Haščik, P., Fik, M., Bučko, O., Rajsky, M., Pavelkova, A. (2026). Meat performance and physico-chemical evaluation of wood pigeon (Columba palumbus) meat. Agriculture and Forestry, 72 (1): 7-20. https://doi:10.17707/AgricultForest.72.1.01

DOI: 10.17707/AgricultForest.72.1.01

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MEAT PERFORMANCE AND PHYSICO-CHEMICAL EVALUATION OF WOOD PIGEON (*Columba palumbus*) MEAT

SUMMARY

The present study evaluated the meat performance and physico-chemical properties of the wood pigeon (*Columba palumbus*), one of the most widespread game species in Europe, with the aim of assessing its nutritional potential and suitability as an alternative source of high-quality protein. A total of 20 pigeons (10 males, 10 females) were analysed for carcass characteristics, overall chemical composition, amino acid and fatty acid profiles, cholesterol content and colour parameters. The average live body weight was 476.7 g, with significantly higher values in males (514.8 g) than in females (457.7 g; P=0.031). The carcass yield averaged 67.2%, which is comparable with domesticated meat-type pigeons. Breast muscles contained 24.1% protein, 0.72% intramuscular fat, and 46 mg/100 g cholesterol, confirming the lean and protein-rich nature of this species. Amino acid analysis revealed lysine, leucine and arginine as the predominant essential amino acids, highlighting its high-quality protein profile. The fatty acid composition was dominated by monounsaturated fatty acids (47.2%), followed by saturated fatty acids (31.9%) and polyunsaturated fatty acids (17.0%), with oleic acid being the most abundant fatty acid. Wood pigeon meat was darker ($L^*\approx35$) than conventional poultry meat, reflecting its greater myoglobin content. Compared with domesticated pigeons and various poultry species, *C. palumbus* meat was found to be leaner, richer in protein, and nutritionally favourable in terms of amino acid and lipid composition. These findings confirm its value as a meat with potential to diversify sustainable protein sources in the human diet.

Keywords: wood pigeon, meat, chemical composition, amino acids, fatty acids, meat colour

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Notes: The authors declare that they have no conflicts of interest. Authorship Form signed online.
Recieved:06/10/2025 *Accepted:23/12/2025*

INTRODUCTION

The increasing global demand for high-quality animal protein highlights the importance of identifying sustainable alternatives to conventional poultry species such as chicken and turkey. Among various poultry species, pigeon meat stands out for its premium qualities due to its rich nutritional profile and unique taste. Among wild avian species, the wood pigeon (*Columba palumbus*), one of the most widespread game birds in Europe, has attracted growing attention as a potential source of nutritious and lean meat.

Pigeon meat represents a traditional yet currently marginal component of global animal production. Its consumption is markedly lower compared with major meat types, primarily due to the absence of industrial-scale production and the fact that pigeon rearing for meat ("squab production") is carried out predominantly on small, regionally oriented farms (Hunter *et al*., 2010; Calder, 2015). Market reports show that global pigeon meat production constitutes only a minor segment of the poultry sector and is geographically unevenly distributed, with greater significance in certain regions of Asia, the Middle East, and the Mediterranean, where its consumption is historically rooted (Simopoulos, 2016). Within the European Union, pigeon meat is not recorded as a distinct category in livestock production statistics but is classified under "other meats," a group that over the long-term accounts for less than 1% of total meat consumption, highlighting its limited market prevalence (Mensink *et al*., 2003; Eur-Lex, 2013). Its wider expansion is also constrained by specific legislative and sanitary requirements governing the production and marketing of non-standard animal-derived foods, including EU regulations related to animal products and consumer health protection, which emphasize strict conditions for processing and food-safety control (Hunter *et al*., 2010). In addition to regulatory constraints, cultural and consumer preferences play an important role, as pigeon meat is perceived in many European and non-European countries primarily as a culinary specialty than a regular dietary component. Overall, the prevalence of pigeon meat consumption remains low, and its production and utilization are significant mainly within specific traditional and regional contexts.

