

MEAT PERFORMANCE AND MEAT QUALITY OF WILD DUCKS (*ANAS PLATYRHYNCHOS*) REARED IN DOMESTIC CONDITIONS

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ABSTRACT

The aim of the work was to evaluate the meat performance, colour and basic chemical composition (g.100 g⁻¹ of water, protein, fat, and cholesterol) of the breast and thigh muscles (n=20) of the wild ducks reared in domestic conditions. The L* values of the wild ducks ranged from 32.86 (breast muscle) to 36.88 (thigh muscle). The a* value ranged from 10.70 (thigh muscle) to 11.96 (breast muscle). By evaluating the b* parameter, we observed a similar tendency as with the L* value. The highest b* values were measured in the thigh muscle (10.13) and lower in the breast muscle (7.49). The proportion of breast (36.41%) and thigh (21.33%) from the carcass weight of wild ducks is relatively high, and a high average carcass yield (74.03%) was also found. The water content varied from 71% (thigh muscle) to 72.52% (breast muscle). The average protein content of breast 24.11 g.100 g⁻¹ and thigh muscle was 22.84 g.100 g⁻¹. The higher fat content was measured in breast muscle (1.82 g.100 g⁻¹) and lower (1.45 g.100 g⁻¹) in thigh muscle. The cholesterol content in meat from wild ducks ranged from 0.049 g.100 g⁻¹ (thigh muscle) to 0.051 g.100 g⁻¹ (breast muscle).

Keywords: wild duck, domestic condition, meat performance, chemical composition, colour

INTRODUCTION

Consumer interest in good nutrition and a healthy lifestyle has increased recently. Not only should meals satisfy our senses, but they should also be nutritionally sound (Brückner *et al.*, 2005; Lin & Chang, 2005; Makala, 2013). Due to the rise in cardiovascular diseases in persons who primarily consume beef meat, physicians recommended to decrease their intake of red meat and increase intake for chicken meat (Pfeuffer, 2001). Consequently, we can see a steady rise in the consumption of poultry meat in many different countries. Dietetic quality is becoming increasingly important, even for ducks, especially for carcasses with meat (Isguzar, Kocak & Pingel, 2002; Wawro *et al.*, 2004). The main purpose of keeping ducks is to provide meat. According to Huang *et al.* (2013), ducks are one of the most economically significant species of waterfowl in the world and a major source of high-quality protein for many people. In compared to other fowl, experts have paid little attention to duck meat. More options for consumers on a diet are now available thanks to the increased availability of duck cuts like breast and thighs in recent times. The process of killing a duck is often the same as that of a chicken. Duck is regarded as red meat since its breasts contain more red muscle fibre than those of chickens (Smith *et al.*, 1993). Consumers from various nations have recently expressed increasing interest in native breeds of waterfowl, particularly ducks, in their quest for new food products that are safe and good to eat (Uhlířova *et al.*, 2018).

Based on native poultry breeds, it is possible to produce quality and safe foods desired by consumers in many countries. The carcasses obtained from native ducks aged 8 weeks have a high content of breast muscle (12.9% to 15.8% meat) that is high in protein and low in fat and has a desirable profile of fatty acids rich in polyunsaturated fatty acid, including linoleic and arachidonic fatty acids (Gornowicz & Książkiewicz, 2011; Muhlisin *et al.*, 2013). China produced the most duck meat in 2022 (4,800,000 tonnes), followed by Vietnam and France in a comparison of 69 countries. Global output of duck meat reached 6,068,757 tonnes in 2022, according to FAOSTAT. This is 28.1% greater than ten years ago and 2.31% less than the prior year. The total amount of duck meat produced has historically ranged from 335,922 tonnes in 1961 to 6,209,141 tonnes in 2021. Since 1961, the average annual growth has been 4.86%. China was the top-ranked nation, producing 79.1% of the world's duck meat. In 2022, the 10 largest countries will make up approximately 91.5%, with the top 3 holding an 84% share (URL 1).

