Meat of Guinea fowl. II. Influence of the fattening period on main technological properties of Guinea fowl meat (*Numida meleagris*) – a local population in Bulgaria

Matina Nikolova[1*], Petya Veleva[2], Ivan Penchev[3]

[1] Department of Animal Science, Faculty of Agronomy, Agricultural University – Plovdiv, Bulgaria

[2] Department of Agricultural Engineering, Faculty of Agriculture, Trakia University – Stara Zagora, Bulgaria

[3] Department of Morphology, Physiology, and Nutrition, Faculty of Agriculture, Trakia University, 6000 – Stara Zagora, Bulgaria

[*]Corresponding author: dimitrova@hotmail.com

Citation: Nikolova, M., Veleva, P., & Penchev, I. (2021). Meat of Guinea fowl. II. Influence of the fattening period on main technological properties of Guinea fowl meat (*Numida meleagris*) – a local population in Bulgaria. *Zhivotnovadni Nauki*, *58*(3), 32-41 (Bg).

Abstract

A study on the basic technological properties of meat (pH, water-holding capacity, cooking loss, and meat tenderness) from a free-ranged, pearly-gray local Bulgarian population of Guinea fowl was conducted. The effect of three fattening periods (16, 20, and 24 weeks) in two consecutive economic years was investigated. The average pH values of the breast muscles, reported for the period from 25 minutes to 24 hours after slaughter, varied from 6.70 to 5.74 for the group of male fowls and from 6.80 to 5.74 for the group of female fowls, respectively. The mean pH values of the thigh muscles for the same period were: from 7.21 to 6.32 for the male fowls and from 7.53 to 6.21 for the female individuals. The data analysis showed that bird sex and age did not affect the pH values of meat. As the slaughter age increased, the values of WHC in the analyzed muscles decreased, which is the reason for the breast and thigh muscles of Guinea fowls fattened for the longest period, to be evaluated as being of the best quality. The investigation of the two types of muscles revealed that the thigh muscles have better water-holding capacity compared to the breast muscles. No significant differences between both sexes were reported for that characteristic. A significant effect of the fattening period on the cooking loss was found, varying between 26.91% and 46.16% depending on the muscle type, sex, and age of the birds. Meat tenderness was not affected by the bird sex and age at slaughter, with average values ranging from 293.09 °P to 309.75 °P.

Keywords: Guinea fowl, meat, technological properties, pH, WHC

Месо от токачки. II. Влияние на периода на угояване върху основни технологични свойства на месо от токачки (*Numida meleagris*) – местна българска популация

Матина Николова[1*], Петя Велева[2], Иван Пенчев[3]

[1] Катедра по животновъдни науки, Факултет по агрономство, Аграрен университет – Пловдив

[2] Катедра по агроинженерство, Аграрен факултет, Тракийски университет – СтараЗагора

[3] Катедра по морфология, физиология и хранене, Аграрен факултет, Тракийски университет – Стара Загора
[*]Автор за кореспонденция: E-mail: dimitrova@hotmail.com

Резюме

С настоящото изследване са проучени технологичните качества (стойности на pH, водозадържаща способност (ВЗС), загуба при печене и крехкост) на месото от местна за България популация токачки с перлено-сив цвят на оперението, отглеждани свободно. Изследван е ефектът от три периода на угояване (16, 20 и 24 седмици) в две последователни икономически години. Средните стойности на pH на мускулите на гърдите, отчетени за периода от 25-та минута до 24-ия час след клането, варират от 6,70 до 5,74 за групата на мъжките птици и съответно от 6,80 до 5,74 за групата на женските птици. Средните стойности на pH на мускулите на бедрото за същия период са: от 7,21 до 6,32 за мъжките и от 7,53 до 6,21 за женските птици. Анализът на данните показа, че полът и възрастта на птиците не влияят върху стойностите на pH на месото. С увеличаването на възрастта на клане на птиците стойностите на ВЗС в анализираните мускули намаляват, което е причината за мускулите на гърдите и бедрата на птиците, угоени за най-дълъг период, да бъдат оценени като по-добри по този технологичен показател. Изследването на двата вида мускули показва, че мускулите на бедрата имат по-добра способност да задържат собствената си вода в сравнение с мускулите на гърдите. Не се отчитат значителни разлики между двата пола по този показател. Установен е значителен ефект на периода на угояване върху загубите при печене, вариращ между 26,91% и 46,16% в зависимост от мускулния тип, пола и възрастта на птиците. Крехкостта на месото не се влияе от пола на птиците и възрастта им при клане, като средните стойности варират от 293,09 °P до 309,75 °P.

