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CARCASS COMPOSITION AND PHYSICOCHEMICAL AND SENSORY PROPERTIES OF MEAT FROM BROILER CHICKENS OF DIFFERENT ORIGIN

SKŁAD TUSZKI ORAZ WŁAŚCIWOŚCI FIZYKOCHEMICZNE I SENSORYCZNE MIĘSA KURCZĄT BROJLERÓW O RÓŻNYM POCHODZENIU

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ABSTRACT

Three commercial lines of broiler chickens, Ross 308, Hubbard Flex and Hubbard F15 were investigated. Preslaughter weight, weight of eviscerated carcass with neck and dressing percentage were the highest in Hubbard Flex and the lowest in Ross 308 chickens. Analysis of carcass composition showed statistically significant differences in the content of neck, wings, breast muscles, skin with subcutaneous fat, abdominal fat and remainders of the carcass. The highest muscle content (total proportion of breast and leg muscles in carcass) was found in Hubbard Flex chickens, and the lowest body fat content (total proportion of skin with subcutaneous fat and abdominal fat) in Ross 308 birds. Chicken origin had a significant effect on pH_{15}, water holding capacity, colour lightness (L*), yellowness (b*) and aroma and juiciness of breast muscles.

Keywords: broiler, meat colour, sensory properties, tissue composition

DETAILED ABSTRACT

Badania przeprowadzono na kurczętach brojlerach z linii komercyjnych: Ross 308, Hubbard Flex, Hubbard F15. Największą masę ciała przed ubojem, masę tuszki patroszonej z szyją i wydajność rzeźną miały kurczęta Hubbard Flex, a najmniejsze Ross 308. Analiza składu tuszek wykazała statystyczne istotne zróżnicowanie pod względem zawartości szyi, skrzydeł, mięśni piersiowych, skóry z tłuszczem podskórnym, tłuszczu sadełkowego i pozostałości tuszki. Największe umięśnienie (udział mięśni piersiowych i nóg) stwierdzono u kurcząt Hubbard Flex, a najmniejsze otłuszczenie (łączny udział skóry z tłuszczem podskórnym i tłuszczu sadełkowego) u ptaków Ross 308. Pochodzenie kurcząt wpłynęło istotnie na wartości pH_{15}, wodochłonność, jasność barwy (L*), wysycenie barwy żółtej (b*) oraz zapach i soczystość mięśni piersiowych.

Słowa kluczowe: brojler, barwa mięsa, skład tkankowy, właściwości senoryczne

DETAILED ABSTRACT

Celem pracy było porównanie masy ciała, wydajności rzeźnej, składu tuszki, właściwości fizykochemicznych i sensorycznych mięsa kurcząt brojlerów z trzech linii komercyjnych - Ross 308, Hubbard Flex, Hubbard F15 - utrzymywanych w warunkach produkcji wielkotowarowej. Kurczęta utrzymywano w typowych warunkach produkcyjnych, w budynkach zamkniętych o regulowanych parametrach środowiska, na ściółce. Ptaki żywiono ad libitum przemysłowymi pełnoporcjowymi mieszankami paszowymi dla kurcząt brojlerów. Po 6. tygodniach odchowu z każdej grupy (linii) wybrano losowo po 20 osobników, do dysekcji. Po uboju, odpierzeniu i wypatroszeniu, oznaczono pH mięśni piersiowych i nóg, a następnie wykonano rozbiór (dysekcję) całych tuszek. Z każdej tuszki wyodrębniono: mięśnie piersiowe, mięśnie ud i podudzi (nóg), skrzydła ze skórą, szyję bez skóry, skórę z szyi, skórę z tłuszczem podskórnym, tłuszcz sadełkowy i pozostałości tuszki. Ponadto w trakcie patroszenia wyodrębniono serce, wątrobę, żołądek mięśniowy – jadalne podroby. Poszczególne elementy tuszki i podroby zważono, następnie obliczono ich procentowy udział w tuszce patroszonej z szyją (elementy tuszki) lub masie ciała przed ubojem (podroby). Kurczęta Hubbard Flex cechowały się największą masę ciała przed ubojem, masę tuszki patroszonej z szyją i wydajnością rzeźną. Najmniejsze wartości w/w cech stwierdzono u kurcząt Ross 308. Tuszki kurcząt Huubard Flex charakteryzowały się największa zawartością (%) szyi, mięśni piersiowych i tłuszczu sadełkowego, a najmniejszą pozostałości tuszki. W tuszkach Hubbard F15, w porównaniu do pozostałych ocenianych grup kurcząt, stwierdzono najmniejszą zawartość szyi, mięśni piersiowych, mięśni nóg i tłuszczu sadełkowego, a u Ross 308 najmniej skóry z tłuszczem podskórnym. Najlepiej umięśnione tuszki - największy udział mięśni piersiowych i nóg łącznie - stwierdzono u kurcząt Hubbard Flex, a najmniej otłuszczone – największa zawartość skóry z tłuszczem podskórnym i tłuszczu sardelowego łącznie - ptaki Ross 308. Pochodzenie kurcząt wpłynęło istotnie na właściwości fizykochemiczne i sensoryczne porównywanych grup kurcząt brojlerów. Wartości parametrów L* i b* mięśni piersiowych kurcząt Hubbard F15 były istotnie większe (jaśniejsze mięso) niż kurcząt Ross 308 i Hubbard Flex. Mięśnie piersiowe kurcząt Ross 308 charakteryzowały się istotnie mniejszym natężeniem i pożądalnością zapachu mięśni piersiowych od pozostałych grup kurcząt. U kurcząt Hubbard Flex stwierdzono natomiast istotnie mniejszą soczystość. Mięśnie piersiowe kurcząt Hubbard Flex odznaczały się ponadto najmniejszą kruchością oraz natężeniem i pożądalnością smakowitości.

