

COMPARISON OF CARCASS COMPOSITION AND MEAT QUALITY IN FIVE-WEEK BROILER CHICKENS OF VARIOUS ORIGIN

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Abstract. The aim of the article has been to provide a comparison of the slaughter value and meat quality in five-week Hubbard Flex and Ross 308 broiler chickens. A higher body weight before slaughter ($P \leq 0.05$), weight of eviscerated carcass with the neck and dressing percentage were recorded for Ross 308 crossbreds. Hubbard Flex broiler chicken carcass, as compared with Ross 308 broiler carcass, showed a significantly higher percentage content of wings and leg muscles and a significantly lower content of breast muscle. The breast muscle pH₁₅ values were lower than the leg muscle pH₁₅ values. As for colour lightness (L^*) evaluation for breast and leg muscles and the yellowness (b^*), in both crossbred groups significant differences ($P \leq 0.05$) were found. The discriminants of the sensory broiler chicken breast and leg muscle evaluation compared after thermal treatment were similar. Between the broiler groups, significant differences ($P \leq 0.05$) were identified for aroma desirability and leg muscle tenderness.

Key words: broiler, dressing percentage, carcass composition, pH, meat colour, sensory evaluation

INTRODUCTION

The share of poultry meat in the total meat production in Poland accounts for 38% and shows a rising tendency. In 2014 the production of broiler chickens,

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providing a basic slaughter material for poultry meat production was 2,100 thousand tonnes [Wencek et al. 2015]. A growing demand for poultry meat comes mostly from its high nutritive and dietary value and favourable price, as compared with the price of meat of other slaughter animal meat [Augustyńska-Prejsnar and Sokołowicz 2014]. An increase in poultry meat production and demand results in increasing efforts to enhance the meat quality. A pursuit of a good poultry product quality calls for a regular evaluation of broiler chickens originating from today offered parent stocks; to much extent, they are responsible for the slaughter value and meat quality [Milczarek et al. 2015].

An important criterion applied to evaluate the slaughter value of broiler chicken carcasses are dressing percentage, share of culinary parts and carcass muscle content. Broiler chickens demonstrate a high dressing percentage, accounting for 70–71% (with 74–75% offal) [Łukaszewicz 2008]. That indicator is considered very significant since it determines the amount of material for sale. Similarly the composition of broiler chicken carcass is also essential; a high content of muscle, especially breast muscle, and a low fat content, enhance poultry meat consumption.

The meat quality is made up of a number of traits, however consumers are most concerned about the sensory quality; the colour, tenderness, taste intensity (intensity and desirability), juiciness and aroma (intensity and desirability) [Augustyńska-Prejsnar and Sokołowicz 2014]. The meat colour is crucial and, at the same time, it is a quality criterion which is easiest to evaluate. Changes in colour are often the first observed indicators of quality deterioration and nutritive meat value. They depend on the concentration, chemical form and aerobic metabolism of myoglobin [Augustyńska-Prejsnar and Sokołowicz 2014]. Fresh poultry meat should be light red in colour. Tenderness is considered the most important parameter in terms of meat quality [Nowak 2005]. It is expressed with a subjective sense of firmness, flexibility or elasticity. Here the animal age is very important. Young animals, due to a relatively low muscle fibre diameter, are more tender than older animals [Zdanowska-Sąsiadek et al. 2013]. The average taste intensity is a combination of two sensory sensations: flavour and aroma [Nowak and Trziszka 2010, Zdanowska-Sąsiadek et al. 2013]. Broiler chicken meat shows a poor flavour-aroma profile which develops after thermal treatment. Older birds meat is more intensive, more typical in terms of flavour and aroma. Various muscles of the same bird differ in taste intensity. A low taste intensity is found for breast muscles [Augustyńska-Prejsnar and Sokołowicz 2014]. Thigh muscles, on the other hand, show a greater flavour and aroma intensity [Szkucik et al. 2007]. Juiciness sensed as dryness or moisture of meat is also a trait which determines its quality. A positive juiciness score is recorded for meat with adequate moisture [Zdanowska-Sąsiadek et al. 2013]. The meat moisture is affected by the content of

intermuscular fat, tenderness, water-holding capacity as well as thermal treatment methods and duration.

