https://doi.org/10.17221/91/2022-CJAS

Carcass characteristics and breast meat quality in fast-, medium- and slow-growing chickens

Jaroslav Valenta, Darina Chodová, Eva Tůmová, Mohamed Ketta*

Department of Animal Science, Czech University of Life Sciences Prague, Czech Republic

**Corresponding author: valentajaroslav@af.czu.cz*

Citation: Valenta J., Chodová D., Tůmová E., Ketta M. (2022): Carcass characteristics and breast meat quality in fast-, medium- and slow-growing chickens. Czech J. Anim. Sci., 67: 286–294.

Abstract: The aim of the present study was to compare carcass characteristics and meat quality of fast- (Ross 308), medium- (Hubbard JA757) and slow-growing (ISA Dual) chickens (n = 1 980). When the chickens reached an average live weight of 2 kg, 40 birds (males to females, 1 : 1) of each genotype were randomly selected and slaughtered for carcass analysis. *Pectoralis major* (PM) muscle samples were taken to determine the physical and chemical parameters of the meat quality. The fast- and medium-growing genotypes had higher (+3.24% and +3.84%, respectively) dressing out percentages than the slow-growing chickens. As expected, the breast percentage significantly decreased in the order of fast growth > medium growth > slow growth. The abdominal fat percentage was the lowest in Ross 308 chickens, but the abdominal fat percentage in JA757 and ISA Dual chickens did not differ. For edible organs, fast- and medium-growing chickens had heavier hearts and livers than slow-growing chickens. In contrast, ISA Dual chickens showed heavier gizzards. Genotype dramatically affected the chemical composition of PM muscle. The ISA Dual chickens exhibited a significantly higher proportion of dry matter and protein and lower ether extract and cholesterol content than Ross 308 chickens, with intermediate values for JA757 chickens. The ISA Dual group had a lower ash content than Ross 308 and JA757 groups. In terms of physical parameters, the ISA Dual chickens had higher lightness and yellowness and lower redness, pH 24, and cooking loss than those of the other genotypes. Concerning all genotypes, the shear force values increased from fast- to slow-growing chickens. In conclusion, this study found a difference between the genotypes. Although the slow-growing chickens showed the lowest dressing out and breast percentages compared with the other genotypes, the breast meat of the slow-growing chickens had more favourable nutritional properties.

Keywords: poultry; genotype; dual-purpose; carcass yield; physical and chemical meat quality

For many decades, the poultry industry has been focused on fast growth and high carcass yield. As a result, modern meat-type genotypes reach more than 2 kg body weight at 35 days of age (Zaid et al. 2020). Intensive selection for a high growth rate and breast yield has negative consequences, manifested by increased susceptibility of poultry to some health issues (Chodova et al. 2021a). Over the last 15 years, due to significant economic losses, interest has gradually focused mainly on chicken breast meat abnormalities. These modern myopathies, commonly known as White Striping, Wooden Breast and Spaghetti Meat, which mainly affect the *pectoralis major* muscle, have characteristic features reflecting their names (Baldi et al. 2021). The occurrence of these myopathies leads to deterioration of technological and textural properties, reduction in the nutritional value and consumer

Supported by the Ministry of Agriculture of the Czech Republic (Project NAAR No. QK1910387).

https://doi.org/10.17221/91/2022-CJAS

concerns about animal welfare (Petracci et al. 2019). In addition, today's welfare-sensitive society pays more attention to rearing conditions and has ethical concerns related to the killing of male chicks from layer lines. Consequently, chicken meat production is diversifying because consumer demands for animal welfare and breeding conditions are more focused on less intensive systems (Tumova et al. 2021). The common opinion among consumers is that the quality of meat comes from alternative or even from organic farming conditions. The poultry industry has undergone significant changes, especially in the last 50 years. The progress that has been made lies mainly in the emergence of modern fast-growing chickens with high breast yield as the most commercially valuable part of the carcass. In general, the slaughter age in non-intensive systems is higher than that in conventional breeding, even though EU regulations prescribe 81 days in organic production. In this context, fast-growing genotypes are not suitable for a long production period. One of the many ways to reduce health problems and affect meat quality in fast-growing chickens is to introduce feed restrictions, which many studies have recently focused on (Tumova et al. 2022a, b).

