Ann. Anim. Sci., Vol. 14, No. 3 (2014) 685–696 DOI: 10.2478/aoas-2014-0028

INFLUENCE OF ORIGIN OF LAYING HENS ON THE QUALITY OF THEIR CARCASSES AND MEAT AFTER THE FIRST LAYING PERIOD*

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Abstract

The aim of the study was to assess the quality of carcasses and meat from selected native breeds and breeding lines of hens after using them for laying eggs in terms of their usefulness as raw material in traditional old Polish cuisine. Hens included in the programme for the protection of genetic resources were the object of this study. They belonged to the following breeds/breeding lines: Greenleg Partridge (Z-11), Rhode Island Red (R-11), New Hampshire (N-11) and Barred Rock (WJ-44) – 30 hens from each line. The hens were kept in a closed hen house under standard raising conditions. Eight hens were selected from 56-week-old hens of each line which were subjected to analysis after being slaughtered. As a result of the research conducted, it was found that:

– Among the hens under study, heavier layers, i.e. Barred Rock (WJ-44), New Hampshire (N-11) and Rhode Island Red (R-11), which are characterized by good muscling and dressing percentage similar to that of broiler chickens, proved to be most suitable for use as meat.

– The meat from WJ-44 hens contained most cholesterol and least protein, and the meat from Z-11 birds had the least fat compared to the other lines.

– At the end of the laying period, meat and broth from WJ-44, N-11 and R-11 hens obtained better sensory scores than those from the carcasses of Z-11 hens, which makes them an attractive raw material for traditional Polish cuisine.

Key words: hens, meat quality, biodiversity

The quality of poultry carcasses and meat, which determines the dietary value, culinary and processing usefulness, is shaped by a variety of genetic and environmental factors in which the system of bird raising and nutrition plays an important role (Franco et al., 2012 b; Połtowicz and Doktor, 2011). The quality of eggs from native breeds from backyard and ecological raising was recognized, as it was the object of many studies, while publications concerning the quality of chicken meat after the laying

*This study was financed from statutory activity No. 03-004.1.

period are scarce and require further research. The majority of studies concerning the quality of poultry meat pertain to young slaughter poultry, mostly broilers and turkeys. Meat obtained from laying hens after a 9-month exploitation period is not particularly important for slaughterhouses and processing plants which offer a low price for such livestock, which does not exceed 10% of the value of a laying hen beginning egg production. Until the middle of the 20th century, hen raising was dominated by general purpose birds with higher body weight, which were used for both laying eggs and for meat. Such breeding lines have survived in some European countries and are used on ecological farms or for "Label Rouge" production etc. (Fanatico et al., 2006). Poland has a numerous collection of hens included in the protection programme and, to meet the interest of domestic consumers in products from yarded birds and traditional old Polish cuisine, research was undertaken at the National Research Institute of Animal Production to examine these populations not only for egg production but also for meat production.

The aim of the study was to assess the quality of carcasses and meat from selected native breeds (breeding lines) of hens after using them for laying eggs in terms of their usefulness as raw material in traditional old Polish cuisine.

Material and methods

Hens included in the programme for the protection of genetic resources were the object of this study. They belonged to the following native breed laying hens: Greenleg Partridge (Z-11), Rhode Island Red (R-11), New Hampshire (N-11) and Barred Rock (WJ-44) – 30 hens from each line. The birds were kept on an experimental farm from August 2011 to June 2012 in a hen house without outdoor runs, at a stocking density of 5.5 hens/m^2 of the usable area, in a floor rearing system and were fed *ad libitum* with a feed mixture containing 16% of total protein and 11.3 MJ/kg of metabolizable energy. The microclimate conditions on the farm were automatically controlled and ensured the relative humidity of 60%, temperature of 16°C and the lighting programme recommended for laying hens, i.e. 16 hours of light and 8 hours of darkness (16L:8D). The laying hens used automatic drinkers.

At 56 weeks of age, 8 hens were selected from each group. They were weighed individually and slaughtered. Before the slaughter the birds were not fed for 12 hours with free access to water. After the slaughter and after chilling for 24 hours, the carcasses were weighed and next the loss of body weight as a result of evaporation was calculated.

