertheless, many authors (Pisarski and Zięba 2003, Pisarski et al., 2004) in their experiments did not find any significant differences in the tissue composition after up to 40% of hull-less barley was included in a feed ration for slaughter birds.

In addition, the inclusion of hulled barley in rations contributed to a decreased (P≤0.05) carcass fattening grade, which is shown by a significantly lower content of abdominal fat (by 6%) and skin with subcutaneous fat (by 2%) in comparison to birds from the control group. On the other hand, chickens fed with rations containing hull-less barley showed the highest fattening grade. Similarly, Pisarski et al. (2006), Janocha (2011) and Sharifi et al.

**Table 3.** Results of slaughter analysis of broiler chickens

| Item | Group | | | SEM |
|---|---|---|---|---|
| | K | D I | D II | |
| Body weight before slaughter (g) | 2140$^{b}$ | 2185$^{a}$ | 2145$^{b}$ | 9.01 |
| Cold carcass weight (g) | 1620$^{b}$ | 1670$^{a}$ | 1610$^{b}$ | 11.89 |
| Weight muscles total | 757$^{ABb}$ | 789$^{Aa}$ | 721$^{Bc}$ | 9.24 |
| breast | 385$^{A}$ | 395$^{A}$ | 352$^{B}$ | 7.22 |
| thight | 219 | 233 | 223 | 5.10 |
| drumstick | 153$^{AB}$ | 161$^{A}$ | 146$^{B}$ | 2.27 |
| Slaughter yield (%) | 75.70 | 76.43 | 75.06 | 0.46 |
| Content in cold carcass (%) | | | | |
| Muscles total | 46.72$^{AB}$ | 47.30$^{A}$ | 44.78$^{B}$ | 0.51 |
| breast | 23.76$^{a}$ | 23.65$^{a}$ | 21.86$^{b}$ | 0.44 |
| thigh | 13.52 | 13.95 | 13.85 | 0.28 |
| drumstick | 9.44$^{AB}$ | 9.64$^{A}$ | 9.07$^{B}$ | 0.13 |
| *Abdominal fat* | 2.04$^{ab}$ | 1.92$^{b}$ | 2.17$^{a}$ | 0.06 |
| Skin with subcutaneous fat | 13.27 | 13.05 | 13.54 | 0.53 |

A, B – values in rows with different letters differ significantly at $P \leq 0.01$
a, b – values in rows with different letters differ significantly at $P \leq 0.05$
SEM - standard error of the means
group K –the control group fed standard diet without barley
group DI –the group fed 30% (starter/grower) of hulled barley
group DII –the group fed 30% (starter/grower) of hull-less barley

(2012) in their studies noted decreased muscularity and an increased content of abdominal fat in the carcasses of chickens receiving rations with hull-less barley. In turn, Teymouri et al. (2018) replacing corn with naked barley in diets of broiler chickens noted a reduction in body fat (1.51 vs. 2.02).

The type of feed rations had no significant effect on the dry matter, total protein and crude ash content in the evaluated muscles (Table 4).

Significant differences in the crude fat content were observed. The highest content ($P \leq 0.05$) of crude fat (1.77 and 1.60%) was characteristic of the breast muscles of experimental chickens in comparison to the muscles of control birds (1.19%). On the other hand, the least amount of fat in the leg muscles was found in birds from the group receiving rations with hulled barley (5.67%). The results correspond to those obtained by Pisarski and Zięba (2003), Pisarski et al. (2004) and Banaszkiewicz et al. (2017). Similarly, Pisarski et al. (2006) in the experiments on slaughter birds fed with rations containing from 45% to 50% of hulled or hull-less barley found an increased content of intramuscular fat both in the breast and thigh muscle (hull-less barley feed). In turn, Bekta and Fabijańska (2004), having included 60% of hull-less barley, observed a similar dry matter, ash and protein content in the breast and thigh muscles and a clearly lower amount of crude fat – 0.93% d.m. for breast muscles and 2.98% d.m. for leg muscles.