INTRODUCTION

Chicken meat production in the world was 74.006 million tonnes in 2010. The largest producers of chicken meat are the United States (16.348 million tones) followed by China (12.500 million tones) and Brazil (11.420 million tones). In Poland, poultry meat production in 2009 was around 1.266 thousand tonnes, with chicken meat accounting for around 70% (USDA,2010a,b).

The rapid increase in meat production is influenced by very good conversion of feed (low FCR) per kg gain, which results from the rapid initial growth of chickens, the adaptation of diet composition to meet chicken needs, the improvement of environmental conditions, and the intensification of production to reduce production costs. The consumption of broiler chicken meat increased mainly as a result of its low

price, easy processing, diversity, and high nutritive value. Chicken meat has a high content of high-value protein and readily available fats, a low cholesterol content, and is tender and fine-fibred (Grabowski and Kijowski, 2004).

Chicken meat production in Poland is based on four-strain crosses born to parents sourced from several European breeding centres. In 2009, 11 commercial hybrids (Ross 308, Ross 508, Ross 708, Ross PM3, Hubbard Flex, Hubbard F15, Hubbard JA57, Cobb 500, Hybro G+, Hybro PN+, Hybro PN+) were approved for marketing in Poland (KRD-IZ, 2009).

Fast-growing broiler chickens are usually slaughtered at 6 weeks of age, which is associated with the attainment of optimum body weight, high dressing percentage, high content of breast muscles, high feed conversion and feather maturity. For some consumers, in particular the food service industry, chickens are also raised to the age of 4-5 weeks. Increasingly more chickens are slaughtered at 12-15 weeks of age and 3-4 kg body weight, and their carcasses are used to make poultry products (Grabowski and Kijowski, 2004).

In addition to high content of meat (especially breast muscles) and low content of skin with subcutaneous fat and abdominal fat in carcass, modern consumers are also paying more attention to the quality of meat as a result of the increased incidence of lifestyle-related diseases such as obesity, diabetes, heart attacks and atherosclerotic strokes. Apart from good meatiness and low fatness of broiler carcasses, more importance is now given to the chemical composition, fatty acid profile, cholesterol content, microstructure, and physicochemical and sensory properties of meat. According to Fletcher (2002), the major poultry meat quality attributes are appearance, texture, juiciness, flavour and functionality. Meat colour is a very important quality trait as it determines the appearance of meat and plays an important role in consumer acceptance of a product. Meat colour depends mainly on myoglobin content, chemical structure of heme, and pH of meat. Myoglobin content is mainly influenced by bird species and age and muscle type, whereas pH of animal muscles is associated with their biochemical state at slaughter and the advancing rigor mortis. Tenderness and juiciness of meat is largely determined by the content of intermusuclar fat (Tůmová and Teimouri, 2010).