In contrast, medium- and slow-growing genotypes are required for alternative systems due to their vitality and adaptability (Almasi et al. 2015). The medium-growing genotype has been defined as chickens with a daily gain of 25–30 g/day and the slow-growing genotype has been defined as chickens with a daily gain of up to 20 g and a live weight of 2.2–2.5 kg in 56–81 days (Dal Bosco et al. 2012). Medium-growing chickens are a crossbreed of fast- and slow-growing genotypes and are suitable for semi-intensive breeding systems. Slow-growing chickens are usually male layer hybrids used for meat production and dual-purpose chickens (Chodova et al. 2021a). As a good alternative, dual-purpose chickens offer the use of both sexes, hens for eggs and cockerels for meat. The use of dual-purpose male chicks for meat is more appropriate than the use of cockerels from egg-type chickens, as their feeding is not economically acceptable (Evaris et al. 2019; de Haas et al. 2021). With respect to culling of day-old male chicks, a possible solution is feeding of dual-purpose cockerels. However, compared to specialized broiler lines, limited performance is to be expected with dual-purpose chickens (Mueller et al. 2018).

As there are several medium- and slow-growing dual-purpose chicken breeds available, particularly in Europe, it is necessary to compare parameters between different chicken genotypes that affect profitability and consumer acceptability. Therefore, the aim of the present study was to compare carcass yield and meat quality parameters in chickens with different growth rates at the same level of carcass weight.

MATERIAL AND METHODS

At the International Poultry Testing Station Ústrašice, an evaluation was performed on fast- (Ross 308), medium- (JA757) and slow-growing (ISA Dual) genotypes of chickens. The chickens were reared according to the Directive 2010/63/EU for animal experiments, and all procedures were approved by the Ethics Committee of the Central Commission for Animal Welfare of the Ministry of Agriculture of the Czech Republic.

Animals and experimental design

In this study, fast- (Ross 308), medium- (Hubbard JA757), and slow-growing (ISA Dual) chickens were used. A total of 1 980 1-day-old chickens (males to females, 1 : 1) were wing-signed and divided into 12 indoor littered floor pens. All birds were separated by genotypes with four replicates (165 chickens per pen) and reared in environmental conditions corresponding to the requirements for the growing chickens. Throughout the trial, all groups were fed the same conventional diet, and water was available *ad libitum*. The stocking density was 11.35 birds per m^2, and the lighting regime was 23 h of light from one to seven days of age, 18 h of light from eight to 67 days of age, and 23 h of light from 68 to 70 days of age. The experiment finished at a mean live weight of 2 000 g and ages of 35, 42 and 70 days for Ross 308, Hubbard JA757 and ISA Dual chickens, respectively. A total of 120 chickens (40 per genotype at a sex ratio of 1 : 1) were randomly selected for carcass analysis. Birds were slaughtered in the experimental slaughterhouse of the International Poultry Testing Station Ústrašice. Chickens were electrically stunned before killing, exsanguinated, plucked after a hot bath and manually eviscerated.

https://doi.org/10.17221/91/2022-CJAS

The head and feet were removed by hand. Then, the carcasses were chilled for 24 h at 4 °C. The carcass weight without giblets was used to calculate the cold dressing out percentage (DOP). For carcass analysis, breasts, abdominal fat, heart, liver, and gizzard were weighed. The breast was selected for evaluation because it is the main valuable part of the chicken. The percentage of breasts was evaluated as breast meat weight divided by cold carcass weight without giblets. Furthermore, abdominal fat was selected for analysis owing to its relationship with chemical meat composition. The abdominal fat (AF) percentage was calculated by dividing the weight of the abdominal fat by the cold carcass weight. Finally, internal organs (heart, liver, and gizzard) were related to growth. Measurements of meat quality were performed in the *pectoralis major* muscle 24 h *post mortem*.

Meat chemical analyses

The meat chemical composition was determined on the right breasts. The dry matter, crude protein, ether extract and ash were analysed by the Association of Official Analytical Chemists-approved methods (AOAC 1995). Dry matter was determined by oven drying the samples at 105 °C to a constant weight. Crude protein was determined using the Kjeldahl method (with a factor of 6.25), and the Soxhlet method was used for the ether extract assay. Ash content was determined based on the weight of raw and ashed samples (at 550 °C in a muffle furnace). Finally, cholesterol content was determined using a validated gas chromatographic method (Model 5000; PerkinElmer, Inc., Waltham, MA, USA). For analysis, 2 g samples of PM muscle were saponified using potassium hydroxide in ethanolic solution, and cholesterol was extracted with n-hexane. Total cholesterol in PM muscle was calculated based on the external standard technique and a standard curve peak area vs. concentration, and the results were expressed as mg of cholesterol per 1 000 g of meat.