Ключови думи: Токачки, месо, технологични качества, pH, ВЗС

Abbreviations:
GLM – General Linear Model
LSD – Least Significant Differences test
WHC – Water holding capacity

Introduction

Nowadays, as in the past, Guinea fowl are raised for the production of meat and eggs, highly valued by the consumers for their taste, nutritional, and dietary values. In many West African countries, Guinea fowl is the second most important source of meat and eggs after the chicken species (Ayorinde, 1991). On the other hand, in several European countries (France, Italy, Poland, Hungary, etc.) and some other countries (Japan, Russia, etc.) the species is raised on an industrial scale and is an approach to market expansion and diversification of poultry meat. Worldwide, the Guinea fowl eggs and the meat from Guinea fowl broilers are among the most expensive compared to those obtained from other farm poultry species.

The technological properties of meat are determined by its structural and mechanical properties, i.e. pH, water-holding capacity (WHC), color's characteristics, tenderness, cooking loss, etc. (Barbut et al., 2000; Owens et al., 2000; Van Laack et al., 2000; Qiao et al., 2001; Lonergan et al., 2003; Fraqueza et al., 2006).

Complex biological and physicochemical changes in the muscle structure started after the poultry slaughter. In live birds, the pH of the meat has high values, but after slaughter, processes of anaerobic glycogen degradation start, as a result of which lactic acid is accumulated and the pH values decrease. It is known

that poultry meat is characterized by high pH values. Many authors (Riegel et al., 2003; Genchev et al., 2010) underlined that in most farm bird species, pH is close to neutral immediately after slaughter (pH 7.0) and it decreases in the process of postmortem rigidity (*rigor mortis*) – 6.02 to 6.41. Guinea fowl is a poultry species characterized by high physical activity, thus consuming a significant part of the glycogen reserves in the muscles. Debut et al. (2003) considered that the breast muscle is more sensitive to the physical activity of birds. Postmortem glycolysis is accelerated and most often it ends by the 45th minute, after which the pH values remain almost unchanged (Drbohlav & Drbohlavova, 1987). Kudryashov et al. (2018) found that more lactic acid was accumulated in the thigh muscles compared to the breast muscle, as evidenced by the established pH values.

After fattening Guinea fowl to the age of 13 and 16 weeks, Kokoszyński et al. (2011) reported pH values of 6.10 and 5.90 in the breast muscle in 13-week-old male and female Guinea fowl, respectively. The pH values of the thigh muscles were 6.50 in males and 6.30 in females, respectively. Acidity results in 16-week-old Guinea fowl were 6.10 of the breast muscles (both sexes) and 6.40 and 6.50 in the thigh muscles of males and females, respectively. Referring to breast muscles, Mohamed et al. (2012) reported pH values from 5.94 to 6.12; Pudyszak et al. (2005) established pH values of 6.10–6.40 two hours after slaughter and Baéza et al. (2001) – 6.16–6.45.

Water is the medium, in which all the biochemical processes defining the life of every animal organism take place. Water is about 70–75% in the muscle tissue and the amount of protein is about 10–15%. During heat treatment, part of the free and bound water is released. The ability of the protein structure of the muscles to retain a certain amount of water is assessed by the water-holding capacity. According to Valkova-Yorgova et al. (2000), that capacity was the highest immediately after slaughter, after that starting to decrease. An important and determining factor for WHC of meat is its pH. The lower pH value of meat shows that its WHC decreases and hence, its tenderness (Van Laack et al., 2000).

Meat tenderness is an important technological and culinary indicator in its overall assessment. It can also be considered as a combination of meat hardness and plasticity. Meat tenderness is influenced by several environmental, genetic, and technological factors. Saxena et al. (2009) added to those factors the metabolic state of the organism and the stress factors during growth or immediately before the slaughter. Meat tenderness depends largely on the permeability of cell membranes. According to the author, that is especially important for fast-growing birds, due to the so-called 'flowing membranes' of the muscle tissue or dehydration, which is caused by the low antioxidant status of the muscle fibers.

Considering the insufficient research in our country on that farm bird species, including on its meat production performance, the present study aimed to investigate some of the major technological properties of meat: pH values, WHC, cooking loss during heat treatment and meat tenderness in a local population of Guinea fowl fattened to different ages (16, 20, and 24 weeks).

Material and Methods

Materials

The experimental work on the present study was conducted in the poultry farm of the Training and Experimental Fields of the Agricultural University – Plovdiv, Bulgaria. A total of 90 pearl-gray Guinea fowls of a local population were used, divided into three groups of 30 (by equal numbers of both sexes). The birds were raised free-range, in light-type polymer premises open to free-range yards. Phase feeding on compound feed, prepared on the poultry experimental farm of the Agricultural University – Plovdiv, Bulgaria according to the relevant recipe was applied, depending on the bird category and age (Marinov et al., 2016).