The aim of the study was to compare body weight, dressing percentage, carcass composition, and physicochemical and sensory properties of meat from three commercial lines of broiler chickens (Ross 308, Hubbard Flex, Hubbard F15) kept under large-scale farm conditions.

MATERIALS AND METHODS

Subjects were 42-day-old Ross 308, Hubbard Flex and Hubbard F15 chickens obtained from Drobex Company, located in Solec Kujawski, Poland. Throughout rearing (July-August 2010), broilers were kept on straw in environmentally controlled confinement buildings (3 halls, each with an area of about 1000 m^2). At 42 days, stocking density was from 27.3 $kg*m^{-2}$ to 27.6 $kg*m^{-2}$ (13 birds per m^2). Birds were fed ad libitum commercial diets for broiler chickens: starter 1 (21 % protein and 3% fat) from day 1 to 7, starter 2 (20.5 % protein and 4% fat) from day 8 to 21, grower (19 % protein and 6% fat) from day 22 to 34, and finisher (18 % protein and 7 % fat) from day 35 of rearing. During rearing, Ross 308 and Hubbard Flex chickens received water supplemented with the antibiotics enofloxacin (1 week, for 3 days) and doxycycline (4 weeks, for 3 days). All the flocks were vaccinated through drinking water against Newcastle disease and Gumboro disease.

At 6 weeks of age, 10 males and 10 females (60 birds in total) were randomly selected from each production line for dissection. After slaughter, defeathering and evisceration, whole carcasses of broilers were dissected according to the method described by Ziołecki and Doruchowski (1989). Each carcass was divided into breast muscles, thigh and lower thigh (leg) muscles, wings with skin, neck without skin, neck skin, skin with subcutaneous fat, and abdominal fat. In addition, the heart, liver and gizzard (giblets) were separated during evisceration. Individual carcass components and giblets were weighed and their percentages in eviscerated carcass with neck (carcass components) or in preslaughter weight (giblets) were calculated. The determination of pH of breast and leg muscles (thighs) was carried out 15 min postmortem. The measurement was made with a spearhead pH electrode connected to a CP-401 pH meter (Elmetron). The electrode was placed at a 45º angle, halfway through the muscle thickness. pH values were read accurate to 0.01.

After cutting (dissection) of the carcasses, samples of breast and leg muscles were collected to determine water holding capacity, colour variables and sensory properties. Water holding capacity of breast and leg muscles was determined using a modified version of the method reported by Grau and Hamm. A meat sample weighing 280 mg to 320 mg (0.280 g – 0.320 g) was placed on a filter paper (5 cm x 5 cm) between two glass plates (25 cm x 25 cm), which were weighed down with a 2 kg weight for 5 min. After pressing the sample was weighed again to calculate water holding capacity of the meat from the ratio of sample weight after pressing to its weight before pressing (mg), multiplied by 100 %. Meat colour was determined in fresh breast muscles on the Hunter scale – L* (colour lightness), a* (redness) and b* (yellowness) using a Minolta CR310 chroma meter.

Breast and leg muscles were subjected to sensory evaluation to determine aroma intensity, aroma desirability, juiciness and tenderness of meat. Meat samples for sensory evaluation were cooked in a 0.6% table salt solution, in a water to meat ratio of 2 : 1. After cooking, the samples were chilled to 60 °C (1993) and subjected to taste panel evaluation by a standing committee of 5 evaluators in accordance with a 5-point hedonic scale described by Baryłko-Pikielna (1975). A 5-point scoring system was used to evaluate aroma and taste intensity (5 = very pronounced, 4 = pronounced, 3 = slightly pronounced, 2 = perceptible, 1 = imperceptible); aroma and taste desirability (5 = very desirable, 4 = desirable, 3 = neutral, 2 = slightly undesirable, 1 = very undesirable); juiciness (5 = juicy, 4 = moderately juicy, 3 = slightly juicy, 2 = slightly dry, 1 = dry); and tenderness (5 = very tender, 4 = tender, 3 = slightly tender, 2 = tough, 1 = very tough).

The numerical data were analysed statistically by calculating arithmetic means (x) and variation coefficients (cv). Significance of differences between the mean values of different lines was determined using analysis of variance and Student's t-test. The calculations were made with Statistica software.