Chilled carcasses were subjected to simplified slaughter analysis. To this end, dressing percentage without giblets was calculated as the ratio of weight of chilled eviscerated carcass to preslaughter body weight. Next, the weight of breast and leg muscles, giblets, leg bones, and abdominal fat was determined, and the percentage of these parts in the carcass with giblets was calculated.

Samples of breast and leg muscles were collected from each carcass to define their acidity and water binding capacity (water absorption, leakage, thermal loss).

The acidity of muscles was determined using a CyberScan10 pH-meter equipped with a glass electrode for examining meat. The pH measurement was performed 15 minutes (pH_{15min}) and 24 hours (pH_{24h}) after the slaughter.

The colour of the carcasses, breast muscles and leg muscles was determined 24 hours postmortem in the L*a*b* colour system (CIE 1976) using a Minolta CR 310 reflection spectrophotometer, where L* represents lightness, a* denotes redness and b* yellowness. Carcass colour is the average value from 5 carcass measurements and 2 breast and leg muscle measurements performed on the inside surface immediately after separation from the bones.

Water absorption of breast and thigh muscles was determined using the Grau-Hamm method (1953) based on the amount of juice from mechanically squeezed sample.

Juice loss was determined after 24-hour storage of breast muscle and thigh muscle samples at +4°C, while cooking loss was determined from muscle loss during cooking.

The meat tenderness measurement was performed using a texture analyser (Stable Micro Systems). For this purpose, a cylinder was cut out from the cooked breast muscle with a diameter of 10 mm and a length of 30 mm. The collected sample was cut with a blade at three sites perpendicularly to the muscle fibres and the final result of the measurement was provided as an average value.

Samples of breast and leg muscles were also collected to determine the chemical composition, namely total protein content (using the Kjeldahl method), fat content (using the Soxhlet method), and cholesterol content (using gas chromatography) (Rong-Zhen et al., 1999). The sensory assessment of the meat and broth was made using a formula developed in accordance with the method described by Baryłko--Pikielna and Matuszewska (2009). A panel of 10 adult people participated in the assessment. The scoring scale was 0-5 points, with 5 being the best score and 1 the worst score.

The results were statistically analysed and the significance of differences was determined by means of one-way analysis of variance using Duncan's test (Statistica 6.0). The study was approved by the Local Ethics Committee (no. 2/2010).

Results

Large differences in the body weight of the hens were observed (Table 1). Z-11 laying hens were the lightest and R-11 hens slightly heavier with significant differences in relation to N-11 and WJ-44 hens ($P \leq 0.01$). Similar differences were found in the carcass weight after chilling and in the leg and breast muscles of all four breeding lines under analysis, with a difference of around 100% between the lightest Z-11 and heaviest WJ-44 hens.

The colour of carcasses from Z-11 hens received the lowest, and that of carcasses from N-11 hens the highest scores for lightness (L*) ($P \leq 0.01$) (Table 1). The carcasses of R-11 hens received the lowest redness (a*) scores, with a significant difference in relation to the carcasses of the other lines (P≤0.05). Yellowness (b*) was highest in N-11 hens and lowest in Z-11 hens (P≤0.05). Carcass weight loss during chilling was lowest in R-11 hens and highest in Z-11 hens (Table 2).

Table 1. Body weight, breast and leg muscles weight and carcass colour of 56-week-old hens (arithmetic means± SD)

Item	Z-11	R-11	N-11	WJ-44
Body weight (g)	1833.7 A±109.4	2166.2 B±111.0	2740.0 C±282.7	2750.0 C±329.8
Carcass weight without giblets (g)	1198.8 A±56.95	1472.0 B±217.3	1920.9 C±99.09	2091.3 C±254.7
Breast muscle weight (g)	198.1 A±11.82	228.5 A±25.45	311.1 B±35.92	386.1 C±51.39
Leg muscle weight (g)	219.8 A±23.56	303.2 C±34.67	379.8 B±27.22	447.1 D±48.39
Carcass colour				
L* – lightness	70.10 A±1.28	71.40 AB±1.44	72.20 B±1.06	71.38 AB±1.53
a* – redness	3.17 b±0.693	2.07 a±0.384	2.90 b±0.342	2.82 b±0.978
b* – yellowness	10.81 a±1.80	11.23 ab±0.72	12.68 b±1.85	12.30 ab±1.46

a, b – values in rows with different letters differ significantly (P<0.05).
A, B, C, D – values in rows with different letters differ highly significantly (P<0.01).