Taking into account the fact that the subject of the study was a late-maturing, slow-growing, not specifically bred for meat production, free-range local population of Guinea fowl, two of the longest fattening periods for obtaining meat from young Guinea fowls, known in the available lit-

erature, were selected, i.e. 20 and 24 weeks. A shorter fattening period of 16 weeks was also studied, which is the longest one used in broiler production of Guinea fowls. At the end of each fattening period (16, 20, and 24 weeks), 6 males and 6 females of average live weight for the given group were selected for the experiment. The study was carried out in two replications in two consecutive years.

Methods

The following technological properties were studied for the assessment of meat quality: pH-values, water-holding capacity (WHC), cooking loss during heat treatment, and meat tenderness. The studies comprised two muscle groups – breast (*m. Pectoralis superficialis* and *m. Pectoralis profundus*) and thigh (*m. Femorotibialis*).

Slaughtering and primary processing of the Guinea fowls was carried out by the requirements of Ordinance No. 20 of 01.11.2012 on minimizing the suffering of the birds during slaughter or killing. The birds were slaughtered after 12 hours of fasting (free access to water).

The pH values of the breast and thigh muscles were measured at 25 min, 4 h, and 24 h *post mortem*. Standard skinless parts of the carcass were used. The pH values of the studied muscles were determined using a portable pH-meter Hanna HI99121 equipped with a glass electrode and an electrode for measuring the temperature.

The classical method of Grau & Hamm (1953) described by Zahariev & Pinkas (1979) modified by Petrov (1982) was used to determine the WHC of meat. The indicator was established 24 hours *post mortem*. The test was performed by compressing the meat on a filter paper, placed between two plexiglass slides, then pressed with a weight of 5 kg for 5 minutes. The WHC of the sample was calculated by the formula:

$$\text{WHC, \%} = \frac{\text{Sample weight before pressing} - \text{Sample weight after pressing}}{\text{Sample weight before pressing}} \times 100$$

For determining the cooking loss, the samples were weighed on a scale and then placed in a forced convection oven preheated to 200 °C. The duration of cooking the sample in the oven depended on its weight. The principle of the method is based on maintaining a temperature of 75-80 °C for 15 minutes in the inner part of the sample (Petracci & Baeza, 2009). After heat treatment, the samples were weighed again on the same scale.

The calculation of the cooking loss after heat treatment was performed according to the formula:

$$\text{Cooking loss, \%} = \frac{\text{Weight of the fresh sample} - \text{Weight of the cooked sample}}{\text{Weight of the fresh sample}} \times 100$$

The penetration method was used to measure meat tenderness. RA penetrometer (VEB Feinmess Dresden, Germany) equipped with a penetration needle was used. The principle of the method is based on the depth of penetration of the needle into the meat sample under the pressure of the own weight of the screw and the needle, which is 103.3 g for that device. The values of meat tenderness were reported in degrees of penetration (°P), where 1 °P = 0,1 mm *m. Pectoralis superficialis* was mainly studied 24 hours *post mortem*.

Statistical data processing

The statistical analysis included obtaining the main statistics (mean values – $\overline{x}$; Standard Deviations – SD, and Coefficients of determination – R^2) for the investigated technological properties of meat and univariate data analysis to examine the effect of sex and fattening period length on the technological qualities of meat of a local Bulgarian population of Guinea fowl. Based on that, a General Linear Model (GLM) was obtained, given as

$Y = \overline{x} + G + e$, where

Y – are the measurements of the technological properties of meat,

$\overline{x}$ – are the mean values,

G – are the factors of influence (sex and fattening period) and

e – are the random residual errors.

A Least Significant Differences test (LSD) was applied to find the significant differences between the investigated groups where p-values < 0.05 were considered statistically significant. The data have been processed using statistical package IBM SPSS Statistics 17.0 WinWrap Basic, Copyright 1993 – 2007.