Pigeon meat is recognized for its high nutritional value, characterized by low fat content and high digestibility, making it a desirable source of protein for human consumption (Chang *et al*., 2023a; Chang *et al*., 2023b). Due to its favourable chemical composition, pigeon meat is often recommended for health-conscious individuals and those seeking lean protein options. Understanding the nutritional makeup of pigeon muscle, particularly regarding conventional components such as water, crude protein, and crude fat, is essential for evaluating its value as a food source (Winiarska-Mieczan *et al.*, 2016).

In addition to proximate and nutritional parameters, physico-chemical and technological traits play a crucial role in determining the overall performance of meat (Sule *et al.*, 2024). Comparative evaluations have revealed that pigeons, both domestic and wild, typically produce leaner and more protein-rich muscle tissues than conventional poultry, although their meat can be perceived as darker and less tender due to the predominance of oxidative muscle fibres adapted for sustained flight (Listrat *et al.*, 2016).

Despite its nutritional advantages and cultural significance in game meat traditions, scientific data on the meat quality of the wood pigeon remain limited. Most previous investigations have concentrated on domestic pigeons (*C. livia domestica*) (Pomianowski *et al.,* 2009; Sule *et al.,* 2024), leaving a gap in comprehensive characterization of *C. palumbus*. Understanding its proximate composition, as well as its physico-chemical properties, is therefore essential for assessing its potential role as a sustainable protein source in modern diets.

The aim of this study was to evaluate the meat performance and physicochemical properties of wood pigeon meat by assessing its basic chemical composition, amino acid and fatty acid profile, and colour. By comparing available data with data from other pigeon species and conventional poultry, this work provides new insights into the nutritional value, processing suitability, and quality attributes of *C. palumbus* meat.

MATERIAL AND METHODS

The biological material used in the study was 20 wood pigeons (10 females, 10 males) from the hunting area in Piešťany (Slovak Republic). The pigeons were not fed; they consumed only natural forage. The age of the pigeons (approximately 3 months) was estimated based on their development of plumage, ossification of the skull (pneumatization of the skull) and the stage of wing feather interweaving in accordance with EU and hunting biology standards. The pigeons were shot legally (Hunting Act of the Slovak Republic 274/2009 Coll.). After killing they were weighed using a WTC 2000 laboratory scale with an accuracy of 0.01 g (RADWAG, Poland) and transported in cooling boxes at 4 °C to the Institute of Food Sciences of the Slovak University of Agriculture in Nitra for further analyses.

Slaughter and measurements

After defeathering, the carcasses were weighed using a laboratory scale WTC 2000 with an accuracy of 0.01 g (RADWAG, Poland) and subsequently meat and carcass yields were determined by dissection according to Haščík *et al.* (2024). Samples were taken from the most valuable parts of the carcass (breast muscle - musculus pectoralis major and thigh muscle - musculus biceps femoris) during dissection and stored at 4 °C for meat-quality assessment, including colour, and analysed 24 hours after slaughter. At the same time, additional organs were extracted and weighed, including shanks, head, digestive system, giblets, heart, liver, gizzard, neck, CY (%), breast part, thigh part, wings. Carcass yield was calculated as the weight of the carcass together with offal as a percentage of the live weight of the pigeons. The yield of the breast muscle and the yield of the thigh muscle were calculated as a percentage of the eviscerated body weight.

Chemical composition

The basic chemical composition of the wood pigeon meat samples (water, crude protein, crude fat, and cholesterol content) was examined using the

INFRATEC 1265 instrument (Germany), which operates in transmittance mode within a range of 2 nm from 850 to 1050 nm. After being homogenized, the 50 g samples were put into a 90×90×15 mm glass cup and scanned twice. Each sample's spectrum was calculated as log 1/T (T=transmittance) and represented the average of five scan locations. The results are given in g/100 g. Every determination was made three times.