**Table 4.** Chemical composition of muscles

| Item | Breast muscles | | | SEM | Leg muscles | | | SEM |
|---|---|---|---|---|---|---|---|---|
| | K | D I | D II | | K | D I | D II | |
| Nutrients (%) | | | | | | | | |
| Dry matter | 25.83 | 25.79 | 25.79 | 0.05 | 26.07 | 26.00 | 26.41 | 0.18 |
| Crude ash | 1.17 | 1.14 | 1.15 | 0.02 | 1.05 | 1.02 | 1.02 | 0.01 |
| Crude protein | 23.34 | 22.68 | 22.97 | 0.26 | 18.60 | 19.15 | 18.97 | 0.18 |
| Crude fat | 1.19[b] | 1.77[a] | 1.60[a] | 0.11 | 6.04[ab] | 5.67[b] | 6.14[a] | 0.38 |
| Fatty acids (% in total acids) | | | | | | | | |
| $C_{14:0}$ | 0.13 | 0.25 | 0.20 | 0.18 | 0.13 | 0.24 | 0.25 | 0.19 |
| $C_{16:0}$ | 21.15[b] | 23.90[a] | 24.89[a] | 0.23 | 19.78[b] | 23.15[a] | 24.16[a] | 0.16 |
| $C_{16:1}$ | 2.18[b] | 3.86[a] | 3.72[a] | 0.29 | 2.50 | 4.58 | 5.00 | 0.03 |
| $C_{18:0}$ | 4.92[b] | 6.74[a] | 5.99[ab] | 0.21 | 3.33 | 4.69 | 4.52 | 0.17 |
| $C_{18:1}$ | 34.15 | 34.39 | 34.72 | 0.08 | 34.99 | 35.79 | 36.59 | 0.61 |
| $C_{18:2}$ | 34.50[b] | 26.16[a] | 26.32[a] | 0.45 | 36.77[A] | 27.71[B] | 25.91[B] | 0.59 |
| $C_{18:3}$ | 1.47[b] | 1.86[a] | 1.43[b] | 0.04 | 1.40[b] | 2.00[a] | 1.64[b] | 0.15 |
| SFA | 26.43[b] | 31.23[a] | 31.43[a] | 0.48 | 23.49[b] | 28.51[a] | 29.68[a] | 0.41 |
| UFA | 73.18[a] | 68.56[b] | 68.36[b] | 0.38 | 76.32[a] | 71.37[b] | 70.20[b] | 0.35 |
| MUFA | 36.65[a] | 39.12[b] | 39.13[b] | 0.05 | 37.77[b] | 40.91[ab] | 42.08[a] | 0.55 |
| PUFA | 36.53[a] | 29.44[b] | 29.23[b] | 0.04 | 38.55[A] | 30.46[B] | 28.12[B] | 0.56 |
| DFA | 78.20[a] | 75.30[b] | 74.35[b] | 0.37 | 79.65[a] | 76.06[b] | 74.72[b] | 0.48 |
| OFA | 21.28[b] | 24.15[a] | 25.09[a] | 0.29 | 19.91[b] | 23.39[a] | 24.41[a] | 0.27 |

A,B–valuesinrowswithdifferentlettersdiffersignificantlyatP≤0.01
a, b – values in rows with different letters differ significantly at P≤0.05
SEM - standard error of themeans
group K –the control group fed standard diet without barley
group DI –the group fed 30% (starter/grower) of hulled barley
group DII –the group fed 30% (starter/grower) of hull-less barley
SFA–saturatedfattyacids, UFA–unsaturatedfattyacids, MUFA–monounsaturatedfattyacids, PUFA – polyunsaturated fatty acids, DFA – neutral or hypocholesterolemic fatty acids = MUFA + C18:0, OFA – hypercholesterolemic fatty acids = C14:0 +C16:0