Results and Discussion

Values of pH

Table 1 shows the pH values of breast and thigh muscles in Guinea fowl, measured at 25 min, 4 h, and 24 h *post mortem*, depending on sex, duration of the fattening period, and averaged data. The mean pH values of the breast muscles reported in the period from 25th minute to 24th hour for the two years of the experiment varied from 6.70 to 5.74 in male birds, and from 6.80 to 5.74 in the female, respectively. pH in the thigh muscles for the same time interval showed slightly higher average values from 7.21 to 6.32 in the male and from 7.53 to 6.21 in the female Guinea fowl. The results obtained confirmed that the discussed dynamics of pH values of meat, depending on the sex and the slaughter age, was statistically insignificant. The same

Table 1. pH-values of breast and thigh muscles depending on sex and duration of the fattening period
Test: LSD

Values of pH		$\bar{x} \pm SD$								
		16 weeks			20 weeks			24 weeks		
		25 min	4 h	24 h	25 min	4 h	24 h	25 min	4 h	24 h
First experimental year										
Breast muscles	Male	6.61 ± 0.27 ns	6.33 ± 0.17 ns	6.20 ± 0.21 ns	5.90 ± 0.03 ns	5.74 ± 0.09 ns	5.71 ± 0.07 ns	6.19 ± 0.37 ns	5.98 ± 0.07 ns	5.88 ± 0.08 ns
	Female	6.44 ± 0.33 ns	6.10 ± 0.20 ns	5.88 ± 0.11 ns	5.92 ± 0.12 ns	5.74 ± 0.11 ns	5.66 ± 0.11 ns	6.26 ± 0.31 ns	6.04 ± 0.14 ns	6.01 ± 0.14 ns
Thigh muscles	Male	7.10 ± 0.20 ns	6.80 ± 0.20 ns	6.55 ± 0.08 ns	6.61 ± 0.24 ns	6.47 ± 0.15 ns	6.32 ± 0.10 ns	6.79 ± 0.29 ns	6.60 ± 0.22 ns	6.49 ± 0.16 ns
	Female	6.98 ± 0.18 ns	6.57 ± 0.14 ns	6.25 ± 0.21 ns	6.60 ± 0.15 ns	6.35 ± 0.10 ns	6.21 ± 0.06 ns	6.73 ± 0.14 ns	6.54 ± 0.15 ns	6.42 ± 0.11 ns
Second experimental year										
Breast muscles	Male	6.70 ± 0.19 ns	6.23 ± 0.16 ns	6.09 ± 0.11 ns	6.66 ± 0.32 ns	6.35 ± 0.14 ns	6.14 ± 0.20 ns	6.63 ± 0.35 ns	6.21 ± 0.05 ns	6.02 ± 0.10 ns
	Female	6.80 ± 0.27 ns	6.33 ± 0.18 ns	6.15 ± 0.05 ns	6.68 ± 0.40 ns	6.33 ± 0.22 ns	6.16 ± 0.19 ns	6.61 ± 0.36 ns	6.24 ± 0.16 ns	6.15 ± 0.18 ns
Thigh muscles	Male	7.01 ± 0.28 ns	6.72 ± 0.19 ns	6.48 ± 0.24 ns	7.21 ± 0.12 ns	6.85 ± 0.18 ns	6.54 ± 0.26 ns	7.05 ± 0.53 ns	6.71 ± 0.29 ns	6.27 ± 0.51 ns
	Female	7.01 ± 0.26 ns	6.70 ± 0.22 ns	6.27 ± 0.41 ns	7.18 ± 0.23 ns	6.77 ± 0.13 ns	6.59 ± 0.11 ns	7.53 ± 0.32 ns	6.80 ± 0.24 ns	6.45 ± 0.16 ns

Coefficient of determination for the First experimental year: R^2 = 0. 334; for the Second experimental year: R^2 = 0.108

**The differences in the mean pH-values were statistically significant at a significance level p < 0.05*
***ns – shows no significant differences (p > 0.05)*

findings were reached by Kokoszyński et al. (2011), who analyzed breast and thigh muscles of Guinea fowl of two different age groups (13 and 16 weeks of age). The authors reported pH values ranging from 6.10 to 5.90 in the breast meat and from 6.50 to 6.30 in the thigh meat.

Results similar to those obtained in the present study were also reported by Mohamed et al. (2012). The authors carried out experiments with 5 groups of Guinea fowl up to 7 weeks of age, fed on different levels of protein and energy, finding pH values from 5.94 to 6.12. Pudyszak et al. (2005) established the pH values two hours after slaughter and reported pH values within 6.10–6.40. Baéza et al. (2001) measured pH values of Guinea fowl meat varying from 6.16 to 6.45.

The technological qualities of meat, according to other researchers, are complemented by its structural and mechanical properties, water holding capacity, and color characteristics (Barbut et al., 2000; Owens et al., 2000; Van Laack et al., 2000; Qiao et al., 2001; Lonergan et al., 2003; Fraqueza et al., 2006). Despite the conclusions of most authors that the pH values measured 24 hours after the slaughter had a great influence on the color characteristics of meat, Le Bihan-Duval et al. (2008) confirmed that some of the parameters of the color characteristics are influenced by other factors that are not relevant to pH values.