The present research has aimed at providing a comparison of five-week Hubbard Flex and Ross 308 broiler chickens in terms of slaughter value and meat quality. The working hypothesis has assumed differences between Hubbard Flex and Ross 308 crossbreds in body weight, dressing percentage, carcass composition, physiochemical and sensory meat properties.

MATERIAL AND METHODS

The experimental material was made up of 15 Hubbard Flex and 15 Ross 308 broiler chicken carcasses received after thirty-five-day-old birds slaughter. Broiler chickens, prior to slaughter, were kept in closed buildings (two halls, each with an area of about 1000 m²) with controlled environment parameters, on bedding. The animal density on the thirty-fifth day was about 19 birds · m⁻². The birds were fed ad libitum with broiler chicken complete-ration compound feeds. After the fifth week of chicken life, from each production stock, about 1/3 of the bird flock was taken. Prior to slaughter the bird body weight was determined. Chickens were slaughtered, plucked and eviscerated. The carcass sample was randomly selected for research.

Eviscerated carcasses with the neck were each determined separately applying wing tags and weighed with Precisa 5/12 electronic scales, provided by Medicat, at the accuracy down to 0.1 g. The crossbreds dressing percentage was assayed. Whole Hubbard Flex and Ross 308 broiler chicken carcass dissection was made following the methodology described by Ziotecki and Doruchowski [1989]. For each carcass the neck without skin, wings with skin, breast muscles, leg muscles, skin with subcutaneous fat, abdominal fat and remainders were separated.

About 15 minutes after slaughter the level of acidification of breast and leg muscles was determined. The measurement was taken with a mobile pH-meter (provided by a German company, Matthäus) equipped with a combined glass stiletto electrode. The electrode was placed at 45°, half the way through the muscle thickness.

The breast and leg muscle colour was evaluated 24 hours after chicken slaughter with Minolta CR 310 photocolourimeter, determining the colour lightness (L*), the share of redness (a*) and the share of yellowness (b*) [Itten 1997].

The sensory analysis of breast and leg muscles was performed according to the Baryłko-Pikielnia and Kostyra scoring [2007]. Cooked meat aroma, juiciness, tenderness and taste intensity were defined. The evaluation was made with a five-score scale, where 5 was the highest and 1 – the lowest score.

The results were statistically verified by calculating the arithmetic mean and standard deviation for the traits. The significance of differences between the groups was evaluated with the Student's *t*-test.

RESULTS AND DISCUSSION

The data on the body and carcass weight, dressing percentage and the percentage share of selected parts of eviscerated carcass with the neck in 35-day broiler chickens are given in Table 1. The bird groups differed significantly in terms of body weight before slaughter ($P \leq 0.05$). The average 35-day-old Hubbard Flex chicken body weight was 85 g lower than in Ross 308 crossbreds. Kuźniacka et al. [2014] report on the average body weight in 5-week Hubbard Flex broilers of 1978 g. Gruzewska et al. [2008], presenting the rearing results for 11 broiler groups, recorded a considerably lower average weight of Hubbard Flex crossbreds (1610 g) and higher – Ross 308 crossbreds (2217 g). A higher body weight in 5-week Ross 308 broilers was noted by Murawska et al. [2011], and much lower in the same crossbreds – by Biesiada-Drzazga et al. [2011] and Hossain et al. [2012].