The objective of our study was to evaluate the meat performance, colour and basic chemical composition of the breast and thigh muscles of wild duck meat reared in domestic conditions.

MATERIAL AND METHODS

In the experiment, 20 pcs wild duck (*Anas platyrhynchos*) (10 females, 10 males) was used as the biological material. The farm breeding wild ducks were 133 days old. Table 1 indicate composition of feed mixtures for wild duck. The wild ducks were euthanized and slaughtered in a permitted manner and transported in cooling boxes to the Institute of Food Sciences, SUA Nitra.

Slaughter and measurements

We then subjected the wild ducks (*Anas platyrhynchos*) carcasses to slaughtering. The wild ducks were slaughtered by conventional neck cut, bled, feathers removed, and eviscerated. Examined parameters in experiment were as follows: live body weight (BW) at the and fattening period (133 d); carcass weight (CW); giblets weight; liver weight; gizzard weight; heart weight; neck weight; abdominal fat; gizzard fat; breast part weight; thigh part weight; breast muscle weight; thigh muscle weight; wings part weight (all in g), and carcass yield (CY) (%).

All animals used in this study were handled following the national legislation on animal welfare (DL n. 126, 07/07/2011, EC Directive 2008/119/EC). Wild ducks were slaughtered in compliance with Regulation 1099/2009 of the European Union on the protection of animals at the time of killing.

Chemical composition

For the basic chemical analysis of the muscle tissue, we took samples of muscle tissue from arguably the most valuable parts of the wild duck carcass (Haščík *et al.*, 2023), which were stored at a temperature of 4 °C.

After the carcass had been previously deboned, we collected 25 g samples from each of the separate muscles, which allowed us to obtain an average meat sample. This process produced an average sample of 50 g, which was utilised for chemical analysis. At the Slovak Centre for Agricultural Research in Nitra, we processed the chemical composition of the muscle using the Fourier transform infrared spectroscopy (FTIR), Nicolet 6700 instrument. We assessed the water, total proteins, crude fat, and cholesterol contents in a g.100 g⁻¹ sample of meat.

Table 1 Feed mixtures composition for wild duck (kg.100 kg⁻¹)

| Ingredients | Feed from day | supplied 1 st to 21 st | Feed supplied from 22 st to 133 rd day |
|--|---------------|--|--|
| Wheat meal | 55.40 | | 57.60 |
| Soybean meal (48% CP) | 17.40 | | 10.00 |
| Maize | 17.00 | | 17.40 |
| Rapeseed oil | 1.00 | | 1.60 |
| Calcium carbonate | 0.80 | | 6.00 |
| Dicalcium phosphate | 2.00 | | 2.00 |
| Premix Euromix ¹ | 1.00 | | 1.40 |
| Fish meal (71% CP) | 5.40 | | 4.00 |
| Nutrient content (g.kg ⁻¹) | | | |
| ME _N (MJ.kg ⁻¹) | 11.89 | | 12.34 |
| Crude fibre | 30.30 | | 36.43 |
| Crude protein | 205.20 | | 179.40 |
| Lysine | 10.85 | | 9.33 |
| Methionine + Cystine | 8.45 | | 7.52 |
| Tryptophan | 2.31 | | 2.02 |
| Threonine | 7.05 | | 6.45 |
| Ca | 9.98 | | 8.78 |
| P | 5.21 | | 4.07 |

Notes: CP = crude protein; Ca = calcium; P = phosphorus; ME_N = nitrogen-corrected metabolizable energy; MJ = megajoule; ¹active substances per kilogram of premix: vitamin A 15 000 IU; vitamin E 20 mg; vitamin D₃ 2 000 IU; riboflavin 6 mg; cobalamin 20 µg; Mn 60 mg; Zn 40 mg; Fe 40 mg; Cu 6 mg; I 1 mg; Se 0.2 mg.