From the coefficient of determination in the first experimental year $R^2 = 0.334 < 0.4$ and in the second $R^2 = 0.108 < 0.2$, it can be concluded that in the first year there was a moderate correlation between the factors age in weeks, muscle type, and hour, and, the pH value, while in the second experimental year that correlation was weak.

Water-holding capacity (WHC)

Table 2 presents the mean values of the WHC of the different muscle types in 16, 20, and 24-week-old male and female Guinea fowl, respectively. The analyses were performed on *m. Femorotibialis* and *m. Pectoralis profundus* (deep pectoral muscle), and *m. Pectoralis superficialis* (superficial pectoral muscle).

In the first experimental year, the values obtained for WHC were slightly higher than in the second. The results established for WHC show that the mean values in the analyzed muscles, expressed as a percentage, decreased with the increase of the slaughter age from 16 to 20 and 24 weeks. That is the reason for the breast and thigh muscles to be evaluated as being of better quality in the Guinea fowl fattened for the longest studied period.

No significant differences between the two sexes were reported, but higher values were observed in the females, especially in the second experimental year. WHC of the superficial pectoral muscle had values from 17.39% to 22.15% in 16-week-old birds and reached a water loss of 13.02% to 15.06% in 24-week-old male and female Guinea fowl. In the deep pectoral muscle WHC, varied from 16.75% to 23.02% for the shortest fattening period. The water loss during meat compression in 24-week-old Guinea fowl was between 11.29% and 13.82%. The results obtained show that the thigh muscle had a better water holding capacity. The mean values of WHC of *m. Femorotibialis* ranged from 13.31% to 15.92% in 16-week-old slaughtered birds, from 12.99 to 14.89% in 20-week-old birds, and from 7.36% to 10% in the males and the females fattened for the longest period.

Kokoszyński et al. (2011) analyzed WHC in 13-week (62.50–69.60%) and 16-week old Guinea fowl (61.30–67.20%) and established lower values in the longer fattened birds, similar to the results in the present study. Water loss in meat, found by the above-cited authors, was much higher in percentage, compared to the WHC of breast and thigh muscles, obtained in the present experiment. The data found in the present study were lower than those of Oblakova et al. (2017). The author's research team established WHC in chickens of different genotypes from 22.56% to 28.39% in the thigh muscle and from 28.15% to 30.24% in the breast muscle.

The results show that Guinea fowl muscles had a better WHC compared to other animal species. The observed water loss during meat compression of pork from two different breeds varied within 24–25%, analyzed by Penchev et al. (2018).

From the coefficients of determination in the first experimental year ($R^2 = 0.491 < 0.6$) and

Table 2. Water-holding capacity (%) of breast and thigh muscles in Guinea fowl depending on sex and duration of fattening period, 24 h *post mortem*
Test: LSD

WHC (%)	$\bar{x} \pm SD$								
	16 weeks			20 weeks			24 weeks		
	m. P. superficialis	*m. P. profundus*	*m. Femoro-tibialis*	*m. P. superficialis*	*m. P. profundus*	*m. Femoro-tibialis*	*m. P. superficialis*	*m. P. profundus*	*m. Femoro-tibialis*
First experimental year									
Male	22.15 ± 9.42 bde	18.05 ± 4.24 bdf	15.82 ± 4.45 bef	24.84 ± 8.73 cde	20.87 ± 4.12 cdf	13.71 ± 3.50 cef	14.41 ± 1.73 bcde	12.84 ± 2.93 bcdf	7.36 ± 2.07 bcef
Female	21.52 ± 3.83 bde	23.02 ± 3.49 bdf	17.13 ± 2.77 bef	21.04 ± 5.95 cde	21.33 ± 8.36 cdf	12.99 ± 2.86 cef	15.06 ± 4.70 bcde	13.82 ± 3.01 bcdf	10.00 ± 4.07 bcef
Second experimental year									
Male	17.39 ± 4.32 abe	16.75 ± 5.22 abf	13.31 ± 4.40 abef	15.18 ± 4.74 ace	16.29 ± 3.53 acf	14.82 ± 4.65 acef	13.02 ± 2.45 bce	11.29 ± 2.27 bcf	7.84 ± 2.06 bcef
Female	19.15 ± 3.61 abe	21.58 ± 4.38 abf	15.92 ± 2.27 abef	15.96 ± 3.86 ace	14.04 ± 1.77 acf	14.89 ± 4.33 acef	14.14 ± 2.98 bce	13.08 ± 2.77 bcf	9.02 ± 2.81 bcef
Coefficient of determination in the First experimental year: $R^2 = 0.491$; in the Second experimental year: $R^2 = 0.402$									