Amino acid composition

The determination of amino acids was performed using the method of Straková *et al*. (2015) on an automatic amino acid analyser AAA 400 (Ingos a.s., Prague, Czech Republic). The pigeon meat (5 g) was placed in a 50 ml polypropylene centrifuge tube and then 15 ml of hydrochloric acid solution with a concentration of 0.02 mol/l was added and mixed in a vortex mixer until the sample was fully dispersed. The mixture was made up to 25 ml and then centrifuged for 10 minutes at 8800 rpm and 4 °C. Then 2 ml of supernatant was collected, and 2 ml of 8% salicylic acid solution was added. After 30 minutes of maintenance at 4 °C and 10 minutes of centrifugation at 10,000 rpm, the supernatant was removed and washed with 2 ml of n-hexane. The mixture was centrifuged for 10 min at 10,000 rpm and then filtered through a 0.22 μm membrane before analysis using an automatic amino acid analyser L-8900 (Hitachi High-tech Co., Ltd., Shanghai, China). For the determination of individual amino acids, acid hydrolysis in 6 N HCl at 110 °C for 24 h was performed. Quantification was based on the colour reaction of amino acids with the oxidising agent ninhydrin. After conversion to 100% dry matter, the resulting amino acid values were expressed in grams of amino acid content per 100 g of muscle. Two sets of determinations were performed.

Fatty acid composition

Fat was extracted from the lyophilized samples using Soxhlet extraction with petroleum ether. The methodology of Soxhlet extraction was adapted from Luque de Castro and Priego-Capote (2010) and modified by ISO 12966-2:2017: preparation of methyl esters of fatty acids, animal and vegetable fats, and oils. The fat content was expressed as g/kg of dry matter and fatty acids methyl ester profile in %.

The chemical reagents used for fat and fatty acid determination were: petroleum ether 40–65 °C (Sigma–Aldrich, Steinheim, Germany), methanol for chromatography (Sigma–Aldrich, Steinheim, Germany), $NaHSO_4$ H_2O (Centralchem, Bratislava, Slovakia), Na_2SO_4 (Centralchem, Bratislava, Slovakia), KOH (Centralchem, Bratislava, Slovakia), HCl 33–36% (Centralchem, Bratislava, Slovakia), filter medium Hyflo Super Cel (diatomaceous earth) (Sigma–Aldrich, Steinheim, Germany), anhydrous N-hexane for chromatography (Sigma–Aldrich, Steinheim Germany), 42 component standard FAME mix 10 mg/mL in methylene chloride containing C4-C24 FAME (2–4% relative concentration), manufacturer Supelco, catalog number 47885-U chromatography (Sigma–Aldrich, Steinheim, Germany). Apparatus: vacuum oven (Fisher

Scientific, Waltham, MA, USA) temperature adjustable (100±3 °C). Tecator Soxtec System HT 1043 Extraction unit (Gemini, Apeldoom, the Netherlands) apparatus at a flow rate of 10 cycles/h or 10 mL/min.

Meat colour measurement

Instrumental colour measurements of meat samples were performed using a spectrophotometer (Konica Minolta CM-2600d, Osaka, Japan) with the setting Specular Component Included (SCI). D65 light source and a 10° observer, with a port 8 mm in diameter were used. The white plate calibration was performed at 23 °C, as suggested by the manual. The results were coordinates in the colour interface of the Commission International de l'Eclairage (CIE) L^* a^* b^* system (L^*=0, black; L^*=100, white; 100+a^*=redness; -a^*=greenness; +b^*=yellowness; -b^*=blueness). Using the optically passive glass aperture cover that came with the colorimeter to ensure a consistently level sample surface, colour measurements were made at three random positions on each sample (Bianchi *et al.,* 2005). A white tile was used to calibrate the colorimeter (Minolta calibration plate: C:Y=93.66, =0.3150, y=0.3217).

Statistical analysis

All analyses were performed in triplicate, unless the description indicates otherwise. Results were reported as means±standard deviations of measurements. Data were analysed using Student t-test at a significance level of P≤0.05 (α=0.05) to test for differences between mean values. Data were analyses using XLSTAT® software (version 2018.5.52280, Addinsoft, New York).

RESULTS AND DISCUSSION

Meat performance

The average meat performance values of Wood pigeon (*C. palumbus*) are given in Table 1.