RESULTS

The mean body weight of broiler chickens ranged from 2088 g (Ross 308) to 2151 g (Hubbard Flex). In accordance with body weight, carcass weight and dressing percentage were the highest in Hubbard Flex chickens and the lowest in Ross 308 chickens (Table 1). The chickens from three lines differed significantly in dressing percentage. The production hybrids also showed significant differences in the content of neck, wings, breast muscles, skin with subcutaneous fat, abdominal fat and remainders of the carcass in eviscerated carcass. Compared to the carcasses of the other hybrids, the carcasses of Hubbard Flex chickens contained significantly

Table 1. Body weight and carcass composition in broiler chickens
Tabela 1. Masa ciała i skład tuszki kurcząt brojlerów

Trait - Cecha	Characteristics Charakterystyki	Crossbred - Mieszaniec		
		Ross 308	Hubbard Flex	Hubbard F15
Body weight (g)	x	2088	2151	2144
Masa ciała (g)	cv	4.4	2.4	3.2
Carcass weight (g)	x	1508	1576	1564
Masa tuszki (g)	cv	6.3	3.2	4.0
Dressing percentage (%)	x	72.2 b	73.3 a	72.9 ab
Wydajność rzeźna (%)	cv	2.4	1.4	1.6
Neck (%)	x	3.4 a	3.7 b	3.3 ab
Szyja (%)	cv	7.6	6.2	10.6
Wings (%)	x	10.8 a	10.1 b	10.8 a
Skrzydła (%)	cv	9.2	4.1	7.5
Breast muscles (%)	x	29.3 a	30.2 a	26.9 b
Mięśnie piersiowe (%)	cv	8.6	6.7	5.5
Leg muscles (%)	x	21.9	22.0	21.8
Mięśnie nóg	cv	8.7	8.1	7.1
Skin with fat (%)	x	8.8 bc	10.0 ac	10.5 a
Skóra z tłuszczem (%)	cv	19.2	12.4	8.8
Abdominal fat (%)	x	1.8 ab	1.9 a	1.6 b
Tłuszcz sadełkowy (%)	cv	31.3	47.2	30.0
Remainders (%)	x	24.0 ac	22.1 bc	25.1 a
Pozostałości (%)	cv	10.1	13.1	6.5

a, b, c − mean values in rows, marked with different letters, differ significantly (P ≤0.05)
a, b, c – wartości średnie w rzędach oznaczone różnymi literami różnią się statystycznie istotnie (P ≤0,05)

more neck and breast muscles, and significantly less wings and remainders of the carcass. The carcasses of Hubbard F15 birds had significantly lower proportions of neck, breast muscles and abdominal fat, and higher proportions of skin with subcutaneous fat and remainders of the carcass. The carcasses of Ross 308 chickens were characterized by significantly lower fatness (proportion of skin with subcutaneous fat). Chicken origin had no significant effect on the weight and proportion of giblets (heart, liver and gizzard). The highest weight and proportion of giblets in the body was found in the heaviest Hubbard Flex birds and the lowest in the lightest Ross 308 birds (Table 2). The commercial hybrids of broiler chickens

Table 2. Giblets weight and content (%) in body weight of broiler chickens
Tabela 2. Masa i udział (%) podrobów w masie ciała kurcząt brojlerów

Trait - Cecha	Characteristics Charakterystyki	Crossbred - Mieszaniec		
		Ross 308	Hubbard Flex	Hubbard F15
Giblets (g)	x	78.9	87.3	84.3
Podroby (g)	cv	12.6	10.9	10.3
Giblets (%)	x	3.8	4.1	3.9
Podroby (%)	cv	11.8	10.7	9.5

differed significantly in the pH of breast muscles determined 15 min. postmortem. Significantly lower pH_{15} values of breast muscles were found in Hubbard F15 chickens. Significant differences between the hybrids were also found for water holding capacity of breast muscles. Breast muscles of Hubbard F15 chickens were characterized by the lowest water holding capacity. pH_{15} values of leg muscles did not differ significantly and were higher than the pH_{15} of breast muscles (Table 3), which contributed to the higher water holing capacity of the meat from legs.