**The differences in the mean values of the WHC (%) were statistically significant at a significance level $p < 0.05$, as follows: a – 16 and 20 weeks of age; b – 16 and 24 weeks of age; c – 20 and 24 weeks of age; d – m. P. superficialis and m. P. profundus; e – m. P. superficialis and m. Femorotibialis; f – m. P. profundus and m. Femorotibialis*

in the second ($R^2 = 0.402 < 0.6$), it can be concluded that the correlation between the factors age of slaughter, length of the fattening period, and type of muscles, and, WHC was significant for both years.

Cooking loss

The quality of meat as raw material for storage and processing depends on its hydrophilic properties and cooking loss during heat treatment (roasting). Table 3 presents the cooking loss during heat treatment, depending on the sex of the birds and the duration of the fattening period.

The mean values of the indicator were slightly higher in the male birds in both studied muscle types (superficial and deep pectoral muscle). In *m. Pectoralis profundus* (deep pectoral muscle) cooking loss was higher compared to *m. Pectoralis superficialis* (superficial pectoral muscle). The general trend in both deep and superficial pectoral muscles showed an increase in cooking loss in Guinea fowl fattened for a longer period. In *m. Pectoralis profundus* the mean values varied from 38.94% to 42.69% in 16-week old birds at slaughter. The same muscle had values from 43.79% to 46.16% in the birds fattened up to 24 weeks of age. Cooking loss during heat treatment of *m. Pectoralis superficialis* ranged from 29.14% to 31.56% in 16-week-old Guinea fowl and from 37.30% to 41.61% in 24-week-old birds.

Analyzing the cooking loss in different genotypes of chickens, Oblakova et al. (2017) reported values ranging within 27.69% and 32.39%, which were similar to the results in the superficial pectoral muscle of 16-week-old Guinea fowl in the present study. In studies on meat quality, Lonergan et al. (2003) and Fanatico et al. (2005) reported that the cooking loss depended significantly on the genetic type.

From the coefficients of determination ($R^2 = 0.505 < 0.6$) in the first experimental year and ($R^2 = 0.608 < 0.8$) in the second experimental

year, it can be concluded that there was a significant correlation between the factors of the fattening period and muscle type and the indicator cooking loss in the first experimental year. The correlation was high in the second year of the study.

Meat Tenderness

Table 4 presents the mean values of the tenderness of the breast muscle of male and female Guinea fowl of 16, 20, and 24 weeks of age in the two experimental years. The values ranged from 291.60 to 309.75 °P. No significant differ-

Table 3. Cooking loss (%) of breast and thigh muscles in Guinea fowl, depending on sex and fattening period duration, 24 *post mortem*
Test: LSD

Cooking loss (%)		$\bar{x} \pm SD$					
		16 weeks		20 weeks		24 weeks	
		m. P. superficialis	*m. P. profundus*	*m. P. superficialis*	*m. P. profundus*	*m. P. superficialis*	*m. P. profundus*
First experimental year							
Male		30.49 ± 3.26 ^{bd}	41.95 ± 6.11 ^{bd}	30.24 ± 4.88 ^{cd}	40.48 ± 5.28 ^{cd}	37.30 ± 3.63 ^{bc}	46.16 ± 3.72 ^{bc}
Female		29.14 ± 5.64 ^{bd}	38.94 ± 2.80 ^{bd}	29.84 ± 3.66 ^{cd}	37.89 ± 5.73 ^{cd}	39.33 ± 11.81 ^{bc}	43.79 ± 4.49 ^{bc}
Second experimental year							
Male		31.56 ± 3.04 ^{abd}	42.69 ± 5.71 ^{abd}	27.41 ± 5.61 ^{acd}	41.46 ± 5.92 ^{acd}	40.45 ± 2.87 ^{bc}	45.93 ± 3.96 ^{bc}
Female		30.26 ± 5.55 ^{abd}	39.92 ± 2.78 ^{abd}	26.91 ± 4.16 ^{acd}	36.27 ± 4.61 ^{acd}	41.61 ± 4.63 ^{bc}	44.33 ± 3.59 ^{bc}
Coefficient of determination in the First experimental year: $R^2 = 0.505$; in the Second experimental year: $R^2 = 0.689$							

**The differences in the mean values of cooking loss (%) were statistically significant at a significance level $p < 0.05$, as follows: a – 16 and 20 weeks of age; b – 16 and 24 weeks of age; c – 20 and 24 weeks of age; d – m. P. superficialis and m. P. profundus.; e – males and females.*