Table 1. Body weight and carcass composition of broiler chickens

Tabela 1. Masa ciała i skład tuszki kurecząt brojlerów

Trait – Cecha	Crossbred – Mieszaniec			
	Hubbard Flex		Ross 308	
	\bar{x}	SD	\bar{x}	SD
Body weight, g – Masa ciała, g	2039 ^a	172	2124 ^b	128.1
Carcass weight, g – Masa tuszki, g	1460	136.4	1529	99.6
Dressing percentage, % – Wydajność rzeźna, %	71.6	3.5	72.0	4.0
Neck, % – Szyja, %	3.1	0.3	3.2	0.5
Wings, % – Skrzydła, %	10.6 ^a	0.6	9.8 ^b	0.6
Breast muscles, % – Mięśnie piersiowe, %	25.9 ^a	3.2	28.7 ^b	2.4
Leg muscles, % – Mięśnie nóg, %	21.1 ^a	1.5	19.4 ^b	1.6
Skin with fat, % – Skóra z tłuszczem, %	10.6	1.0	10.3	1.2
Abdominal fat, % – Tłuszcz sadelkowy, %	1.4	0.6	1.4	0.5
Remainders, % – Pozostałości, %	27.3	2.9	27.2	2.9

a, b – mean values in rows, marked with different letters, differ significantly ($P \leq 0.05$).

a, b – wartości średnie w rzędach oznaczone różnymi literami różnią się statystycznie istotnie ($P \leq 0,05$).

Adequately to the body weight, a lower weight of eviscerated carcass was recorded for Hubbard Flex than Ross 308 chickens. A much lower weight of eviscerated carcass (1216.3 g) than in this experiment was reported for 5-week Ross 308 broiler chickens by Biesiada-Drzazga et al. [2011], and higher (1618.9 g), by Murawska et al. [2011]. Kuźniacka et al. [2014] reported a much higher weight of eviscerated carcass without neck in 6-week Hubbard Flex crossbreds (1907 g).

Dressing percentage in both broiler chicken groups was similar and accounted for 71.6% in Hubbard Flex and 72.0% in Ross 308. A lower dressing percentage (70.0%) than in this experiment in 5-week Ross 308 broiler chickens was noted by Biesiada-Drzazga et al. [2011]. Skomorucha et al. [2010] found in 6-week Ross 308 crossbreds a lower dressing percentage and a higher – in Hubbard Flex crossbreds (71.09% and 73.31%, respectively). Similar results for 6-week Hubbard Flex broiler chickens (73.8%) were recorded by Kuźniacka et al. [2014].

In both animal groups, no significant differences in the percentage neck content were found. The neck share in eviscerated carcasses of the broiler chicken groups compared was lower than in 42-day chickens recorded by Kuźniacka et al. [2014] and Kokoszyński and Bernacki [2008].

Hubbard Flex broiler carcasses, as compared with Ross 308 broiler carcasses, demonstrated a significantly higher percentage content of wings and leg muscles. A lower percentage content of wings in 6-week Hubbard Flex broiler chicken carcasses and a higher in Ross 308 chicken carcasses were noted by Kokoszyński et al. [2013]. Biesiada-Drzazga et al. [2011] report on the share of leg muscles in 5-week Ross 308 crossbreds accounting for 21.9%, and it was 2.5% higher than in this experiment. A higher percentage content of leg muscles in 6-week Hubbard Flex and Ross 308 broiler carcasses was also recorded by Skomorucha et al. [2010] and Kokoszyński et al. [2013].

The percentage share of breast muscles in the carcass eviscerated with the neck was significantly ($P \leq 0.05$) higher in Ross 308 chickens. Much lower values (26.8%) of that trait in 35-day Ross 308 crossbreds were noted by Biesiada-Drzazga et al. [2011]. Gawęcki et al. [2001], Janocha et al. [2003] and Skomorucha et al. [2010] found a lower percentage content of breast muscles in 6-week chicken carcasses, similarly as Adamski et al. [2004] in 7-week Hubbard and Ross 308 chicken carcasses. Broiler chickens of the same origin as those in this experiment, evaluated by Kokoszyński et al. [2013], however, showed a higher percentage share of breast muscles in carcass.