Table 1. Meat performance of Wood pigeon (*C. palumbus*) (g)

Parameter	♀	♂	♀+♂	**P-value** (♀:♂)
Live BW	457.70±42.07	514.80±21.37	476.73±45.18	0.031
CW	275.08±28.78	304.83±10.33	284.99±27.76	0.078
Shanks	7.26±0.60	7.45±0.72	7.33±0.62	0.643
Head	16.41±1.91	16.15±0.69	16.33±1.57	0.799
Digestive system	23.55±4.65	23.80±4.78	23.63±4.47	0.932
Giblets	33.80±4.47	37.85±1.85	35.15±4.20	0.119
Heart	5.78±0.67	7.03±1.12	6.19±1.00	0.033
Liver	10.48±2.26	10.95±1.11	10.63±1.91	0.705
Gizzard	10.14±1.61	11.43±1.33	10.57±1.59	0.200
Neck	7.41±1.26	8.45±0.77	7.75±1.19	0.165
CY (%)	67.50±3.48	66.63±2.67	67.21±3.13	0.671
Breast part	138.88±17.08	158.83±8.23	145.53±17.34	0.045
Thigh part	27.93±3.88	32.85±2.25	29.57±4.10	0.043
Wings	56.85±5.54	61.75±1.90	58.48±5.13	0.123

Notes: BW – live body weight; CW – carcass weight; CY – carcass yield; mean±SD (standard deviation); means significant differences between rows (P≤0.05) determined with Student t-test.

The average live body weight of wood pigeons in this study was 476.7 g, with males (514.8 g) being significantly heavier than females (457.7 g; P=0.031). Correspondingly, carcass weights were higher in males (304.8 g) than in females (275.1 g), although this difference did not reach statistical significance (P=0.078). Carcass yield averaged 67.2%, which is consistent with previously reported values for domestic meat-type pigeons, typically ranging from 65 to 70% (Pomianowski *et al.*, 2009; Sule *et al.*, 2024). The breast portion accounted for the largest share of the carcass (145.5 g on average), with males showing a significantly greater breast-muscle weight (158.8 g vs. 138.9 g; P=0.045). Similarly, thigh weights were higher in males (32.9 g) compared to females (27.9 g; P=0.043).

No significant differences were observed between sexes in liver and digestive tract weights, as well as stomach and neck weights. These patterns correspond with the findings of Haščík *et al.* (2024) in California pigeons. Male feral pigeons showed significantly larger hearts compared to females (7.0 g vs. 5.8 g; P=0.033). The relative weight of offal (35.15 g) suggests that wood pigeons provide an additional source of edible by-products, although in lower quantities than domestic pigeons (Haščík *et al.*, 2024), but their commercial use in game species remains limited.

Chemical Composition

The proximate composition of breast and thigh muscles of wild wood pigeon (*C. palumbus*) confirmed the species' lean and protein-rich nature (Table 2). Breast muscle contained on average 73.51% moisture, 24.09% protein, 0.72% intramuscular fat, and 0.046 g/100 g cholesterol, whereas thigh muscle contained 72.74% moisture, 23.31% protein, 1.47% fat, and 0.049 g/100 g cholesterol. A significant sex-related difference was found only in intramuscular fat of breast muscle, with males exhibiting higher fat levels (1.02%) than females (0.57%; P=0.005). Protein and cholesterol contents did not differ between sexes.

Table 2. Chemical composition of the most valuable parts of Wood pigeon (*C. palumbus*) (g/100 g)

Parameter	♀	♂	**P-value (♀:♂)**	♀ + ♂
		Breast muscle		
Water	73.53±0.71	73.48±0.36	0.893	73.51±0.62
Total Protein	24.25±0.34	23.79±0.27	0.056	24.09±0.38
Crude Fat	0.57±0.22	1.02±0.10	0.005	0.72±0.28
Cholesterol	0.044±0.00	0.050±0.01	0.053	0.046±0.01
		Thigh muscle		
Water	72.91±0.48	72.41±0.61	0.185	72.74±0.58
Total Protein	23.18±0.45	23.58±0.32	0.178	23.31±0.45
Crude Fat	1.52±0.34	1.37±0.37	0.534	1.47±0.36
Cholesterol	0.050±0.01	0.046±0.01	0.312	0.049±0.01

Notes: mean±SD (standard deviation); means significant differences between rows (P≤0.05) determined with Student t-test.