Meat physical analyses

Physical meat parameters were measured in the right breast. At 24 h, the ultimate pH was detected using a Jenway 3510 pH metre (Jenway, Essex, UK) with a glass injection probe introduced 1 cm deep into the PM muscle. The colour parameters were measured 24 h *post mortem* in the transverse section of the PM muscle using a Minolta SpectraMagic™ NX analyser (Konica Minolta Sensing, Inc., Osaka, Japan) with a CIEL*a*b* system (CIE, Commission Internationale de l'Eclairage, 1976). Cooking loss was measured by calculating the difference between the weight of the raw and cooked (for 1 h at 75 °C) PM samples. Furthermore, meat tenderness was evaluated in the breast meat. Dissected meat samples were frozen and stored at –20 °C. After defrosting at 4 °C for 24 h and packing in zip-tied plastic bags, the samples were heated in a water bath at 75 °C for 1 hour. Each cooled meat sample was cut perpendicularly to the muscle fibres into a 2 × 1 cm^2 cuboid. Shear force values were determined in PM muscle with a Warner–Bratzler shear blade containing a triangular hole to detect maximum shear force (F_{max}; N) on an Instron Model 3342 instrument (Instron, Norwood) using the following parameters: load cell (20 N), crosshead speed (100 mm/min), and sampling rate (20 points/s).

Statistical analysis

The data were processed with SAS software v9.4 (SAS Institute 2013). The carcass yield and meat quality data were analysed by the GLM procedure. Differences between means with $P < 0.05$ were considered statistically significant and tested by Duncan's test. $P < 0.05$ was considered significant for all analyses, and statistically significant differences are indicated by different superscript letters. For all statistical analyses, the individual bird was the experimental unit.

RESULTS

Carcass characteristics

The results of the carcass characteristics are presented in Table 1. The fast-growing Ross 308 chickens and medium-growing JA757 chickens had higher (+3.24 and +3.84%, respectively) DOP ($P < 0.001$) than the slow-growing ISA Dual chickens. The highest ($P < 0.001$) breast meat percentage was found in the fast-growing Ross 308 chickens,

https://doi.org/10.17221/91/2022-CJAS

Table 1. Carcass characteristics of fast-growing Ross 308 on day 35, medium-growing JA757 on day 42, and slow-growing ISA Dual on day 70, fattened to a slaughter weight 2 kg (for each genotype n = 40)

Carcass characteristics	Genotype			SEM	*P*-value
	Ross 308	JA757	ISA Dual		
DOP (%)	71.78[a]	72.38[a]	68.54[b]	0.34	< 0.001
Breast meat (%)	28.01[a]	22.57[b]	15.19[c]	0.53	< 0.001
Abdominal fat (%)	1.32[b]	2.81[a]	3.01[a]	0.12	< 0.001
Heart (g)	11.39[a]	10.58[a]	8.40[b]	0.21	< 0.001
Liver (g)	43.83[a]	42.13[a]	30.81[b]	0.82	< 0.001
Gizzard (g)	20.34[b]	22.61[b]	26.31[b]	0.52	< 0.001

DOP = dressing out percentage; SEM = standard error of the mean
[a–c]Means ± SEM with different superscripts vary significantly ($P < 0.05$) within the row

followed by the medium-growing JA757 chickens; the lowest percentage was found in the ISA Dual chickens. Ross 308 chickens had a lower ($P < 0.001$) AF percentage than the JA757 and ISA Dual chickens. The yield of the heart and liver was higher ($P < 0.001$) in fast-growing Ross 308 chickens and medium-growing JA757 chickens than in slow-growing ISA Dual chickens. In contrast, ISA Dual chickens had a higher ($P < 0.001$) yield of gizzard than the JA757 and Ross 308 chickens.