The fat content in the carcasses of the crossbreds studied was similar, just like the share of carcass remainders. The percentage content of skin with subcutaneous fat and abdominal fat in the carcasses of the bird groups was higher than reported by Adamski et al. [2004] in 7-week broiler chicken crossbreds. Kokoszyński et al. [2013] in 6-week Hubbard Flex and Ross 308 broiler chicken carcasses recorded a lower content of skin with subcutaneous fat (10.0%, 8.8%, respectively) and a higher content of abdominal fat (1.9%, 1.8%, respectively). A similar content of skin with subcutaneous fat (10.3%) in 42-day Hubbard Flex broilers and a higher share of abdominal fat (2.4%) were noted by Kuźniacka et al. [2014]. Biesiada-Drzazga et al. [2011] report on a percentage content of carcass remainders in 35-day Ross 308 broiler chickens being much higher and accounting for 36.4%.

Kokoszyński and Bernacki [2008], investigating 6-week Hubbard Evaluation and Ross 308 chickens, recorded similar values of the carcass remainders as in this research.

Table 2 provides data on muscle tissue acidification 15 minutes after slaughter and on meat colour discriminants. Meat acidity is the most objective trait informing of the course of post-slaughter glycolysis, the main cause in meat quality difference. Changes in the rate of glycogen breakdown can affect poultry meat pH and thus its colour. It is assumed that the right poultry meat pH must range from 5.9 to 6.2 [Niewiarowicz 1978, Żywica et al. 2011].

Table 2. Reaction (pH₁₅) and color of breast and leg muscles of broiler chickens

Tabela 2. Odczyn (pH₁₅) i barwa mięśni piersiowych i nóg kurcząt brojlerów

Trait – Cecha	Crossbred – Mieszaniec			
	Hubbard Flex		Ross 308	
	\bar{x}	SD	\bar{x}	SD
Breast muscles – Mięśnie piersiowe				
pH ₁₅ – pH ₁₅	6.4	0.3	6.4	0.2
L* (lightness) – L* (jasność barwy)	54.8 ^a	3.0	58.2 ^b	2.9
a* (redness) – a* (natężenie barwy czerwonej)	12.9	4.3	11.5	1.7
b* (yellowness) – b* (natężenie barwy żółtej)	6.6	1.5	6.3	1.3
Leg muscles – Mięśnie nóg				
pH ₁₅ – pH ₁₅	6.8	0.2	6.8	0.2
L* (lightness) – L* (jasność barwy)	49.8 ^a	3.0	52.9 ^b	1.8
a* (redness) – a* (natężenie barwy czerwonej)	17.3	1.2	16.3	1.3
b* (yellowness) – b* (natężenie barwy żółtej)	3.9 ^a	1.1	5.0 ^b	0.6

a, b – mean values in rows, marked with different letters, differ significantly ($P \leq 0.05$).

a, b – wartości średnie w rzędach oznaczone różnymi literami różnią się statystycznie istotnie ($P \leq 0,05$).

The level of muscle tissue acidification 15 minutes after slaughter in the chicken groups under study was high (more than 6.40) and suggested an occurrence of meat type DFD (dark, firm, and dry). According to Swatland [2008], high pH values are responsible for dark colour meat, whereas low pH values are characteristic for meat lighter in colour, which was not confirmed in this research. The high pH₁₅ values for breast muscles must have been due to low temperatures (winter season) throughout the chicken transport to the slaughterhouse. Jakubowska et al. [2004], investigating broiler chickens from various suppliers, report on average pH₁₅ values for breast muscles of 5.58 for meat type PSE, 6.07 for normal meat and 6.53 for DFD meat. The breast muscle pH₁₅ values similar to those reported in this research were assayed by Glamoclija et al. [2015].