These results highlight that wild wood pigeon meat is a nutritionally valuable lean meat, with higher protein levels and much lower fat compared with those of domesticated pigeons. Pomianowski *et al*. (2009) reported that meat-type pigeons such as Wrocław, King, and Europigeon had breast protein levels ranging from 21.7 to 23.6%, while intramuscular fat was substantially higher (4.3–7.1%). Kokoszyński *et al.* (2020) also documented fat levels exceeding 4% in Carrier and King pigeons, together with slightly lower protein values (~22%). In contrast, *C. palumbus* displayed protein levels above 24% and fat below 1%, making it considerably leaner than all investigated domesticated breeds.

Cholesterol concentrations in *C. palumbus* breast muscle (~46 mg/100 g) were like or slightly higher than those reported in domesticated pigeons (23.6–44.4 mg/100 g; Pomianowski *et al.*, 2009). Despite minor variability, both domestic and wild pigeons present cholesterol contents comparable to chicken breast (~47 mg/100 g; Ponte *et al*., 2004), and markedly lower than in turkey (34–85 mg/100 g; Komprda *et al*., 2002) or ostrich (63–68 mg/100 g; Horbańczuk *et al*., 1998).

Amino acid composition

The amino acid profile of *Columba palumbus* meat (Table 3) demonstrated high nutritional quality, with breast muscles containing higher concentrations of most essential amino acids than thigh muscles.

Table 3. Amino acid composition of Wood pigeon (*C. palumbus*) meat (g/100 g)

AA/Group	**Muscle**	♀	♂	**P-value (♀:♂)**	♀ + ♂
Threonine	Thigh	1.02±0.09	0.96±0.10	0.421	1.00±0.10
	Breast	1.13±0.10	0.99±0.08	0.047	1.08±0.11
Valine	Thigh	0.94±0.06	0.90±0.06	0.333	0.93±0.06
	Breast	1.02±0.08	0.96±0.07	0.283	1.00±0.08
Methionine	Thigh	0.73±0.07	0.68±0.07	0.359	0.71±0.07
	Breast	0.80±0.07	0.79±0.06	0.906	0.80±0.07
Isoleucine	Thigh	0.91±0.10	0.85±0.11	0.462	0.89±0.11
	Breast	1.07±0.11	0.99±0.09	0.266	1.05±0.11
Leucine	Thigh	1.82±0.18	1.71±0.21	0.423	1.79±0.20
	Breast	2.09±0.21	1.91±0.16	0.175	2.03±0.21
Phenylalanine	Thigh	0.92±0.09	0.87±0.10	0.428	0.91±0.09
	Breast	1.07±0.11	0.98±0.08	0.222	1.04±0.11
Lysine	Thigh	1.94±0.20	1.83±0.23	0.459	1.90±0.21
	Breast	2.30±0.24	2.13±0.20	0.296	2.25±0.24
Cysteine	Thigh	0.31±0.03	0.30±0.03	0.478	0.31±0.03
	Breast	0.33±0.02	0.31±0.02	0.156	0.32±0.03
Histidine	Thigh	1.01±0.10	0.93±0.11	0.250	0.98±0.11
	Breast	1.02±0.10	0.98±0.08	0.480	1.01±0.10
Arginine	Thigh	1.45±0.15	1.38±0.17	0.473	1.43±0.16
	Breast	1.73±0.18	1.59±0.14	0.248	1.69±0.18

Notes: mean±SD (standard deviation); means significant differences between rows (P≤0.05) determined with Student t-test.

Lysine (2.25 g/100 g), leucine (2.03 g/100 g), and arginine (1.69 g/100 g) were the predominant essential amino acids, confirming the superior protein quality of pigeon breast meat. A significant sex effect was observed only for threonine in breast muscle, with higher concentrations in females (1.13 g/100 g) than in males (0.99 g/100 g; P=0.047).

These results are consistent with earlier findings in domesticated pigeons, where sex-related differences in amino acid composition were negligible (Pomianowski *et al.*, 2009). When compared with domestic meat-type breeds such as King, Carrier, and Europigeon, *C. palumbus* showed comparable or higher values for lysine and leucine (Kokoszyński *et al*., 2020). The high lysine and leucine content reflects the metabolic specialization of pectoral muscles and underlines the suitability of wild pigeon meat as a high-quality protein source.