Table 4. Tenderness (°P) of *m. Pectoralis superficialis* in Guinea fowl depending on sex and fattening period duration, 24 h *post mortem*
Test: LSD

Tenderness (°P)	$\bar{x} \pm SD$		
	m. P. superficialis		
	16 weeks	20 weeks	24 weeks
First experimental year			
Male	299.90 ± 51.43 ^{ns}	293.09 ± 55.80 ^{ns}	308.13 ± 67.64 ^{ns}
Female	305.70 ± 82.75 ^{ns}	298.95 ± 67.74 ^{ns}	300.10 ± 56.56 ^{ns}
Second experimental year			
Male	298.65 ± 53.15 ^{ns}	301.30 ± 91.52 ^{ns}	309.40 ± 35.39 ^{ns}
Female	309.75 ± 76.22 ^{ns}	291.60 ± 69.92 ^{ns}	305.75 ± 38.31 ^{ns}
Coefficient of determination in the First experimental year: $R^2 = 0.009$; in the Second experimental year: $R^2 = 0.010$			

**The differences in the mean values of meat tenderness (°P) were statistically significant at a significance level $p < 0.05$*
***ns - shows no significant differences ($p > 0.05$)*

ences were found in both sexes and the two years of the study.

Since the coefficient of determination in the first examined year was $R^2 = 0.009 < 0.2$ and in the second $R^2 = 0.010 < 0.2$, it can be concluded that the relationship between the duration of the fattening period and meat tenderness in both years was weak.

Conclusions

The average pH values of breast and thigh muscles, reported at 25th min and 24th h in both replicates were not influenced by bird sex and age.

WHC in the analyzed muscles decreased with increasing the slaughter age from 16 to 20 and 24 weeks, which is the reason for the breast and thigh muscles of Guinea fowl fattened for the longest period, to be evaluated as being of better quality.

Comparing the two types of muscles shows that the thigh muscles had a better water holding capacity. No statistically significant differences between the two sexes were registered for that characteristic.

The general trend in both deep and superficial pectoral muscles was an increase in cooking loss in Guinea fowl fattened for a longer period.

Meat tenderness was not influenced by both factors sex and slaughter age, which makes that type of fowl a source of meat with high technological and culinary qualities.

References

Ayorinde, K. L. (1991). Guinea fowl (Numida meleagris) as a protein supplement in Nigeria. *World's Poultry Science Journal*, *47*(1), 21-26.

Baeza, E., Lessire, M., Berri, C., & Juin, H. (2001, September). Compared carcass and meat characteristics of label and standard guinea fowl. In *15. European symposium on the quality of poultry meat*. WPSA Turkish Branch.

Barbut, S., Zhang, L., & Marcone, M. (2005). Effects of pale, normal, and dark chicken breast meat on microstructure, extractable proteins, and cooking of marinated fillets. *Poultry science*, *84*(5), 797-802.

Debut, M., Berri, C., Baeza, E., Sellier, N., Arnould, C., Guemene, D., ... & Le Bihan-Duval, E. (2003). Variation of chicken technological meat quality in relation to genotype and preslaughter stress conditions. *Poultry Science*, *82*(12), 1829-1838.

Drbohlav, V. & Drbohlavova, D. (1987). Effect of storage on some traits characterizing broiler chicken meat quality. *Food Science, III, 1,* 25-29.

Fanatico, A. C., Cavitt, L. C., Pillai, P. B., Emmert, J. L., & Owens, C. M. (2005). Evaluation of slower-growing broiler genotypes grown with and without outdoor access: meat quality. *Poultry science*, *84*(11), 1785-1790.

Fraqueza, M. J., Cardoso, A. S., Ferreira, M. C., & Barreto, A. S. (2006). Incidence of pectoralis major turkey muscles with light and dark color in a Portuguese slaughterhouse. *Poultry Science*, *85*(11), 1992-2000.

Genchev, A., Ribarski, S., & Zhelyazkov, G. (2010). Physicochemical and technological properties of Japanese quail meat. *Trakia Journal of Sciences*, *8*(4), 86-94.

Grau, R., & Hamm, R. (1953). A simple method for the determination of water binding in muscles. *Naturwissenschaften*, *40*(1), 29-30.

Kokoszyński, D., Bernacki, Z., Korytkowska, H., Wilkanowska, A., & Piotrowska, K. (2011). Effect of age and sex on slaughter value of guinea fowl (Numida meleagris). *Journal of Central European Agriculture, 12*(2)*,* 255-266.