Table 3. Reaction (pH_{15}) and water holding capacity (WHC) of breast and leg muscles in broiler chickens
Tabela 3. Odczyn(pH_{15}) i wodochłonność (WHC) mięśni piersiowych i nóg kurcząt brojlerów

Trait - Cecha	Characteristics Charakterystyki	Crossbred - Mieszaniec		
		Ross 308	Hubbard Flex	Hubbard F15
pH_{15} – breast muscles	x	6.12 a	6.00 a	5.79 b
pH_{15} – mięśnie piersiowe	cv	4.1	4.5	2.9
pH_{15} – leg muscles	x	6.41	6.38	6.45
pH_{15} – mięśnie nóg	cv	3.1	3.0	2.1
WHC − breast muscles (%)	x	60.9 c	57.9 b	65.2 a
WHC- mięśnie piersiowe (%)	cv	5.1	3.9	4.8
WHC − leg muscles (%)	x	69.7	69.2	71.6
WHC− mięśnie nóg (%)	cv	3.5	2.9	2.3

a, b, c - mean values in rows, marked with different letters, differ significantly (P ≤0.05)

a, b, c – wartości średnie w rzędach oznaczone różnymi literami różnią się statystycznie istotnie(P ≤0,05)

The breast muscles of 6-week-old chickens of different origin differed significantly in colour lightness (L*) and yellowness (b*). The L* and b* values of breast muscles from Hubbard F15 chickens were significantly higher (lighter meat) than those of Ross 308 and Hubbard Flex chickens (Table 4).

Table 4. Colour of breast muscles in broiler chickens
Tabela 4. Barwa mięśni piersiowych kurcząt brojlerów

Trait- Cecha	Characteristics Charakterystyki	Crossbred - Mieszaniec		
		Ross 308	Hubbard Flex	Hubbard F15
(L*) – lightness	x	56.8 b	57.1 b	60.9 a
(L*) - jasność	cv	5.1	4.8	3.6
(a*) – redness	x	13.3	12.9	13.7
(a*) – wysycenie barwy czerwonej	cv	10.8	10.9	13.8
(b*) – yellowness	x	5.2 b	5.8 b	7.2 a
(b*) – wysycenie barwy żółtej	cv	22.9	58.9	30.1

a, b - mean values in rows, marked with different letters, differ significantly (P ≤0.05)

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

Table 5 . Sensory properties of breast muscles in broiler chickens
Tabela 5. Właściwości sensoryczne mięśni piersiowych kurcząt brojlerów

Trait- Cecha	Characteristics Charakterystyki	Crossbred - Mieszaniec		
		Ross 308	Hubbard Flex	Hubbard F15
Aroma intensity	x	4.2 b	4.5 a	4.5 a
Intensywność zapachu	cv	16.0	10.2	9.6
Aroma desirability	x	4.1 b	4.4 a	4.4 a
Pożądalność zapachu	cv	16.1	12.0	9.3
Juiciness	x	4.4 a	4.1 b	4.4 a
Soczystość	cv	10.2	13.9	8.4
Tenderness	x	4.4	4.2	4.4
Kruchość	cv	11.6	12.9	8.4
Taste intensity	x	4.4	4.3	4.4
Intensywność smakowitości	cv	9.3	12.1	10.0
	x	4.4	4.3	4.4
Taste desirability	cv	9.5	12.3	6.5
Pożądalność smakowitości				

a, b - mean values in rows, marked with different letters, differ significantly (P ≤0.05)
a, b – wartości średnie w rzędach oznaczone różnymi literami różnią się statystycznie istotnie(P ≤0,05)

The analysis of sensory properties of meat from the hybrids studied showed that breast muscles of Ross 308 chickens had significantly lower aroma intensity, aroma desirability of breast muscles compared to the other chicken groups. Significantly lower juiciness was observed in Hubbard Flex chickens. The breast muscles of Hubbard Flex chickens were also characterized by the lowest tenderness, taste intensity and taste desirability (Table 5).