In the studies the use of hulled or hull-less barley meal in the rations had an influence on the fatty acids profile of the lipids of the analysed muscle (Table 4). The breast and leg muscles of experimental chickens (DI and DII) were characterised by a significantly (P≤0.05) higher share of SFA and a lower share of UFA in comparison to the muscles of control birds. A similar relationship (lower share) was observed for polyunsaturated fatty acids (PUFA). In both analysed muscles a significant (P≤0.05) increase in the percentage of palmitic acid and myristic acid, that is, so-called hypercholesterolemic acids (OFA), was observed. On the other hand, the share of neutral and hypocholesterolemic acids (DFA) decreased as a result of a considerably lower share of linoleic acid in the lipids of the meat of experimental birds in comparison to the control group. The results correspond to the studies by Pisarski et al. (2006). In the breast muscles (1.86 vs. 1.47-1.43%) and leg muscles (2.00 vs. 1.40-1.64) of birds fed with rations containing hulled barley, the content of linoleic acid (C18:3) was significantly higher (P≤0.05). Similarly, studies carried out by Banaszkiewicz et al. (2017) showed that the meat of slaughter chickens fed with a feed ration containing hulled barley contained a higher percentage of linoleic acid (1.80%) than the meat of control chickens and those fed with a ration containing 20% of hull-less barley.

Colour is one of the most important characteristics of the quality of poultry meat that is of great importance to consumers. It is also a significant indicator of the technological suitability of meat that can be sold as a raw material or in a processed form (Nowak and Trziszka 2010). The breast muscles of chickens fed with rations containing hulled barley were characterised by a lighter colour compared with control group (Table 5).

This finding is supported by the significantly (P≤0.05) higher values of the colour component L* (57.9) and lower values of the component a* (2.48). Many authors (Michalczuk et al., 2012; Kokoszyński et al., 2013), in their studies, found a large span of the value of chicken breast colour parameters, in particular parameter L* – from 41 to 67. In the opinion of the above-mentioned authors, this could be a result of, among other factors, a different genotype, age of birds, feeding regime and blood loss degree.

Studies by the present author showed that the meat of experimental chickens was significantly more acidic than the meat of control birds (Table 5).

The initial $pH_{15}$ value of breast muscles indicates that the meat of experimental chickens can be classified as normal meat, whilst the meat of control birds had a DFD (Dark, Firm, Dry) defect as its pH exceeded 6.4. In turn, the $pH_{15}$ value of thigh muscles in the evaluated groups ranged from 6.24 to 6.04. According to Milan et al. (2011), if the pH is too high, the DFD defect occurs, and low pH leads to the development of PSE defects.

**Table 5.** Physical properties of muscles

| Item | Group | | | SEM |
|---|---|---|---|---|
| | K | D I | D II | |
| Colour of breast muscles | | | | |
| L* | 56.2[b] | 57.9[a] | 56.8[a] | 1.23 |
| a* | 2.85 | 2.48 | 2.69 | 0.89 |
| b* | 4.98 | 4.01 | 4.99 | 0.87 |
| Acidity of breast muscles | | | | |
| $pH_{15}$ | 6.47[a] | 5.98[b] | 6.01[b] | 0.21 |
| $pH_{24}$ | 5.37 | 5.31 | 5.29 | 0.11 |
| Acidity thigh muscles | | | | |
| $pH_{15}$ | 6.24 | 6.12 | 6.04 | 0.17 |
| $pH_{24}$ | 5.71 | 5.78 | 5.69 | 0.09 |

a, b – values in rows with different letters differ significantly at P≤0.05
SEM - standard error of the means
group K –the control group fed standard diet without barley
group DI –the group fed 30% (starter/grower) of hulled barley
group DII –the group fed 30% (starter/grower) of hull-less barley
L* –lightness of colour, a* –redness, b* –yellowness

The results of the sensory analysis of breast and thigh muscles of broiler chickens are presented in Figures 1 and 2.