Dietary proteins of animal origin provide a complete profile of essential amino acids, making meat a nutritionally dense component of the human diet. Essential amino acids such as lysine, leucine, threonine and histidine - whose intake must be ensured through food (WHO/FAO/UNU Expert Consultation, 2007) - perform diverse physiological functions. Lysine plays a critical role in collagen synthesis and tissue repair, and its biochemical relevance extends to epigenetic regulation through lysine residues in histone modification (Shi and Whetstine, 2007), which underlines the importance of adequate lysine intake during growth and regeneration. Arginine, although conditionally essential, is indispensable during metabolic stress due to its role as the precursor of nitric oxide and its involvement in vascular regulation and wound healing (Wu and Morris, 1998). Leucine, a branched-chain amino acid, functions as a potent anabolic signal via activation of the mTORC1 pathway and thus directly regulates skeletal-muscle protein synthesis and post-exercise recovery (Kimball and Jefferson, 2006; Wolfe, 2017). Threonine is required for the synthesis of mucins that maintain intestinal barrier integrity, and deficiencies impair mucosal protection and gastrointestinal immune function (Bertolo and Burrin, 2008). Histidine serves as a precursor for biologically active compounds such as histamine, carnosine, and anserine, contributing to antioxidant defense, tissue growth, and immune modulation (Brosnan and Brosnan, 2020). Given that deficits of essential or conditionally essential amino acids compromise immune competence and increase susceptibility to meat, by providing these amino acids in an optimal ratio, constitutes a key dietary source supporting growth, tissue repair, metabolic homeostasis, and immune resilience, particularly in periods of elevated physiological demand.

Fatty acid composition

The fatty acid profile of *C. palumbus* revealed a balanced composition, dominated by monounsaturated fatty acids (MUFA), with significant contributions from saturated fatty acids (SFA) and polyunsaturated fatty acids (PUFA) (Table 4).

Table 4. Faty acid composition of of Wood pigeon (*C. palumbus*) meat (g/100 g)

FA/Group	**Muscle**	♀	♂	**P-value (♀:♂)**	♀ + ♂
Lauric	Thigh	0.10±0.01	0.11±0.01	0.684	0.10±0.01
	Breast	0.09±0.01	0.09±0.00	0.180	0.09±0.01
Myristic	Thigh	1.34±0.02	1.37±0.04	0.168	1.35±0.03
	Breast	1.41±0.01	1.38±0.03	0.028	1.40±0.02
Palmitic	Thigh	24.36±0.20	24.46±0.24	0.506	24.40±0.22
	Breast	24.21±0.18	24.13±0.24	0.578	24.18±0.20
Heptadecanoic	Thigh	0.29±0.03	0.30±0.01	0.935	0.30±0.03
	Breast	0.22±0.03	0.28±0.02	0.004	0.24±0.04
Stearic	Thigh	10.78±0.17	10.86±0.11	0.480	10.81±0.16
	Breast	10.47±0.24	10.52±0.11	0.691	10.49±0.21
Oleic	Thigh	35.75±1.61	34.63±3.57	0.513	35.38±2.50
	Breast	14.55±7.09	19.36±4.16	0.007	19.48±9.53
Vaccenic	Thigh	4.77±0.06	4.80±0.08	0.578	4.78±0.07
	Breast	4.97±0.10	4.91±0.03	0.231	4.95±0.09
Linoleic	Thigh	6.68±0.82	5.85±1.06	0.199	6.41±0.99
	Breast	6.64±0.41	9.21±1.92	0.008	7.50±1.67
Conjugated linoleic	Thigh	0.13±0.02	0.13±0.01	0.983	0.13±0.02
	Breast	0.10±0.02	0.12±0.01	0.138	0.11±0.02
α-Linolenic	Thigh	0.27±0.03	0.26±0.03	0.426	0.27±0.03
	Breast	0.24±0.03	0.28±0.02	0.035	0.25±0.03
Eicosenoic	Thigh	0.52±0.07	0.57±0.08	0.250	0.54±0.07
	Breast	0.50±0.13	0.61±0.11	0.216	0.54±0.14
Arachidonic	Thigh	1.67±0.28	1.79±0.28	0.518	1.71±0.29
	Breast	1.65±0.23	1.79±0.31	0.451	1.70±0.27
Eicosapentaenoic	Thigh	0.09±0.02	0.09±0.02	0.812	0.09±0.02
	Breast	0.06±0.02	0.09±0.01	0.040	0.07±0.02
Docosapentaenoic	Thigh	0.13±0.01	0.14±0.01	0.367	0.13±0.01
	Breast	0.12±0.01	0.12±0.01	0.906	0.12±0.01
Docosahexaenoic	Thigh	0.03±0.00	0.04±0.00	0.496	0.03±0.00
	Breast	0.03±0.01	0.03±0.00	0.748	0.03±0.01
Omega 3	Thigh	0.57±0.06	0.54±0.08	0.436	0.56±0.007
	Breast	0.62±0.04	0.61±0.04	0.602	0.62±0.04
Omega 6	Thigh	12.46±0.56	11.35±1.02	0.049	12.09±0.91
	Breast	11.05±0.77	12.45±0.69	0.019	11.52±0.99
∑ SAFA	Thigh	34.79±1.30	34.26±0.80	0.507	34.61±1.18
	Breast	31.70±0.84	32.23±0.31	0.299	31.88±0.75
∑ MUFA	Thigh	49.41±0.55	49.69±0.71	0.500	49.50±0.62
	Breast	46.68±1.33	48.15±1.38	0.136	47.17±1.51
∑ PUFA	Thigh	14.05±0.83	13.56±1.35	0.496	13.88±1.06
	Breast	16.92±1.47	17.31±1.46	0.701	17.05±1.48