Meat chemical composition

Significant differences between genotypes were found in every category (Table 2). The highest dry matter and crude protein contents ($P < 0.001$ for both) in PM muscle were detected in slow-growing ISA Dual chickens, followed by the medium-growing JA757 chickens; the fast-growing Ross 308 chickens had the lowest dry matter and crude protein contents. However, the ether extract and cholesterol content ($P < 0.001$ for both) of PM muscle gradually decreased from fast-growing Ross 308 chickens to medium-growing JA757 chickens and to slow-growing ISA Dual chickens. The ISA Dual chickens exhibited lower ($P = 0.001$) ash content than the JA757 and Ross 308 chickens.

Physical meat quality

Table 3 summarizes the physical parameters of breast meat. The colour of PM muscle measured in transverse section was lighter ($P < 0.001$) with lower redness ($P < 0.001$) and higher yellowness ($P = 0.012$) in slow-growing ISA Dual chickens than in Ross 308 and JA757 chickens. Slow-growing chickens showed lower ($P = 0.013$) pH measured 24 h *post mortem* in comparison with both fast- and medium-growing chickens. The cooking loss was significantly affected by genotype. The slow-growing ISA Dual chickens had the lowest ($P = 0.003$) cooking losses; the cooking

Table 2. Nutritional composition of breast meat of fast-growing Ross 308 on day 35, medium-growing JA757 on day 42, and slow-growing ISA Dual on day 70, fattened to a slaughter weight 2 kg (for each genotype n = 40)

Chemical composition	Genotype			SEM	*P*-value
	Ross 308	JA757	ISA Dual		
Dry matter (g/kg)	249.75[c]	256.97[b]	267.18[a]	1.03	< 0.001
Crude protein (g/kg)	217.44[c]	229.00[b]	238.25[a]	1.03	< 0.001
Ether extract (g/kg)	9.83[a]	4.64[b]	3.47[c]	0.30	< 0.001
Ash (g/kg)	11.64[a]	11.73[a]	11.21[b]	0.06	0.001
Cholesterol (mg/kg)	422.67[a]	338.05[b]	297.12[c]	8.19	< 0.001

SEM = standard error of the mean
[a–c]Means ± SEM with different superscripts vary significantly ($P < 0.05$) within the row

https://doi.org/10.17221/91/2022-CJAS

Table 3. Physical meat quality parameters (pH 24, water-holding capacity, tenderness, and colour) of the *pectoralis major* muscle of fast-growing Ross 308 on day 35, medium-growing JA757 on day 42, and slow-growing ISA Dual on day 70, fattened to a slaughter weight 2 kg (for each genotype n = 40)

Physical parameters	Genotype			SEM	*P*-value
	Ross 308	JA757	ISA Dual		
pH 24[1]	5.86[a]	5.85[a]	5.67[b]	0.03	0.013
Cooking loss (%)	25.94[a]	25.08[a]	23.42[b]	0.30	0.003
F_{max} (N)	9.00[c]	13.06[b]	17.26[a]	0.28	< 0.001
Breast meat colour[2]					
Lightness (L*)	50.36[b]	50.23[b]	56.62[a]	0.47	< 0.001
Redness (a*)	–0.84[a]	–1.07[a]	–2.00[b]	0.10	< 0.001
Yellowness (b*)	7.28[b]	7.66[b]	9.40[a]	0.31	0.012

F_{max} = maximum shear force; SEM = standard error of the mean

[a–c]Means ± SEM with different superscripts vary significantly (P < 0.05) within the row

[1]pH measured 24 h *post mortem*; [2]colour measured in transverse section

losses of Ross 308 chickens did not differ from those of JA757 chickens. Genotype also influenced shear force, which is used to describe meat tenderness. For maximum shear force, slow-growing ISA Dual chickens showed significantly (P < 0.001) higher values than fast-growing Ross 308 chickens with intermediate values for medium-growing JA757 chickens.

DISCUSSION

Carcass characteristics

Generally, the fast-growing chickens reached a standard market weight of 2–2.2 kg at approximately 35 days of age. In this study, fast-growing Ross 308 chickens were grown for 35 days to reach a live weight of 2 kg, compared with 42 days and 70 days for medium-growing JA757 and slow-growing ISA Dual chickens, respectively. Although the slaughter weight was similar, the DOP values varied between genotypes. Concretely, the slow-growing ISA Dual chickens exhibited lower DOP values than medium-growing JA757 and fast-growing Ross 308 chickens (68.54% vs 72.38% and 71.78%, respectively). This finding was in agreement with Devatkal et al. (2019), who compared fast- and slow-growing genotypes. Regarding medium-growing JA757 chickens, different results were previously reported in other studies. Chodova et al. (2021a, b) observed intermediate DOP values. In contrast, Tumova et al. (2021) reported a higher DOP in JA757 chickens than in fast- and slow-growing chickens.