Table 2. Results of slaughter analysis in 56-week-old hens (arithmetic means±SD)

Item	Z-11	R-11	N-11	WJ-44
Carcass weight loss during chilling (%)	1.82±0.18	1.35±0.30	1.71±0.25	1.51±1.13
Carcass yield with giblets (%)	65.18±2.82	67.85±2.42	70.10±2.23	67.32±24.2
Breast meat yield (% of carcass)	15.60 a±0.85	14.97 a±1.50	15.54 a±1.70	17.89 b±1.8
Leg meat yield (% of carcass)	17.77 a±1.26	19.79 b±0.65	18.97 bc±1.12	20.69 c±1.32
Giblets (% of carcass)	5.44 C±0.46	4.23 B±0.59	4.06 B±0.56	3.29 A±0.26
Leg bones (% of carcass)	4.30 b±0.37	4.26 b±0.52	5.26 a±0.70	4.56 b±0.38
Abdominal fat (% of carcass)	6.84±1.76	6.61±2.53	7.14±1.33	6.21±1.68

a, b, c – values in rows with different letters differ significantly (P<0.05).
A, B, C – values in rows with different letters differ highly significantly (P<0.01).

The highest dressing percentage, which was slightly lower than in broilers (Gornowicz, 2008), was obtained for N-11 hens and the lowest for Z-11 hens, but no significant differences were observed (P≥0.05).

Large differences were observed for the carcass percentage of breast muscles, leg muscles, giblets and leg bones. The highest carcass percentage of breast muscles was observed in WJ-44 hens, with statistically significant differences in relation to the other lines (P≥0.05). Z-11 hens had the lowest carcass percentage of leg muscles of all lines (P≤0.05). Giblets percentage was lowest in WJ-44 line and highest in Z-11 line (P≤0.01). N-11 birds had a significantly higher proportion of leg bones in the carcass compared to the other hens (P≤0.05). The carcass content of abdominal fat was high for all hens and exceeded 6% (Table 2).

As shown in Table 3, the breast muscles of the breeding lines differed significantly in terms of their physical features. The muscles of N-11 birds had the lowest pH_{15min} and highest pH_{24h} of all hens ($P \leq 0.05$). The acidity index for leg muscles (pH_{15min}) in the individual lines was at a similar level ($P \geq 0.05$), while pH_{24h} showed large differences (Table 4).

Table 3. Physical characteristics of breast muscles in 56-week-old hens (arithmetic means± SD)

Item	Z-11	R-11	N-11	WJ-44
pH_{15}	6.32 b±0.09	6.31 b±0.10	6.18 a±0.11	6.28 ab±0.11
pH_{24}	5.5 abc±0.10	5.41 a±0.13	5.68 d±0.14	5.56 bcd±0.08
Drip loss 24 h (%)	0.41 ab±0.19	0.41 ab±0.30	0.52 b±0.17	0.27 a±0.14
Cooking loss (%)	30.56 c±2.95	30.49c±1.87	26.96 b±2.23	24.42 a±2.41
Water holding capacity (%)	16.03 ab±3.21	18.55 b±2.58	14.67 a±2.74	16.90 ab±2.60
Shear force (N)	11.96±2.48	12.78±2.20	10.88±2.39	12.45±2.48
Colour				
L* – lightness	54.23 a±2.63	58.0 5b±3.34	57.55 b±1.16	58.00 b±1.67
a* – redness	10.18 a±0.97	10.50 a±1.54	8.91 b±1.35	11.86 c±0.83
b* – yellowness	6.60±1.35	6.86±0.99	6.68±0.64	7.51±1.18

a, b, c, d – values in rows with different letters differ significantly (P<0.05).