Notes: mean±SD (standard deviation); means significant differences between rows (P≤0.05) determined with Student t-test

In breast muscles, SFA accounted for 31.9%, MUFA for 47.2%, and PUFA for 17% of total fatty acids, while in thigh muscles the respective values were 34.6%, 49.5%, and 13.9%. Palmitic acid (24.2%) and stearic acid (10.5%) were the principal SFAs. Oleic acid represented the dominant MUFA, with significantly higher concentrations in males (19.36 g/100 g) than in females (14.55 g/100 g; P=0.007). The PUFA fraction was mainly represented by linoleic (7.5%), arachidonic (~1.7%), and α-linolenic acid (0.25%). Minor but nutritionally relevant amounts of long-chain n-3 PUFA, including eicosapentaenoic and docosapentaenoic acids, were also detected.

The predominance of MUFA, particularly oleic acid, is consistent with previous studies in domesticated pigeons (Pomianowski *et al*., 2009; Kokoszyński *et al*., 2020). However, the higher PUFA proportion observed in *C. palumbus* is in line with findings in wild pigeons by Sakhawat *et al*. (2023), who demonstrated a more favourable PUFA/SFA ratio and higher n-3 fatty acid content in wild compared with farmed pigeons. This difference reflects the ecological impact of diet, with wild pigeons consuming seeds, acorns, and green vegetation, while domesticated breeds are reared on cereal-based diets.

When compared with conventional poultry, the fatty acid composition of *C. palumbus* reveals specific differences. The PUFA content is lower than that of chicken breast (20–25%; Ponte *et al.,* 2004), but like ostrich meat (10–12%; Horbańczuk *et al.,* 1998), whereas the MUFA fraction is considerably higher than in both chicken and turkey (Komprda *et al.,* 2002). This places wood pigeon meat in an intermediate position between poultry and ratites, combining the benefits of MUFA predominance with adequate levels of essential PUFA.