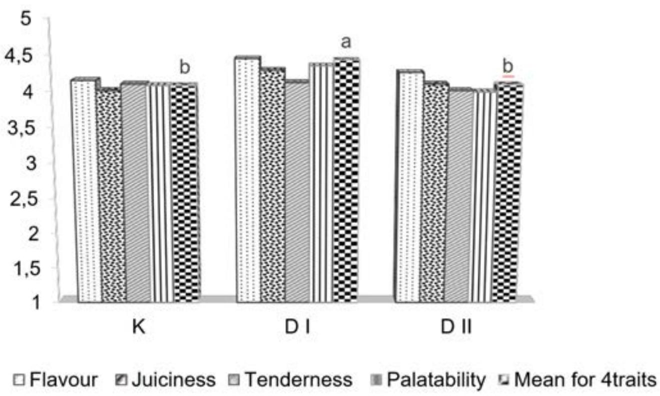


**Figure 1.** Results of breast muscles sensory evaluation (point)

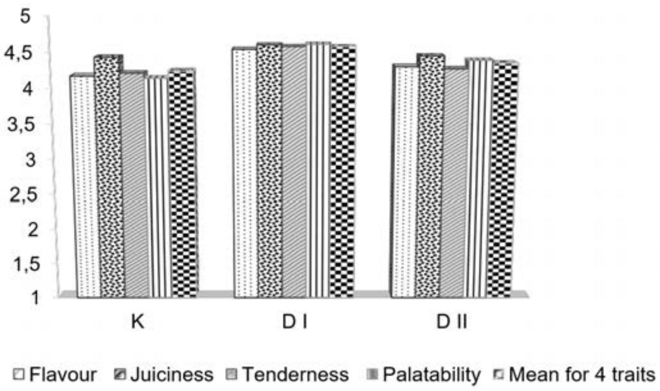


**Figure 2.** Results of thigh muscles sensory evaluation(point)

The results also indicate that both white and red muscles of chickens fed with rations containing hulled barley scored the highest ($P \leq 0.05$) for respective characteristics, i.e. respectively, for smell 4.45 pts and 4.54 pts, juiciness – 4.29 pts and 4.60 pts, tenderness – 4.12 pts and 4.58 pts and palatability – 4.35 pts and 4.61 pts. The results of organoleptic evaluation undoubtedly point to the fact that hull-less barley has an adverse effect on the flavour characteristics of breast and thigh muscles. Augustyńska-Prejsnar and Sokołowicz (2014) claim that one of the factors shaping the sensory quality of meat is the composition of the feed rations as it can have either a positive or a negative effect on the flavour of meat. However, these results do not correspond to the studies by Pisarski et al. (2006). They noted a positive effect of hull-less barley on the sensory qualities and in particular on the tenderness and juiciness of red muscles. Similarly, Banaszkiewicz et al. (2017) demonstrated that the breast muscles of chickens fed with rations containing 20% of hull-less barley were tastier than the muscles of birds fed with rations containing hulled barley. According to Nowak and Trziszka (2010), the palatability of meat and its nutritional value are equally important features determining consumer choices.

## CONCLUSIONS

To sum up, it can be concluded that a 30% inclusion of hulled or hull-less barley in starter and grower feed rations had a significant effect on the pre-slaughter body weight and the cold carcass weight of chickens. The best results were observed for chickens receiving rations with hulled barley. Birds from this group had a significantly better muscularity and less fat in comparison to birds from other groups. The intramuscular fat of experimental birds contained significantly less polyunsaturated fatty acids (PUFA) than that of the control birds. On the other hand, the measurement of the pH reaction of the breast and thigh muscles revealed that the meat of all birds could be classified as normal meat, free of defects (PSE, DFD), whereas the meat of chickens fed with rations containing hull-less barley had a poorer flavour.

The results of post-slaughter analysis and the quality of broiler chicken meat provide grounds for recommending a 30% inclusion of hulled barley in starter and grower rations for slaughter chickens.

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