The pH₁₅ values recorded for leg muscles were higher than the level of acidification of breast muscles, which is related to a greater activity of leg muscles than breast muscles prior to chicken slaughter, which results in a considerable reduc-

tion in the amount of muscle glycogen, and thus lower muscle acidification. The pH₁₅ values for leg muscles provided in literature (Gornowicz and Lewko [2007], Doktor and Połtowicz [2009], Skomorucha et al. [2010]) were lower than reported in this research.

With the present results (Table 2) it was found that breast muscles in Hubbard Flex broiler chickens were darker in colour than Ross 308 chickens, which is seen from significantly ($P \leq 0.05$) lower values of component L* which in both chicken groups were more than 53. According to Qiao et al. [2001], the value of colour parameter L* for breast muscles normal in colour ranges from 48 to 53. Values L* above 53 show that meat is lighter in colour than meat normal in colour, while the value below 46 points to meat which is darker than normal.

Although the level of acidification of muscle tissue 15 minutes after slaughter suggested the occurrence of defect type DFD, still in the case of colour lightness (L*) no such dependencies were found. The opinions on pH being related to colour lightness (L*) vary. Barbut et al. [2008] claim that reflection method colour components can be used to identify the meat defect type PSE and DFD. The authors demonstrated a significant dependence between colour lightness determined by component L*, and poultry meat pH. Hahn et al. [2001], on the other hand, found that the rate of pH decreasing after slaughter does not affect poultry meat colour lightness significantly.

The redness (a*) and yellowness (b*) of breast muscles were higher ($P \leq 0.05$) in Hubbard Flex than Ros 308 chickens. Kokoszyński et al. [2013] reported on the same values of redness for 6-week Hubbard Flex crossbreds (a* 12.9) and higher for Ross 308 (a* 13.3) as well as higher yellowness (b* 5.8 and 5.2, respectively) than in this experiment.

Evaluating the colour lightness for leg muscles and the intensity of yellowness in both crossbred groups, significant differences ($P \leq 0.05$) were identified. Darker colour and a lower value of parameter b* for leg muscles were found for Hubbard Flex broiler chickens. Redness was lower in Ross 308 crossbreds and the differences – non-significant. Doktor and Połtowicz [2009], in an experiment with 42-day Hubbard Flex crossbreds, recorded a darker colour of leg muscles, a lower value of parameter a* and higher – parameter b* than in the chicken groups reported in this study.

The results of the sensory cooked meat evaluation, which covered aroma, juiciness, tenderness and taste intensity, are provided in Table 3. The discriminants of the sensory breast muscle evaluation compared for the Hubbard Flex and Ross 308 broiler chicken groups were similar and did not differ significantly. The scores, however, recorded while making a sensory evaluation of leg muscles showed that Hubbard Flex chickens revealed a significantly higher aroma desirability and significantly lower tenderness, as compared with Ross 308 chicken muscles. The

Table 3. Sensory properties of breast muscles and leg muscles of broiler chickens

Tabela 3. Właściwości sensoryczne mięśni piersiowych i nóg kurcząt brojlerów

Trait – Cecha	Crossbred – Mieszaniec			
	Hubbard Flex		Ross 308	
	\bar{x}	SD	\bar{x}	SD
Breast muscles – Mięśnie piersiowe				
Aroma intensity – Zapach, natężenie	3.4	0.8	3.2	0.8
Aroma desirability – Zapach, pożądalność	3.5	0.8	3.4	0.8
Juiciness – Soczystość	3.8	0.9	3.7	0.6
Tenderness – Kruchość	4.2	0.8	4.3	0.6
Taste intensity – Smakowitość, natężenie	3.6	0.8	3.8	0.5
Taste desirability – Smakowitość, pożądalność	3.7	0.8	3.9	0.6
Leg muscles – Mięśnie nóg				
Aroma intensity – Zapach, natężenie	3.7	0.5	3.7	0.5
Aroma desirability – Zapach, pożądalność	4.1 ^a	0.3	3.9 ^b	0.3
Juiciness – Soczystość	4.0	0.3	3.9	0.7
Tenderness – Kruchość	3.8 ^a	0.4	4.2 ^b	0.5
Taste intensity – Smakowitość, natężenie	3.8	0.4	4.0	0.4
Taste desirability – Smakowitość, pożądalność	4.0	0.2	4.0	0.3

a, b – mean values in rows, marked with different letters, differ significantly ($P \leq 0.05$).