Meat colour measurement

Instrumental colour measurements of meat samples were performed using a spectrophotometer (Konica Minolta CM-2600d, Osaka, Japan) with the Specular Component Included (SCI) setting according to **Hasčik et al. (2023)**.

Statistical analysis

The data obtained were subjected to analysis of variance (ANOVA) using SAS software (version 9.3, Enterprise Guide 4.2, USA). Tables show the results as the mean with standard deviation (SD) (**SAS, 2008**).

RESULTS AND DISCUSSION

The results of the analysis of wild duck carcasses are presented in **Table 2**. Wild ducks (*Anas platyrhynchos*) are characterized by considerable sexual dimorphism, manifested not only by differences in plumage but also by differences in size between the sexes, including differences in body weight (BW), carcass weight and weight of different carcass parts. In our study, the average body weight of males was 1393.55 g and was 121.75 g higher than that of females (1271.80; P≥0.05; Table 2). Similar BW was reported for wild ducks caught during the hunting season in Hungary (**Szász et al., 2006**) or in Czech Republic (**Abdullah & Buchtová, 2022**) and for 8-week-old ducks reared in a semi-intensive system (**Książkiewicz, 2006**). A lower live weight in males (1174.30 g) and in females (1034.10 g) of wild ducks was found by **Janiszewski et al. (2018)**. The average carcass weight of males (830.80 g) was 70.64 g higher than the carcass weight of females (760.16 g; P≥0.05). Higher carcass weight was reported in 12-week-old farm-raised ducks (**Ismoyowati & Sumarmono, 2019**), but **Abdullah & Buchtová (2022)** found average lower CW (626.50 g). The most valuable parts of the carcass are the breast and thighs, followed by the back, wings and neck. Such attractiveness criteria also apply to wild poultry carcasses. In our study, the proportion of breasts and thighs from CW (meat including skin, subcutaneous fat and bones) represented 57.80% of the total weight of carcasses in males and 56.67% in females. The weight of the breast part was higher in males than in females (305.72 g ♂ and 273.27 g ♀; P≤0.05), similarly it was also higher in the thigh part (174.78 g ♂ and 165.17 g ♀; P≥0.05). **Wnuk et al. (2014)** and **Janiszewski et al. (2018)**, found slightly lower weights of valuable parts than in our experiment but confirmed the tendency for the weight of slaughter times to be influenced by gender. **Murawska et al. (2011)** found that muscle tissue weights and the percentage of giblets in chickens during growth have an inverse connection. The weight of giblets of wild ducks was 197.98 g for males, which is 13.61 g more than for females (184.37 g). Lower weights (78.83 g) are declared in their work by **Abdullah & Buchtová (2022)**, respectively **Janiszewski et al. (2018)** found the weight of giblets in male mallard ducks at the level of 159.87 g, or in females 145.90 g.

Table 2 Meat performance of wild duck (g)

| Parameter | ♂ | ♀ | p-value (♂:♀) |
|-------------------------|---------------------------|----------------------------|---------------|
| Live BW | 1393.55±90.54 | 1271.80±41.41 | 0.092 |
| CW | 830.80±51.81 | 760.16±31.97 | 0.098 |
| Giblets | 197.98±21.07 | 184.37±5.88 | 0.365 |
| Heart | 9.45±0.66 | 8.90±0.75 | 0.352 |
| Liver | 23.50±2.50 | 23.43±2.61 | 0.975 |
| Gizzard | 37.63±3.08 ^a | 30.87±1.02 ^b | 0.014 |
| Neck | 127.40±17.13 | 121.17±2.87 | 0.598 |
| Abdominal fat | 19.52±6.98 | | 0.628 |
| Gizzard fat | 4.20±2.70 | 22.80±9.91 | |
| Heart fat | 1.03±0.44 | 2.73±1.09 | 0.453 |
| Internal fats together | 24.75±7.80 | 1.30±0.51 | 0.496 |
| CY (%) | 73.81±0.75 | 26.83±8.44 | 0.755 |
| Breast part | 305.72±13.92 ^a | 74.25±0.92 | 0.515 |
| Breast muscle | 195.88±7.16 ^a | 273.27±11.02 ^b | 0.017 |
| Thigh part | 174.78±17.06 | 177.337±11.19 ^b | 0.033 |
| Thigh muscle | 97.07±6.53 | 165.17±10.41 | 0.455 |
| Wings | 112.10±4.64 | 89.23±10.09 | 0.256 |
| Breast part of CW (%) | 36.86±1.39 | 106.37±4.59 | 0.166 |
| Breast muscle of CW (%) | 23.70±2.12 | 35.96±0.96 | 0.407 |
| Thigh part of CW (%) | 20.94±1.03 | 23.31±0.72 | 0.796 |
| Thigh muscle of CW (%) | 11.68±0.32 | 21.71±0.45 | 0.311 |
| | | 11.71±0.85 | 0.957 |