Table 4. Physical characteristics of leg muscles in 56-week-old hens (arithmetic means± SD)

Item	Z-11	R-11	N-11	WJ-44
pH_{15}	6.63±0.17	6.52±0.11	6.57±0.14	6.52±0.19
pH_{24}	6.01b±0.23	5.81 a±0.11	5.98 ab±0.13	6.09 b±0.23
Drip loss 24 h (%)	0.27 a±0.06	0.27 a±0.12	0.54 b±0.09	0.40 ab±0.24
Cooking loss (%)	41.15 a±1.53	40.95 a±1.62	39.38 ab±2.35	38.49 b±2.70
Water holding capacity (%)	13.18 ab±3.04	16.69 b±2.20	12.68 a±2.97	13.14 ab±4.07
Shear force (N)	29.37 a±2.50	32.45 a±2.81	38.45 b±5.31	32.35 a±3.16
Colour:				
L* – lightness	41.13 a±2.25	48.49 b±3.19	46.81 b±3.06	43.12 a±2.91
a* – redness	17.84 b±1.15	15.88 a±0.70	17.31 b±1.13	18.32 b±1.29
b* – yellowness	5.66 a±1.04	6.58 ab±1.23	7.24 bc±0.95	7.67 c±0.88

a, b, c – values in rows with different letters differ significantly (P<0.05).

Drip loss from breast muscles after 24 hours of chilling was lowest in WJ-44, and twice as high in N-11 hens ($P \leq 0.05$). Drip loss from breast muscles from Z-11 and R-11 hens was much higher, and that from WJ-44 hens lower compared to leg muscles, and in N-11 hens it was at a similar level (Tables 3 and 4).

Table 5. Chemical composition of breast and leg muscles in 56-week-old hens (arithmetic means± SD)

Item	Z-11	R-11	N-11	WJ- 44
Breast muscles				
Protein (%)	24.73 ab±0.35	24.42 ab±0.24	24.89 a±0.89	24.05 b±0.45
Total lipids (%)	1.19 A±0.33	1.30 AB±0.15	1.67 AB±0.15	1.50 B±0.12
Cholesterol (g/kg)	0.44 B±0.031	0.36 A±0.029	0.44 B±0.014	0.52 C±0.055
Leg muscles				
Protein (%)	19.23±0.76	19.60±0.44	19.56±0.75	19.25±0.75
Total lipids (%)	5.86 a±1.05	6.15 a±0.87	7.71 b±1.21	5.91 a±0.96
Cholesterol (g/kg)	0.67 a±0.045	0.63 a±0.042	0.72 ab±0.145	0.80 b±0.059

a, b – values in rows with different letters differ significantly (P<0.05).
A, B, C – values in rows with different letters differ highly significantly (P<0.01).

Table 6. Sensory assessment of meat and broth from 56-week-old hens (arithmetic means±SD)

Breeding line symbol	Odour	Appearance (colour, broth quality)	Flavour
Leg meat			
Z-11	3.7 a±0.97	3.3 a±0.79	3.6 a±1.02
R-11	4.1 ab±0.86	4.2 b±0.51	3.9 ab±1.21
WJ-44	4.4 ab±0.56	4.3 b±0.69	3.5 a±0.76
N-11	4.6 b±0.49	4.5 b±0.46	4.6 b±0.69
Breast meat			
Z-11	4.0 a±0.87	4.2 a±0.56	3.7 ab±0.75
R-11	4.3 ab±0.75	4.6 ab±0.49	4.1 ab±0.84
WJ-44	4.6 ab±0.68	4.7 b±0.46	3.9 a±0.78
N-11	4.8 b±0.37	4.4 ab±0.58	4.6 b±0.73
Broth			
Z-11	3.6 a±1.48	3.2 a±1.23	3.6 a±1.52
R-11	4.3 ab±1.05	4.4 b±0.61	4.4 b±0.64
WJ-44	4.8 b±0.37	4.5 b±0.71	4.4 b±0.51
N-11	4.4 ab±0.73	4.1 b±0.58	4.4 b±0.90

Explanation: sensory assessment on a 5-point scale: 1 – worst, 5 – best.
a, b – values in columns with different letters differ significantly (P<0.05).

Cooking loss from breast muscles was lowest in the WJ-44 line and highest in the native breed Z-11 (P≤0.01) (Table 3). Cooking loss from leg muscles (Table 4) was higher than that from breast muscles.