Table 6. Sensory properties of leg muscles in broiler chickens
Tabela 6. Właściwości sensoryczne mięśni nóg kurcząt brojlerów

Trait - Cecha	Characteristics Charakterystyki	Crossbred - Mieszaniec		
		Ross 308	Hubbard Flex	Hubbard F15
Aroma intensity	x	4.3	4.4	4.4
Intensywność zapachu	cv	8.4	8.2	10.2
Aroma desirability	x	4.3	4.4	4.4
Pożądalność zapachu	cv	8.6	8.2	8.9
Juiciness	x	4.4	4.4	4.4
Soczystość	cv	9.5	8.9	10.2
Tenderness	x	4.4	4.3	4.4
Kruchość	cv	9.8	8.6	10.7
Taste intensity	x	4.4	4.4	4.4
Intensywność smakowitości	cv	8.9	8.6	10.0
	x	4.4	4.4	4.4
Taste desirability	cv	8.9	8.4	9.5
Pożądalność smakowitości				

The commercial hybrids of broiler chickens under comparison did not differ significantly in the sensory scores of leg muscles (Table 6). The leg muscles of Ross 308 chickens were characterized by the lowest aroma intensity and desirability, and Hubbard Flex chickens by the lowest tenderness. Taste intensity, taste desirability and juiciness were at the same level for all broiler groups evaluated.

DISCUSSION

Regardless of origin, the genetic potential of the birds for body weight at 6 weeks of age was similar with no significant differences. In our study, the body weight of 6-week-old broiler chickens of both sexes was similar to the results of Doktor and Połtowicz (2009) and Mehaffey et al. (2006), and lower than the findings of Gawęcki et al. (2001), Gornowicz et al. (2009), Skomorucha et al. (2009) and Yildiz et al. (2009). However, at 6 weeks of age, the analysed birds had greater body weight compared to chickens of the same age investigated by Adamski et al. (2004), Grużewska et al. (2008) and Kokoszyński and Bernacki (2008).

The compared commercial hybrids of broiler chickens were characterized by high dressing percentage. However, the percentage of eviscerated carcass with neck to preslaughter weight of the chickens selected for dissection was lower than in 6-week-old broilers studied by Doktor and Połtowicz (2009). Other authors (Janocha, et al., 2003; Kokoszyński and Bernacki, 2008) obtained similar or higher dressing percentage in lighter chickens aged 6 weeks. However, dressing percentage of the analysed birds was higher than that reported by Gornowicz and Lewko (2007) and Nagy et al. (2006).

The carcasses of the heaviest Hubbard Flex chickens had significantly the highest proportion of neck and the lowest proportion of wings. Adamski et al. (2004) and Kokoszyński and Bernacki (2008) obtained the highest proportion of neck in the lightest birds. The proportion of neck in eviscerated carcass was similar or lower than in 6-week-old chickens studied by Kokoszyński and Bernacki (2008), and wing content was markedly smaller that that reported by Nagy et al. (2006) and Young et al. (2001). The proportion of breast muscles in eviscerated carcasses with neck was significantly higher in chickens with the highest body weight and dressing percentage, i.e. Hubbard Flex. In earlier studies (Adamski, et al., 2004; Gornowicz and Lewko, 2007; Grużewska, et al., 2008; Kokoszyński and Bernacki, 2008; Radu-Rusu, et al., 2008) obtained lower content of breast muscles in eviscerated carcasses from 6-week-old broiler chickens. Havenstein et al. (2003), who compared carcass composition and performance of broilers in 1957 and 2001, found the proportion of breast muscles in the body to increase from 8.4 to 20%, dressing percentage from 60.0 to 72.3%, and the proportion of abdominal fat from 0.27 to 1.4%. Portsmoth (citing in Grabowski and Kijowski, 2004, p. 52) reports that as a result of breeding work, the body weight of broilers has recently increased by 50-55 g and the carcass yield of breast muscles by 1% per year. The proportion of leg muscles in eviscerated carcasses with neck was similar to the values reported by Adamski et al. (2004) and Kokoszyński and Bernacki (2008).