Notes: BW – live body weight; CW – carcass weight; CY – carcass yield; mean±SD (standard deviation); a, b = means significant differences between column (P≤0.05) determined with Duncan test.

Table 3 Chemical composition of wild duck breast and thigh muscles (g.100 g⁻¹)

| Parameter | ♀ | ♂ | p-value (♀:♂) |
|---------------|-------------------------|-------------------------|---------------|
| Breast muscle | | | |
| Water | 71.92±0.31 ^b | 73.12±0.51 ^a | 0.005 |
| Total Protein | 24.17±0.22 | 24.05±0.40 | 0.646 |
| Crude Fat | 1.62±0.16 | 2.01±0.42 | 0.161 |
| Cholesterol | 0.050±0.01 | 0.053±0.01 | 0.264 |
| Thigh muscle | | | |
| Water | 70.46±0.42 ^b | 71.55±0.64 ^a | 0.027 |
| Total Protein | 22.90±0.44 | 22.78±0.31 | 0.668 |
| Crude Fat | 1.24±0.18 ^b | 1.66±0.18 ^a | 0.012 |
| Cholesterol | 0.050±0.01 | 0.048±0.01 | 0.645 |

Notes: mean±SD (standard deviation); a, b = means significant differences between column (P≤0.05) determined with Duncan test.

Significant differences (P≥0.05) were found between male and female wild ducks in the breast and thigh muscles chemical composition (**Table 3**). We found differences between genders (P≥0.05) in the water content in the pectoral muscle (73.12 g.100 g⁻¹ - male: 71.92 g.100 g⁻¹ female) and in the thigh muscle in the water content (71.55 g.100 g⁻¹ - female: 70.46 g.100 g⁻¹ male) and fat (1.66 g.100 g⁻¹ - female: 1.24 g.100 g⁻¹ male). In general, the values of the breast muscle chemical composition were higher than in the thigh muscle in both sexes of mallard (**Söderquist et al., 2022**).

The average protein content in our experiment was higher (24.11 g.100 g⁻¹) than in breast muscle of chickens and wild ducks according to **Ali et al. (2007)**. The average protein content in our experiment was higher (24.11 g.100 g⁻¹) than in breast muscle of chickens and wild ducks according to **Ali et al. (2007)**, but a similar protein content (24.35 g.100 g⁻¹) was found in the meat of wild ducks by **Söderquist et al. (2022)**.

The observed differences in fat content between the breast and thigh portions of meat are not consistent with those previously reported in wild ducks (**Cobos et al., 2000; Nuernberg et al., 2011**) and Peking ducks (**Kokoszynski, 2011; Kokoszynski et al., 2019, 2020**), where the biceps muscle was always leaner than the thigh muscle. The fat content for a portion of breast meat is in the range of values previously reported for wild ducks (ranging from 0.82 to 3.76 g.100 g⁻¹ fresh meat). We found a slightly lower fat content in the thigh meat of mallard duck compared to the works of other authors (2.80 to 4 g.100 g⁻¹ of fresh meat) (**Cobos et al., 2000; Nuernberg et al., 2011; Janiszewski et al., 2018**).

