AMINO ACID AND TRACE ELEMENT CONTENT OF MEAT FROM GUINEA-FOWL /*NUMIDA MELEAGRIS*/ FATTENED TO DIFFERENT AGES

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Abstract: A study of the amino acid composition and the content of the major biogenic trace elements of meat from a local population of guinea-fowl (*Numida meleagris*) fattened to different ages (16 and 20 weeks) was carried out.

Depending on the fattening period duration and the bird sex, the following levels of essential amino acids were established: 50,66-54,29 in the breast muscle and 44,11-47,49% in the thigh muscle, respectively. The nonessential amino acids varied within 33,66-36,10% in the breast muscle and 36,09-38,79 in the thigh muscle. Among the essential amino acids, the highest content of lysine was found in the breast muscle: from 7,57 ± 0,16 to 8,11 ± 0,10, followed by that of leucine: 7,21 ± 0,15 – 7,73 ± 0,10 and arginine: 6, 90 ± 0,14 – 7,39 ± 0,09%. Breast muscle is a good source of methionine: 4,92 ± 0,10 – 5,28 ± 0,07%, depending on the age and sex of the birds.

Among the essential amino acids in the thigh muscle, again the highest percentage of lysine was established: 7,37 ± 0,13 to 7,88 ± 0,07, followed by arginine: 6,50 ± 0,12 to 7,06 ± 0,07 and leucine: 6,34 ± 0,11 to 6,83 ± 0,06%. The thigh muscle of that bird species is relatively poor in the sulfur-containing amino acid methionine: 3,96 ± 0,07 to 4,32 ± 0,04%, compared to the breast muscle.

Among the nonessential amino acids, the highest percentages were established for glutamine and asparagine both in the breast and thigh muscle: 11,45 ± 0,24 to 12,37 ± 0,14 of glutamine and 8,47 ± 0,22 to 12,37 ± 0,14% of asparagine in the breast muscle and 11,44 ± 0,21 to 12,27 ± 0,11 of glutamine and 7.74 ± 0.14 to 8,31 ± 0.08% of asparagine in the thigh muscle, respectively.

High levels of iron were found in the guinea-fowl meat: from 10.90 to 12.67 mg/kg in the breast muscle and from 16,84 to 18,92 mg/kg in the thigh muscle, depending on the sex. Thigh muscle is characterized by a high zinc content of 21,51 to 22,34 versus 7,98 – 9,18 mg/kg in the breast muscle, depending on the sex of the birds. The phosphorus content varied within a narrow range (0,25-0,26 in the thigh muscle and 0,27-0,28% in the breast muscle) and it is not significantly influenced by the sex of the guinea-fowls.

Keywords: guinea-fowls, meat, amino acid, trace elements

INTRODUCTION

In recent years the production and consumption of guinea-fowl products has grown almost all over the world. That is due to the fact that the species can efficiently develop, reproduce and produce output equally well in extremely hot, both dry and moist, and in extremely cold regions, equally well under the conditions of extensive, semi-intensive and intensive production systems (**Ayorinde and Okaeme,** 1984; **Ayorinde et al.,** 1984; **Ayorinde, K. L.**, 1987a; **Ayorinde,** 1987b; **Ayorinde and Ayeni,** 1987a; **Ayorinde and Ayeni,** 1987b; **Ayorinde et al.**, 1989; **Ayorinde,** 1990; **Ayorinde,** 1991a; **Ayorinde, 1995a**, **Ayorinde,** 1991b; **Adeyeye E. I.,** 2011). The species efficiently utilizes feed and practically does not suffer from any disease (**Tye and Gyawu**, 2001; **Moreki**, 2009; **Adeyeye E. I.**, 2011). In addition, the increase of the consumer interest in healthy food produced on small farms and the search for new sources of income by the farmers, has stimulated research on that avian species in recent years (**Bernacki et al.,** 2012).

Guinea-fowl meat is an excellent and healthy alternative to the consumer, but research in that area is still scarce (**Aisha Elfaki M. et al**., 2012). The carcass of the species is characterized by a lower fat and cholesterol content and higher content of protein, essential amino acids and minerals compared to broilers and pullets (**Surgiyska et al.**, 2006; **Aisha Elfaki M. et al**., 2012; **Ayorinde**, 2004; **Cappa and Casati**, 1978; **Singh and Raheja**, 1990).