Kudryashov, L. S., Kudryashova, O. A., Zabiyakin, V. A., & Zabiyakina, T. V. (2018). Nutritional and biological value of Guinea fowl meat raised in a small group under farm conditions. *Journal of the Mari State University, Chapter "Agriculture. Economics", 4,* N. 1a.

Le Bihan-Duval, E., Debut, M., Berri, C. M., Sellier, N., Santé-Lhoutellier, V., Jégo, Y., & Beaumont, C. (2008). Chicken meat quality: genetic variability and relationship with growth and muscle characteristics. *BMC genetics*, *9*(1), 1-6.

Lonergan, S. M., Deeb, N., Fedler, C. A., & Lamont, S. J. (2003). Breast meat quality and composition in unique chicken populations. *Poultry Science*, *82*(12), 1990-1994.

Marinov, B., Todorov, N., Marinov, B., Ilchev, A., Penkov, D., Georgieva, V., Ganchev, G., & Chobanova, S. (2016). Applied feeding of domestic animals, BG ISBN 9789542944126.

Mohamed, A. E., Elhag, Z. M. M., & Mohamed, A. S. (2011). Guinea fowl (Numida meleagris) as a meat bird. *International Journal of Sudan Research*, *2*(1), 97-112.

Oblakova, M., Mincheva, N., Hristakieva, P., Ribarski, S., Penchev, I., Ivanova, I., & Lalev, M. (2017). Evaluation of new slow-growing chicken's genotypes. II.

Qualitative meat traits. *Macedonian Journal of Animal Science*, *7*(1–2), 37–45.

Owens, C. M., McKee, S. R., Matthews, N. S., & Sams, A. R. (2000). The development of pale, exudative meat in two genetic lines of turkeys subjected to heat stress and its prediction by halothane screening. *Poultry Science*, *79*(3), 430-435.

Penchev, I. G., Ribarski, S., Dimitrov, D., Stoyanchev, T., & Ivanova, S. (2018). Meat quality and boar taint in entire male pigs fattened to 90 kg. *Agricultural Science and Technology*, *10*(2), 169-173.

Petracci, M., & Baeza, E. (2010). Harmonization of methodology of assessment of poultry meat quality features, 2009. (www.wpsa.com/downloads/WPSA_WG_Meat_Quality_Harmonization) Available on 26.02.2010.

Petrov, J. (1982). Specific and breed characteristics in the microstructure of skeletal muscle during the ontogenesis of farm animals. Thesis for awarding the scientific degree Doctor of Science (DSc), Trakia University (Bg).

Pudyszak, K., Pomianowski, J., & Majewska, T. (2005). Slaughter value and meat quality of guinea fowl slaughtered at a different age. *Food Sci. Technol. Quality (2005)*, *42*, 27-34.

Qiao, M., Fletcher, D. L., Smith, D. P., & Northcutt, J. K. (2001). The effect of broiler breast meat color on pH, moisture, water-holding capacity, and emulsification capacity. *Poultry science*, *80*(5), 676-680.

Riegel, J., Rosner, F., Schmidt, R., Schuler, L., & Wicke, M. (2003, September). Investigation of meat quality of m. Pectoralis in male and female japanese quails (Coturnix japonica). In *Proceeding of the XVIth European Symposium on the Quality of Poultry Meat* (pp. 23-26). France: Saint-Brieuc.

Saxena, V. K., Sachdev, A. K., Gopal, R., & Pramod, A. B. (2009). Roles of important candidate genes on broiler meat quality. *World's poultry science journal*, *65*(1), 37-50.

Valkova-Yorgova, K., Dimitrov, D., & Danchev, S. (2000). Collagen structure and meat texture. First edition, Higher Institute of Food and Flavour Industries, Plovdiv (Bg).

Van Laack, R. L. J. M., Liu, C. H., Smith, M. O., & Loveday, H. D. (2000). Characteristics of pale, soft, exudative broiler breast meat. *Poultry Science*, *79*(7), 1057-1061.

Zahariev, Z., & Pinkas, A. (1979). Methods of conducting experiments, slaughter analysis, and qualitative assessment of meat. National Agro-Industrial Union, Sofia (Bg).

Order No 20/01.11.2012 on the minimum requirements for the protection and welfare of experimental animals and the requirements for the sites for their use, rearing and/or delivery. Ministry of Agriculture and Food, Sofia - promulgated SG, issue 87 of 9.11.2012, effective as of 01.01.2013, amended with Decision No. 514 of 18.01.2016 of the Supreme Administrative Court of the Republic of Bulgaria – issue No. 9 of 02.02.2016 (Bg).