Cholesterol content in breast and thigh muscle was lower than that found in Peking duck breast and thigh portions (0.071–0.112 g.100 g⁻¹ breast meat and 0.065–0.117 g.100 g⁻¹ thigh meat) (**Woloszyn et al., 2006, 2007**). Compared to other poultry species, the cholesterol content of mallard breast was above the values reported for chicken and turkey breast meat (0.043–0.044 g.100 g⁻¹), while the cholesterol content of mallard thigh was lower than cholesterol in chicken and turkey thigh meat (0.072–0.084 g.100 g⁻¹) (**Chizzolini et al., 1999; Dinh et al., 2011**). The

cholesterol content in the breast and thighs of the wild duck of our experiment is above the values found by other authors in different species of game fowl kept for hunting, such as common pheasant (*Phasianus colchicus*) and red-legged partridge (*Alectoris rufa*) (Quaresma et al., 2016; Antunes et al., 2019). Considering the nutritional recommendations, the daily intake of cholesterol should not exceed 300 mg (Krauss et al., 2000). Therefore, the intake of 100 g of duck breast or thigh meat represents almost 17 to 19% of the recommended maximum daily cholesterol intake.

Table 4 Evaluation of wild duck meat colour

| Muscle | L* | a* | b* |
|-----------------|------------|-------------------------|------------|
| Breast ♂ | 33.09±1.14 | 13.17±0.75 ^a | 8.10±1.19 |
| Breast ♀ | 32.64±1.57 | 10.75±0.84 ^b | 6.88±0.31 |
| <i>p</i> -value | 0.648 | 0.003 | 0.112 |
| Thigh ♂ | 36.37±2.30 | 9.98±1.61 | 10.06±1.17 |
| Thigh ♀ | 37.38±1.13 | 11.42±1.23 | 10.20±0.75 |
| <i>p</i> -value | 0.487 | 0.212 | 0.857 |

Notes: mean±SD (standard deviation); a, b = means significant differences between column ($P \leq 0.05$) determined with Duncan test.

The colour has a key role during meat purchasing. It is considered to reflect the freshness and suitability of meat for certain culinary purposes (Isguzar et al., 2002). The most obvious sign of physiological and biochemical alterations in muscle is the meat colour. Muscle quality is often indicated by the colour, pH, and drip loss of the meat. Muscle myoglobin content and fat deposition have an impact on muscle brightness values; red values indicate myoglobin content, while yellow values indicate the impact of ration pigments (Kim et al., 2008). Numerous prior research investigations evaluating the colour of the pectoral muscle meat have demonstrated that the higher the muscle quality, the greater the a^* value, the smaller the b^* value, and vice versa, the smaller the L^* value (Wu et al., 2018; Wen et al., 2020). Un like in Korean native ducks and commercial ducks (Lee et al., 2015), no significant differences ($P \geq 0.05$) in or colour of breast and thigh meat (L^* , b^* , Table 4) were found between male and female wild ducks. Our values of L reached 33.09% in males and 32.64% in females, and they were similar to those reported by Kim et al. (2008) in Chungdong ori (*Anas platyrhynchos*) ducks, but higher than in Korean native ducks and commercial broiler ducks (Muhlisin et al., 2013; Janiszewski et al., 2018). We found significant values ($P \leq 0.05$) only for the value a^* in the pectoral muscle, where they were slightly higher in males (13.17) compared to females (10.75).

CONCLUSION

In conclusion, it can be concluded that wild ducks (*Anas platyrhynchos*) reared in domestic conditions are characterized by adequate meat yield for this type of waterfowl. The nutritional composition of valuable carcass parts reached a relatively high protein content and low fat content, respectively, cholesterol and for this reason this type of meat can be considered dietary and recommended to be included in the menu of the general public.

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