Lower cooking loss, both from breast and leg muscles was observed in the heavy N-11 and WJ-44 hens. Water holding capacity was the highest for breast and leg muscles from N-11 hens, and the lowest for R-11 hens (P≤0.05) (Tables 3 and 4).

Line N-11 was characterized by the best tenderness of breast muscles and the poorest tenderness of leg muscles compared to the other lines.

The breast muscles of Z-11 hens received the lowest scores for lightness (L*) and yellowness (b*), while the breast muscles of WJ-44 hens were characterized by the highest lightness (L*), redness (a*) and yellowness (b*) values ($P \leq 0.05$) (Table 3). The leg muscles of Z-11 hens obtained the lowest scores for lightness (L*) and yellowness (b*), and those of R-11 hens for redness (a*), differing significantly in relation to the other lines of hens ($P \leq 0.05$) (Table 4).

The highest total protein content and raw fat content was found in breast muscles from N-11 hens (Table 5). The lowest total protein content was observed in breast muscles from WJ-44 hens as compared with the other breeding lines ($P \leq 0.05$). The protein content in leg muscles was similar in individual breeding lines ($P \geq 0.05$). The highest raw fat content, as compared with the other breeding lines was found in the leg muscles of N-11 hens ($P \leq 0.05$). Cholesterol content was lowest in breast muscles from R-11 and highest in breast muscles from WJ-44 hens, with statistically significant differences in relation to Z-11 and N-11 hens ($P \leq 0.01$). In leg muscles, cholesterol was much more abundant in heavy WJ-44 hens compared to lighter Z-11 and R-11 hens ($P \leq 0.05$).

In the sensory assessment of leg and breast meat, the meat of N-11 hens obtained the highest scores for all analysed traits (odour, appearance and flavour) except for appearance of breast meat, where WJ-44 and R-11 hens received the highest score (Table 6). The meat of the lightest hens (Z-11) obtained the lowest scores and the differences between the lines were confirmed statistically ($P \leq 0.05$). Also the broth cooked from the carcasses of Z-11 hens received the poorest score for both appearance and flavour ($P \leq 0.05$). The broth from the meat of WJ-44 hens had the best odour. The broth from the meat of the other lines (except Z-11) received good (>4 pts) and similar scores for appearance and flavour.

Discussion

The role of genetic and environmental factors as well as the role of nutrition in shaping the quality of broiler carcasses and meat were the subject of numerous studies and are now well known (Berri, 2007; Gornowicz, 2008; Bogosavljević-Bošković et al., 2012). Research concerning the quality of poultry meat conducted in this study pertained to the possibility of obtaining meat from hens after a 9-month period of egg laying. Thus, it does not focus on intensive raising but on extensive dual-purpose use aimed at obtaining both eggs and meat.

The body weight before slaughter of one-year-old hens from the four breeding lines assessed in the experiment varied due to their genotype (origin) and confirms the biodiversity of the populations under analysis. On the basis of this research it can be stated that, from the economic point of view, body weight should be one of significant criteria, which need to be taken into account while selecting hens intended for extensive farming with yarding aimed at obtaining both eggs and meat, as hens with higher body weight are characterized by higher dressing percentage.

Colour is a significant element of carcass assessment by the consumer. In the traditional old Polish cuisine, the carcasses of hens used for broth were expected to be yellow (b*). As is evident from the research conducted, the majority of carcasses from hens under analysis meet consumer expectations in this respect. This particularly concerns N-11 hens.

The carcass weight loss during chilling was small, and it was much lower as compared to young broilers (Połtowicz and Doktor, 2011).