The content of skin with subcutaneous fat in the analysed broiler chickens was higher than in 7-week-old birds studied by Adamski et al. (2004). Kokoszyński and Bernacki (2008) obtained similar or higher content of skin with subcutaneous fat in eviscerated carcass with neck compared to broiler chickens investigated in the present study. The content of abdominal fat in carcass was lower (Doktor and Połtowicz, 2009) or similar (Bihan-Duval, et al., 1999) to that reported elsewhere. Lower content of abdominal fat in the carcasses was found by Adamski et al. (2004) in 7-week-old broiler chickens and by Niklova et al. (2007) in 6-week-old broilers. Other studies (Adamski, et al., 2004; Kokoszyński and Bernacki, 2008; Niklova et al., 2007; Smith and Pesti, 2008) also reported a significant effect of genotype on the weight and/or proportion of abdominal fat. Shahin and Elazeem (2005) found no significant effect of chicken origin on the content of meat, fat and bones. When summing up the results obtained by many authors, Tůmova and Teimouri (2010) concluded that the main factors affecting fat deposition are origin, age, sex, feeding method, diet composition and lighting regime.

The quality of chicken meat was evaluated based on pH_{15} values, colour variables, water holding capacity and sensory properties. The pH_{15} values obtained for breast muscles of the compared commercial hybrids of broiler chickens showed no meat defects such as PSE and DFD. pH_{15} values were higher for leg muscles than for breast muscles as a result of higher antemortem motor activity of this body part, which decreased muscle glycogen concentration after slaughter. pH value is also associated with water holding capacity, because a decrease in pH is paralleled by

reduced water binding capacity, and an increase in muscle pH is paralleled by an increase in the water holding capacity of muscle proteins. This is confirmed by the results of other authors (Fletcher, 2002; Qiao, et al., 2007). Doktor and Połtowicz (2009) and Gornowicz et al. (2009) reported higher pH_{15} values of breast muscles (from 6.10 to 6.36) in broiler chickens of different origin. In addition, similar to our study, Dziadek et al. (2002), Gornowicz et al. (2009) and Połtowicz (2000) found origin to have a significant effect on pH_{15} of breast muscles in broiler chickens.
The mean values obtained in our study for colour lightness (L*) of breast muscles are higher than those reported by Bianchi et al. (2006, 2007), Le Bihan-Duval et al. (1999), and Mehaffey et al. (2006). Similar L* values of breast muscles were obtained by Doktor and Połtowicz (2009). Bianchi and Fletcher (2002) and Bianchi et al. (2006) found heavier birds (those with a thicker layer of breast muscles) to have a darker colour of breast muscles compared to lighter birds. In the compared groups of chickens, redness (a*) of breast muscles was higher and yellowness (b*) lower than in the studies by Doktor and Połtowicz (2009) and Bianchi and Fletcher (2002). Higher b* values of breast muscles (12.53 and 13.50) than in our study were obtained by Le Bihan-Duval et al. (1999).
The scores for sensory properties of breast muscles from the analysed broiler chickens (from 4.1 pts. to 4.5 pts.) are similar to those obtained by Janocha et al. (2003) in Redbro, Ross 308 and Hybro G chickens (from 4.08 pts. to 4.50 pts.), and better than in Hubbard birds (from 3.50 pts. to 3.86 pts.). Dziadek and Gornowicz (2003) and Janocha et al. (2003) reported a significant effect of origin on organoleptic properties of broiler chicken meat. In addition, the analysed broiler chickens generally scored higher for leg muscles (from 4.30 pts. to 4.40 pts.) compared to birds studied by Janocha et al. (2003) (from 3.36 pts. to 4.43 pts.). In a study with Anak, Ross and Arbor Acres chickens (Chukwuka Okwunna, 2010) evaluated for organoleptic properties on a 9-point scale, the highest tenderness of thigh muscles was established in Anak chickens (8.00 pts.) and the highest aroma score in Ross chickens (7.56 pts.)

CONCLUSIONS

In summing up the results of the present study, it is concluded that because of the highest body weight, carcass weight and dressing percentage, Hubbard Flex chickens were best suited for production of broiler chickens. The carcasses of these birds were also characterized by the highest content of breast muscles with the lowest water holding capacity and juiciness. On the other hand, Ross 308 chickens were characterized by the lowest body weight, carcass weight and dressing percentage, as well as high muscle content and the lowest fat content. The breast muscles of chickens of this line had the highest pH_{15} and water holding capacity. Ross 308 chickens proved the least suitable for production of broiler chickens because of the lowest body weight. However, the carcasses of these birds had a higher meat content and the lowest fat content, which more closely matches consumer requirements. Hubbard F15 chickens are less useful for processing plants and consumers due to the highest fat content and the lowest muscle content.

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