Breast meat is economically important and the most valuable part of poultry carcasses. In the present study, breast meat percentage was significantly affected by genotype. The breast meat percentage gradually decreased from fast-growing Ross 308 chickens to slow-growing ISA Dual chickens, with intermediate values for medium-growing JA757 chickens. These results are consistent with the findings provided in earlier studies (Fanatico et al. 2008; Mikulski et al. 2011; Mueller et al. 2018; Singh et al. 2021). However, those authors compared only fast- and slow-growing chickens. In addition, an intermediate value of breast meat percentage for the medium-growing genotype was also observed by Chodova et al. (2021a, b) and Tumova et al. (2021).

In the present study, a significantly lower abdominal fat percentage was found in the fast-growing genotype than in the medium- and slow-growing genotypes. Consistent with the present findings, Mikulski et al. (2011), Dogan et al. (2019) and Chodova et al. (2021b) also reported lower abdominal fat percentages in fast-growing chickens. Abdominal fat is the late maturing tissue that increases with age (Tumova and Chodova 2018). Therefore, as a result of long-term selection for intensive growth, fast-growing chickens have a low abdominal fat percentage.

Edible by-products primarily include the heart, liver, and gizzard. In this study, with regard to these giblets, there were significant differences between

https://doi.org/10.17221/91/2022-CJAS

genotypes. The gizzard was heavier for slow-growing ISA Dual chickens than for fast-growing and medium-growing chickens. Similar results were observed by Alshamy et al. (2018) and Singh et al. (2021). In contrast, the heart and liver were heavier in fast-growing and medium-growing genotypes than in the slow-growing genotype. Regarding the heart, Harash et al. (2019) reported similar findings between fast- and slow-growing chickens. The higher weight of the heart and liver observed in fast- and medium-growing chickens is probably related to a faster growth rate. On the other hand, the heavier gizzard in slow-growing chickens could be a result of a longer feeding period.

Meat chemical composition

One of the main reasons driving the popularity of poultry meat in consumers is the healthy nutritional profile compared with pork and beef (Petracci et al. 2015). In addition to nutritional properties, consumers currently believe in better meat quality originating from more animal-friendly rearing conditions. In this context, it is useful to evaluate the nutritional profile of genotypes with slow growth rates and longer feeding periods that are more suitable for alternative farming compared to fast-growing genotypes.

In the present study, genotype significantly influenced the chemical composition of breast meat. With respect to all three genotypes, the dry matter and protein content gradually increased from fast-growing Ross 308 chickens to slow-growing ISA Dual chickens. These results may be related to age at slaughter. In our experiment, the slow-growing chickens were 35 days older than the fast-growing chickens. Regarding the ether extract content, an opposite trend was observed. Although the amount of abdominal fat was highest in the slow-growing ISA Dual chickens, the ether extract content was almost three times higher in the fast-growing genotype than in the slow-growing genotype. According to Metzger et al. (2011), this can be explained by the fact that animals with high growth rates rapidly incorporate fat into cells, replacing water. Lower intramuscular fat content may negatively affect flavour; however, in our study, no sensory analysis was performed to confirm this. Fanatico et al. (2007), Mueller et al. (2018), and Chodova et al. (2021a, b) also found lower ether extract and higher protein contents in breast meat of slow-growing genotypes. Concerning cholesterol, its consumption when eating animals is a major health concern of consumers. In this study, cholesterol content was related to intramuscular fat content, with lower content in breast meat of slow-growing chickens. Similar findings were observed by Chodova et al. (2021b). Furthermore, slow-growing ISA Dual chickens showed lower ash content than both fast- and medium-growing genotypes. Interestingly, Chodova et al. (2021a) did not find any significant differences in the cholesterol or ash content between genotypes. Similarly, in an earlier work by Fanatico et al. (2007), differences were not found in the ash content in breast meat between fast-, medium- and slow-growing chickens.