The dressing percentage of Z-11 hens was similar to the results obtained by Murawska and Bochno (2007) for laying hen roosters. At the same time, the authors indicated that such low dressing percentage may cause the production to be unprofitable. The heavy WJ-44 and N-11 breeding lines were already the subject of research aimed to find slow-growing chickens for the purposes of extensive farming (Koreleski et al., 2008), which found that the optimal period for their raising as slaughter chickens is 12 weeks, because at this age the birds have the body weight and dressing percentage comparable to young broilers. In Spain, native breeds of meat hens reached a body weight of approx. 4–5 kg at 10 months of age and dressing percentage exceeding 80% (Franco et al., 2012 a). Połtowicz (2007) and Połtowicz and Doktor (2012), who examined the meatiness of hybrids resulting from the crossing of 4 lines of native hens with Hubbard meat roosters, obtained birds with the weight ranging from 2126 to 2968 g at the age of 12 weeks and with the dressing percentage of 70.66–76.26%, which was similar to the results obtained in our study with heavier hens (WJ-44 and N-11). Also, Koenig et al (2002) obtained good results for dressing percentage (approx. 67%) by raising up to 49 days roosters of laying hens from two genotypes, although their body weight at the end of the fattening period was small and ranged from 616 to 678 g. The research conducted allows a conclusion that the genotype (origin) of laying hens influences the share of breast muscles in the carcass and the results obtained were comparable with those reported by Połtowicz (2007) in hybrids obtained from the crossing of native breeds with Hubbard meat roosters and with those reported by Berri et al. (2005) for slow-growing chickens raised until 12 weeks of age. While the results of Murawska and Bochno (2007) show that with the raising period of laying hen roosters extended from 10 to 18 weeks, their dressing percentage improves and the share of breast muscles in the carcass increases from 15 to over 20%.

The present study has shown that heavier birds also had a higher proportion of leg muscles. The share of leg muscles in carcasses of all hens under examination was small (16.8–20.69%) and it was much lower than that obtained by Berri et al. (2005) and Połtowicz and Doktor (2012) for slow-growing chickens as well as by Koening et al. (2012) for roosters of laying hens, but comparable with the results obtained for native breeds of hens by Połtowicz and Cywa-Benko (1999) and Połtowicz (2007).

The carcasses of all breeds/breeding lines of hens had a high fat content and the content of depot fat was twice as high as in the studies by other authors (Berri et al., 2005; Połtowicz and Doktor, 2012). Even in broiler chickens with the raising period extended to 63 days, this parameter was below 4% (Zhu et al., 2012). In the research by Gornowicz (2008), depot fat content in the carcasses of 42-day-old chickens ranged from 1 to 2%, and according to Polak (2004) it increases to 3% in 48-day-old chickens. The research conducted shows that the carcass fat content increases in laying hens after reaching sexual maturity (approx. 20 weeks of age), especially in laying hens with genetically determined higher body weight.

Muscle acidity is regarded as an important index of meat quality, as it shows the intensity of glycolytic changes occurring in the muscles. This measurement allows for distinguishing between normal meat and defective PSE or DFD meat. The pH index is also correlated with other physicochemical characteristics of meat (Gardzielewska et al., 1995; Połtowicz, 2000). After slaughter, lactic acid formed in muscles as a result of glycolysis lowers the pH level and the rate of the reduction in the value of this index depends on the quantity of glycogen in muscles before slaughter. In all three experiments, the acidity of breast muscles was higher as compared with leg muscles and such relationships also occur in broilers (Gardzielewska et al., 1995; Gornowicz, 2008).

The cooking loss from breast muscle in all breeding lines under analysis was small and it was much lower than that obtained for broilers (Połtowicz and Doktor, 2011). The loss from thigh muscles was even smaller and it was similar to the results obtained by Berri et al. (2005) and Połtowicz (2007) who examined hybrids of native breeds and meat breeding lines raised up to 13 weeks of age, which indicates greater juiciness of leg muscles.

In the present study, higher cooking loss was recorded in leg muscles than in breast muscles, which is consistent with the research on both broilers (Gornowicz, 2008) and slow-growing chickens (Wattanachant et al., 2004; Połtowicz, 2007). Lower cooking loss and lower raw fat content in both breast and leg muscles were found in the N-11 and WJ-44 heavy hens, and a similar relationship was observed by Fanatico et al. (2005 a) who compared slow- and fast-growing chickens. On the other hand, Franco et al. (2012 b), for hens from a native Spanish heavy breed of Mos, which were raised up to the age of 10 months, observed lower cooking loss in breast muscles and found no effect of bird origin on this characteristic. Gornowicz (2008) observed a significant difference in this characteristic between broilers of different origin and also found a similar relationship in the fat content in muscles.