a, b – wartości średnie w rzędach oznaczone różnymi literami różnią się statystycznie istotnie ($P \leq 0,05$).

intensity of aroma (3.7) and desirability of taste intensity of leg muscles (4.0) were evaluated to be the same in both chicken groups. Lower juiciness and a higher leg muscle taste intensity were recorded for Ross 308 than Hubbard Flex chickens. Kokoszyński et al. [2013], investigating breast and leg muscles in 42-day Hubbard Flex and Ross 308 broiler chickens, with the 1-to-5 scoring, recorded much higher values of taste intensity discriminants.

CONCLUSION

The research shows that Hubbard Flex broiler chickens, as compared with Ross 308 chickens, demonstrated a lower body weight at the age of 35 days ($P \leq 0.05$), a lower weight of eviscerated carcass and dressing percentage. Besides in eviscerated carcasses with the neck in Hubbard Flex crossbreds a significantly lower percentage content of breast muscle and a significantly higher percentage share of leg muscles and wings were noted. The crossbreds carcass fat content was not quite high and it was similar. The breast and leg muscle acidity in the Hubbard Flex and Ross 308 crossbred groups was high and pointed to meat type DFD, which was not confirmed by the measurement of colour lightness L^* . Breast and leg muscles in Hubbard Flex broiler chickens showed a significantly darker

than Ross 308 broilers. Leg muscles in Hubbard Flex crossbreds also demonstrated a significantly lower value of parameter b^* . The analysis of sensory evaluation identified only significant differences for leg muscles. Leg muscles in Hubbard Flex birds showed a significantly higher aroma desirability and significantly lower tenderness.

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PORÓWNANIE SKŁADU TUSZKI I JAKOŚCI MIĘSA PIĘCIOTYGODNIOWYCH KURCZĄT BROJLERÓW O RÓŻNYM POCHODZENIU

Streszczenie. Celem pracy było porównanie wartości rzeźnej i jakości mięsa pięcioletniogodniowych kurcząt brojlerów Hubbard Flex i Ross 308. Większą masę ciała przed ubojem ($P \leq 0,05$), masę tuszki patroszonej z szyją i wydajność rzeźną uzyskały mieszańce Ross 308. Tuszki kurcząt brojlerów Hubbard Flex w porównaniu z tuskami brojlerów Ross 308 charakteryzowały się statystycznie istotnie większą procentową zawartością skrzydeł i mięśni nóg natomiast istotnie mniejszą zawartością mięśni piersiowych. Wartości pH₁₅ mięśni piersiowych były mniejsze niż pH₁₅ mięśni nóg. W ocenie jasności barwy (L*) mięśni piersiowych i mięśni nóg oraz natężenia barwy żółtej (b*), u obu badanych grup mieszańców stwierdzono istotne różnice ($P \leq 0,05$). Porównywane wyróżniki oceny sensorycznej mięśni piersiowych i mięśni nóg kurcząt brojlerów, po obróbce termicznej kształtowały się na zbliżonym poziomie. Między badanymi grupami brojlerów różnice statystycznie istotne ($P \leq 0,05$) stwierdzono pod względem pożądalności zapachu i kruchości mięśni nóg.

Słowa kluczowe: brojler, wydajność rzeźna, skład tuszki, pH, barwa mięsa, ocena sensoryczna

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