Physical meat quality

The most important physical parameter at the consumer's first contact with fresh or processed meat is the colour. Various factors, such as sex, age, genotype, feed, state of haem pigments, stress, slaughter and processing conditions, may affect the meat colour (Mir et al. 2017). The CIE (1976) system colour profile of lightness (L*), redness (a*), and yellowness (b*) was used to evaluate colour in cross-sections of PM muscle. In this study, the breast meat colour of slow-growing ISA Dual chickens was lighter with a higher L* value than that of the fast-growing Ross 308 and medium-growing JA757 chickens (56.62 vs 50.36 and 50.23, respectively), whereas fast- and medium-growing genotypes showed higher redness and lower yellowness. With respect to lightness, our results in all three genotypes are consistent with those of Chodova et al. (2021b) and Dogan et al. (2019), who compared fast- and slow-growing chickens. In contrast, lighter (higher L* value) breast meat was found in fast-growing chickens than in slow-growing ones (Singh et al. 2021). The L* value indicates the degree of paleness (Chodova et al. 2021a). In addition, Petracci et al. (2004) conducted a study that first evaluated the variation in broiler breast meat colour and established that breast meat with L* values higher than 56 could discriminate breast meat with PSE properties. Although the ISA Dual chickens in our experiment showed higher lightness, no pale, soft, exudative meat was observed. In this context, the light col-

https://doi.org/10.17221/91/2022-CJAS

our of ISA Dual chickens may be a characteristic of this genotype.

The pH value represents the level of muscle tissue acidity, which is used in the evaluation of meat quality (Janocha et al. 2021). In the post-mortem period, muscle glycogen is metabolized by anaerobic glycolysis, generating lactate that accumulates and lowers intracellular pH. As a result of these changes, the pH drops 24 h *post mortem* to an ultimate pH (Maltin et al. 2003). These post-mortem events have important consequences in the conversion of muscle to meat. The rate of decrease in the final pH (pH 24) has an impact on meat texture parameters, water-holding capacity, shelf life, and colour. The optimum pH 24 should be approximately 5.6–6.1 (Janocha et al. 2021). In this study, the pH 24 values of all three genotypes ranged from 5.6 to 5.9, which was in accordance with the optimal pH 24. The lowest pH 24 was detected in slow-growing ISA Dual chickens compared with both Ross 308 and JA757 chickens. These results correspond to previous studies (Fanatico et al. 2007; Chodova et al. 2021a) comparing chickens of similar slaughter weight, which showed lower pH 24 values for slow-growing genotypes than for fast-growing ones.

Water-holding capacity is among the most important functional indicators of raw meat as well as of further processed meat products (Mir et al. 2017; Devatkal et al. 2019). Moreover, it can have a direct bearing on the shelf life and sensory characteristics of meat. Mir et al. (2017) characterized water-holding capacity as the maximum amount of water that can be retained by muscle proteins under the conditions prevailing at measurement. Based on this, it is possible to measure this parameter as cooking loss. After heat treatment of the breast meat, such as boiling, differences in water-holding capacity between genotypes were observed. Regarding the cooking loss, the present study showed better water-holding capacity in slow-growing ISA Dual chickens than in fast-growing Ross 308 and medium-growing JA757 chickens (23.42% vs 25.94% and 25.08%, respectively). Lower cooking loss in slow-growing chickens may be due to the higher water-holding capacity of older animals (Chodova et al. 2021a).

Texture, particularly tenderness, is the most important quality attribute associated with overall consumer satisfaction with eating quality (Fanatico et al. 2007; Mir et al. 2017). In this study, genotype dramatically affected the texture of breast meat. Namely, the Warner–Bratzler shear value of slow-growing ISA Dual chickens was almost double that of fast-growing Ross 308 chickens and higher than that of medium-growing JA757 chickens (17.26 N vs 9.00 N vs 13.06 N, respectively). A high shear force value in slow-growing chickens was also observed by Chodova et al. (2021a) and Weng et al. (2022). These results can be explained by the fact that in older chickens, there is an increase in the content of intramuscular connective tissue, which leads to greater hardness of the meat. However, Devatkal et al. (2019) did not find any significant differences in shear force values between slow- and fast-growing chickens. In contrast to the present study, Fanatico et al. (2007) found that breast meat from slow-growing chickens was more tender than meat from fast-growing chickens. The higher tenderness of breast meat from fast-growing chickens may be attributed to the higher intramuscular fat content.