It was found in hens from all breeding lines under analysis that muscles which were lighter in colour were characterized by higher water absorption, which is consistent with the results reported for broilers (Połtowicz, 2000).

Because shear force, which shows meat tenderness, is a characteristic directly correlated with the age of birds, the present results are higher than for the meat of young slaughter chickens (Fanatico et al., 2005 b; Połtowicz and Doktor, 2012). The lower tenderness of meat from the hens under analysis as compared with the meat from young birds is probably the result of greater thickness of muscle fibres and a higher collagen content. No statistically significant differences were found in this research between the individual breeding lines for meat tenderness and the lowest shear force values were obtained for the muscles of Z-11 hens. On the other hand, Fletcher (1999) reported significant differences between 5 commercial lines of 4-week-old broilers. This author also observed that that darker meat (L*) is correlated with lower shear force values, which was also confirmed in our study. Similar to the results of Wattanachant et al. (2004), the shear force values in the legs of one-year-old hens (Table 4) were even 3 times higher than in their breast muscles (Table 3), which indicates the necessity of longer thermal processing and lowers their value in the consumer assessment. The meat of one-year-old hens requires longer thermal processing as compared with meat obtained from intensively farmed chickens.

Meat colour depends on the quantity and degree of oxidation of heme pigment and is one of important parameters in the assessment of meat by consumers (Jakubowska et al., 2004). The research conducted shows the influence of the genotype (origin) of hens on the colour saturation. The darkest breast and leg muscles and the highest redness values were found in the Greenleg Partridge hens (Z-11), which is a characteristic feature of this breeding line, confirmed also by Połtowicz and Cywa-Benko (1999). Both the habit characteristics and the dark colour of the meat make Greenleg Partridge hens similar to wild partridges. It follows from the research by Połtowicz and Cywa-Benko (1999) that among native breeds of hens high diversity occurs in the colour of breast and leg muscles, which additionally confirms their biodiversity.

In the breast muscles of all hens under analysis, the total protein was over 24% and it was higher by 3-4% as compared with young slaughter chickens (Gornowicz, 2008; Połtowicz and Doktor, 2011), but similar to hens from the native Spanish Mos breed (Franco et al., 2012a). Wattanachant et al. (2004) observed a 2% higher protein content and a lower fat content in breast muscles of chickens from the native breed as compared to broiler chickens. Berri et al. (2005), on the other hand, found that the protein level in chicken muscles increased with age.

The sensory quality of meat is determined by flavour, odour, tenderness, juiciness, colour and appearance (Kopeć and Bobak, 2009). In the case of the meat from laying hens these characteristics mostly depend on their type and environmental factors (Farmer, 1999; Krawczyk and Połtowicz, 2004; Połtowicz and Doktor, 2012). The persons tasting the meat and broth from hens of the individual breeds/lines unambiguously indicated the influence of the genotype (origin) on the results of the assessment. The meat (from both breasts and thighs) from the heaviest WJ-44 hens was the best in the tasters' opinions in all three categories of assessment, while the meat of the lightest Z-11 hens received the lowest scores. In a study investigating the influence of broiler genotype on the results of sensory assessment, Gornowicz (2008) also noticed that the heaviest and most muscular Cobb 500 chickens received the best scores from the tasters. Franco et al. (2012 b), on the other hand, obtained better results of sensory assessment for the native Mos hens with lower body weight than for commercial hybrids of heavy hens.

As a result of the research conducted, it was found that:

1. Among the hens under study, heavier layers, i.e. Barred Rock (WJ-44), New Hampshire (N-11) and Rhode Island Red (R-11), which are characterized by good muscling and dressing percentage similar to that of broiler chickens, proved to be most suitable for use as meat.

2. The meat from WJ-44 hens contained most cholesterol and least protein, and the meat from Z-11 birds had the least fat compared to the other lines.

3. At the end of the laying period, meat and broth from WJ-44, N-11 and R-11 hens obtained better sensory scores than those from the carcasses of Z-11 hens, which makes them an attractive raw material for traditional Polish cuisine.

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Received: 30 X 2013
Accepted: 27 II 2014