Dietary fatty acids present in meat, particularly palmitic acid (16:0), stearic acid (18:0), and oleic acid (18:1n-9), play distinct physiological roles that influence lipid metabolism, energy homeostasis, and cardiometabolic health. Palmitic and stearic acids represent major saturated fatty acids (SAFA); however, their metabolic effects differ—palmitic acid is associated with increased LDL-cholesterol and pro-inflammatory signaling, whereas stearic acid is considered neutral due to its rapid desaturation to oleic acid via stearoyl-CoA desaturase (SCD1) (Mensink *et al.,* 2003; Hunter *et al.,* 2010). Oleic acid, the predominant monounsaturated fatty acid (MUFA) in meat, is linked to improvements in plasma lipid profile, insulin sensitivity, and modulation of inflammatory pathways, contributing to its recognized cardioprotective potential (Schwingshackl and Hoffmann, 2012). From a broader perspective, the balance between saturated (SAFA), monounsaturated (MUFA), and polyunsaturated fatty acids (PUFA) in the diet is crucial: while excessive SAFA intake may elevate cardiovascular risk, MUFA and PUFA - especially n-3 and n-6 PUFA - participate in membrane fluidity, eicosanoid synthesis, and regulation of gene expression related to lipid metabolism (Calder, 2015; Simopoulos, 2016). Meat contributes substantially to total fatty acid intake and, depending on species and feeding practices, may serve as an important source of oleic acid and essential PUFA, thereby influencing overall dietary fat quality.

Colour attributes of wood pigeon meat

Instrumental colour analysis confirmed the dark, myoglobin-rich character of wood pigeon meat. Breast muscle exhibited *L**=35.0, *a**=13.4, *b**=10.8, while thigh muscle showed *L**=35.6, *a**=13.6, *b**=11.6. No significant sex differences were observed (Table 5).

Table 5. Evaluation of Wood pigeon (*C. palumbus*) meat colour

Muscle	***L****	***a****	***b****
Breast ♂	35.63±6.58	13.75±1.73	11.50±3.19
Breast ♀	34.72±4.80	13.16±4.07	10.49±2.66
P-value	0.788	0.793	0.573
Thigh ♂	33.70±6.51	12.65±2.16	10.02±3.92
Thigh ♀	36.59±4.76	14.00±1.80	12.35±2.16
P-value	0.397	0.274	0.203
Breast ♂ + ♀	35.02±5.16	13.36±3.38	10.83±2.75
Thigh ♂ + ♀	35.63±5.29	13.55±1.95	11.57±2.91
P-value (♂ + ♀)	0.779	0.866	0.526

Notes: mean±SD (standard deviation); means significant differences between column (P≤0.05) determined with Student t-test

Compared with chicken breast (*L** 50–55; Paleari *et al.*, 1998), wood pigeon breast is markedly darker, reflecting its greater myoglobin concentration. Elevated *a** values indicate intense redness, a characteristic linked to oxidative metabolism of flight muscles (Listrat *et al.*, 2016). Similar values have been described in other game birds, including partridge and pheasant, which share the classification as dark game meats.

The results clearly demonstrate that wild wood pigeon meat combines high protein (~24%), very low intramuscular fat (<1% in breast), low cholesterol (~46 mg/100 g), and dark, myoglobin-rich muscle colour. Compared with domesticated pigeons (King, Carrier, Wrocław, Europigeon, Mondain), wild *C. palumbus* is consistently leaner, richer in protein, and nutritionally superior in lipid quality, though with slightly higher cholesterol. When contrasted with poultry species such as chicken, turkey, and ostrich, wood pigeon meat offers comparable or lower cholesterol levels and higher nutritional density, while its darker colour sets it apart (Haščík *et al.*, 2024).

These characteristics underline the nutritional and functional value of *C. palumbus* as a wild game species, with potential as a premium meat product for consumers seeking lean, high-protein, and micronutrient-rich alternatives to conventional poultry and domesticated pigeons.

CONCLUSIONS

The results show that wood pigeon meat is a nutritionally valuable food, combining high protein content, very low intramuscular fat content and a balanced fatty acid profile dominated by monounsaturated fatty acids. Its amino acid composition underlines its role as a source of high-quality protein, while cholesterol levels remain comparable to those of conventional poultry. Its dark, myoglobin-rich colour reflects its oxidative muscle metabolism, which distinguishes it from domesticated pigeons and chickens, but also places it among other game species. Compared with domestic breeds, wood pigeon meat is leaner and has better protein composition, confirming its potential as a health-promoting game meat. Its nutritional properties support the role of wild pigeons in contributing to sustainable and diverse protein sources in the human diet.

ACKNOWLEDGEMENTS

This work was supported by [APVV] under grant [no. 23-0077].

DECLARATION OF CONFLICTING INTERESTS

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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