CONCLUSION

Up-to-date knowledge is important for understanding the differences in qualitative and quantitative parameters between available chicken genotypes and their appropriate use with respect to the length of the feeding period. The present study focused on fundamental parameters that could better characterize genotypes with slower growth rates compared to conventional commercial fast-growing chickens at similar slaughter weights. A slower growth rate is associated with a prolonged feeding period and allows the use of these genotypes in alternative breeding conditions. In conclusion, the evaluated parameters were influenced by the chicken genotypes. Except for breast meat percentage and abdominal fat percentage, the major carcass characteristics and physical meat quality attributes were similar in fast- and medium-growing chickens. On the other hand, differences in chemical composition were strongly affected by all three genotypes. Based on carcass yield, fast- and medium-growing chickens are certainly much more attractive; however, from a nutritional point of view, the meat of slow-growing dual-purpose chickens can be accepted as healthier, due to both lower fat and cholesterol content and higher protein content.

https://doi.org/10.17221/91/2022-CJAS

Conflict of interest

The authors declare no conflict of interest.

REFERENCES

Almasi A, Andrassyne BG, Milisits G, Kustosne PO, Suto Z. Effects of different rearing systems on muscle and meat quality traits of slow-and medium-growing male chickens. Br Poult Sci. 2015 Apr 10;56(3):320-4.

Alshamy Z, Richardson KC, Hunigen H, Hafez HM, Plendl J, Al Masri S. Comparison of the gastrointestinal tract of a dual-purpose to a broiler chicken line: A qualitative and quantitative macroscopic and microscopic study. PLoS One. 2018 Oct 19;13(10): 22 p.

AOAC – Association of Official Analytic Chemists. Official Method of Analysis. 16th ed. Washington, DC, USA: Association of Official Analytical Chemists; 1995.

Baldi G, Soglia F, Petracci M. Spaghetti meat abnormality in broilers: Current understanding and future research directions. Front Physiol. 2021 May 31;12: 7 p.

Chodova D, Tumova E, Ketta M, Skrivanova V. Breast meat quality in males and females of fast-, medium- and slow-growing chickens fed diets of 2 protein levels. Poult Sci. 2021a Apr;100(4): 9 p.

Chodova D, Tumova E, Ketta M. The response of fast-, medium- and slow-growing chickens to a low protein diet. Czech J Anim Sci. 2021b Mar 2;66(3):97-105.

Dal Bosco A, Mugnai C, Ruggeri S, Mattioli S, Castellini C. Fatty acid composition of meat and estimated indices of lipid metabolism in different poultry genotypes reared under organic system. Poult Sci. 2012 Aug 1;91(8):2039-45.

de Haas EN, Oliemans E, van Gerwen MAAM. The need for an alternative to culling day-old male layer chicks: A survey on awareness, alternatives, and the willingness to pay for alternatives in a selected population of Dutch citizens. Front Vet Sci. 2021 Jun 17;8: 13 p.

Devatkal SK, Naveena BM, Kotaiah T. Quality, composition, and consumer evaluation of meat from slow-growing broilers relative to commercial broilers. Poult Sci. 2019 Nov 1;98(11):6177-86.

Dogan SC, Baylan M, Bulancak A, Ayasan T. Differences in performance, carcass characteristics and meat quality between fast- and slow-growing broiler genotypes. Prog Nutr. 2019 Sep;21(3):558-65.

Evaris EF, Franco LS, Castro CS. Slow-growing male chickens fit poultry production systems with outdoor access. Worlds Poult Sci J. 2019 Sep;75(3):429-44.

Fanatico AC, Pillai PB, Emmert JL, Owens CM. Meat quality of slow- and fast-growing chicken genotypes fed low-nutrient or standard diets and raised indoors or with outdoor access. Poult Sci. 2007 Oct 1;86(10):2245-55.

Fanatico AC, Pillai PB, Hester PY, Falcone C, Mench JA, Owens CM, Emmert JL. Performance, livability, and carcass yield of slow- and fast-growing chicken genotypes fed low-nutrient or standard diets and raised indoors or with outdoor access. Poult Sci. 2008 Jun 1;87(6):1012-21.

Harash GK, Richardson C, Alshamy Z, Hunigen H, Hafez HM, Plendl J, Al Masri S. Heart ventricular histology and microvasculature together with aortic histology and elastic lamellar structure: A comparison of a novel dual-purpose to a broiler chicken line. PLoS One. 2019 Mar 21;14(3): 20 p.

Janocha A, Milczarek A, Laski K, Gluchowska J. Slaughter value and meat quality of broiler chickens fed with rations containing a different share of pea seed meal. Acta Sci Pol Technol Aliment. 2021 Jul-Sep;20(3):265-76.

Maltin C, Balcerzak D, Tilley R, Delday M. Determinants of meat quality: Tenderness. Proc Nutr Soc. 2003 May; 62(2):337-47.

Metzger S, Odermatt M, Szabo A, Radnai I, Biro-Nemeth E, Nagy I, Szendro Z. Effect of age and body weight on carcass traits and meat composition of rabbits. Arch Anim Breed. 2011 Oct 10;54(4):406-18.

Mikulski D, Celej J, Jankowski J, Majewska T, Mikulska M. Growth performance, carcass traits and meat quality of slower-growing and fast-growing chickens raised with and without outdoor access. Asian-Australas J Anim Sci. 2011 Oct;24(10):1407-16.

Mir NA, Rafiq A, Kumar F, Singh V, Shukla V. Determinants of broiler chicken meat quality and factors affecting them: A review. J Food Sci Technol. 2017 Sep;54(10):2997-3009.

Mueller S, Kreuzer M, Siegrist M, Mannale K, Messikommer RE, Gangnat IDM. Carcass and meat quality of dual-purpose chickens (Lohmann Dual, Belgian Malines, Schweizerhuhn) in comparison to broiler and layer chicken types. Poult Sci. 2018 Sep 1;97(9):3325-36.

Petracci M, Betti M, Bianchi M, Cavani C. Color variation and characterization of broiler breast meat during processing in Italy. Poult Sci. 2004 Dec 1;83(12):2086-92.

Petracci M, Mudalal S, Soglia F, Cavani C. Meat quality in fast-growing broiler chickens. Worlds Poult Sci J. 2015 Jun;71(2):363-74.

Petracci M, Soglia F, Madruga M, Carvalho L, Ida E, Estevez M. Wooden-breast, white striping, and spaghetti meat: Causes, consequences and consumer perception of emerging broiler meat abnormalities. Compr Rev Food Sci Food Saf. 2019 Mar;18(2):565-83.

SAS Institute. Statistical Analysis Software for Windows (SAS). Statistics version 9.4 ed. Cary, NC, USA: SAS Institute Inc.; 2013.

https://doi.org/10.17221/91/2022-CJAS

Singh M, Lim AJ, Muir WI, Groves PJ. Comparison of performance and carcass composition of a novel slow-growing crossbred broiler with fast-growing broiler for chicken meat in Australia. Poult Sci. 2021 Mar 1;100(3): 11 p.

Tumova E, Chodova D. Performance and changes in body composition of broiler chickens depending on feeding regime and sex. Czech J Anim Sci. 2018 Dec 6;63(12):518-25.

Tumova E, Chodova D, Skrivanova E, Lalouckova K, Subrtova-Salmonova K, Ketta M, Machander V, Cotozzolo E. Research note: The effects of genotype, sex, and feeding regime on performance, carcasses characteristic, and microbiota in chickens. Poultry Sci. 2021 Feb 1;100(2):760-4.

Tumova E, Chodova D, Volek Z, Ebeid TA, Ketta M, Skrivanova V. A comparative study on the effect of quantitative feed restriction in males and females of broiler chickens, rabbits and nutrias. I. Performance and carcass composition. Czech J Anim Sci. 2022a Feb 6;67(2):47-54.

Tumova E, Chodova D, Volek Z, Ebeid TA, Ketta M, Skrivanova V. A comparative study on the effect of quantitative feed restriction in males and females of broiler chickens, rabbits and nutrias. II. Meat quality. Czech J Anim Sci. 2022b Feb 6;67(2):55-64.

Weng K, Huo W, Li Y, Zhang Y, Zhang Y, Chen G, Xu Q. Fiber characteristics and meat quality of different muscular tissues from slow- and fast-growing broilers. Poult Sci. 2022 Jan 1;101(1): 8 p.

Zaid M, Hussain J, Mahmud A, Javed K, Shaheen MS, Usman M, Ghayas A, Ahmad S. Carcass traits, meat quality, and sensory attributes of fast-growing broilers given outdoor access at different ages. Turk J Vet Anim Sci. 2020;44(5):1039-46.

Received: May 17, 2022
Accepted: June 29, 2022
Published online: July 15, 2022