According to **Ayeni** (1980), guinea-fowl meat is richer in protein (28%) compared to the other agricultural poultry species (20% on average), and it has a higher biological value than the other poultry meats.

Antipova et al. (2011) reported that the protein in guinea-fowl meat has a 3.54% higher biological value than chicken, and its digestibility is close to one. Compared to chicken meat, the guinea-fowl meat is richer in iron, zinc, copper and phosphorus – 4,3, 1,3, 1,3 and 68,0 mg%, respectively.

According to **Adeyeye E. I.** (2011) the total essential amino acids in guinea-fowl meat varied from 30.4 to 43.5 g/100 g of crude protein or from 49.7 to 51.2% of the total amino acid content. The amino acid score showed that lysine ranged from 0.66 to 1.17 (on whole hen's egg comparison), 0.75-1.31 (on provisional essential amino acid scoring pattern) and 0.71-1.25 (on suggested essential amino acid requirements of a preschool child). The essential amino acid index range was 0.87-1.28. Asparaginic acid was the second largest amino acid in the two samples. The same author found a high positive correlation between the total amino acid content and the separate amino acids in the guinea-fowl and hen muscles. Both guinea-fowl meat and eggs are characterized by rich trace element content (**Ayorinde**, 1987b; **Bernacki et al**., 2012). According to **Bernacki et al.**, (2012) guinea-fowl muscles contain several times more potassium and zinc and more than a dozen times as much iron compared to chicken muscles (**Bernacki et al**., 2012). Thus, guinea-fowl meat can be a more attractive alternative than most of the other agricultural livestock and poultry (**Santiago et al**., 2007).

Considering the fact that in Bulgaria there are no traditions of consuming meat from that species, although it has a rich nutritional content and dietary values, and, taking into account the complete absence of research in this field in our country, we set the aim to study the amino acid content and the composition of the major trace elements of vital importance in the meat from young guinea-fowls, reared in a free-range, semi-intensive production system.

MATERIAL AND METHODS

The experimental work of the present study was carried out in the poultry farm of the Training and Experimental Base of the Agricultural University – Plovdiv in 2016, with a local for South Bulgaria guinea-fowl population with a pearl-gray color of the plumage. 20 guinea fowl keets were included in the study (an equal number of both sexes), the fattening period being 20 weeks. Guinea-fowls were fed on complete compound forage, prepared according to recipes by **Marinov et al.** (2016).

Phase feeding was applied according to the following scheme: starter (0-5th week), grower (6th-16th week), finisher (17th-20th week).

The compound feed contained maize, wheat, soybean meal 46, sunflower meal 37, fish meal 72, L-lysine, DL-methionine, chalk, dicalcium phosphate, salt, sodium bicarbonate, vitamin mineral premix and sunflower oil. During the three fattening periods (starter, grower and finisher) different percentages of the substances were supplemented to the forage.

Throughout the fattening period, drinking water was provided to the birds *ad libitum*.

The amino acid composition of the meat was determined at the University of Food Technologies – Plovdiv. It was determined on a dry matter basis. Acid hydrolysis was applied and the amino acid derivatives were analyzed by ELITE La Chromatograph (Hitachi) equipped with a C 18 AccQ-Tag reversed-phase chromatographic column (3.9 mm x 150 mm) and DAD. Elution of the amino acids was accomplished with a gradient mobile phase A-Buffer (WATO52890) of Waters and the mobile phase B – 60% of acetonitrile. Amino acids were detected at 254 nm, at a column temperature of 37°C. The trace element composition of the meat from 20-week old guinea-fowls was determined in the Central Research Laboratory at the Thracian University – Stara Zagora.

RESULTS AND DISCUSSION

The amino acid content of guinea-fowl meat from a local population is presented in **Tabl. 1**. The following levels of essential amino acids were found, depending on the sex of the birds: 50,66-53,68 in the breast and 46,27-47,49% in the thigh muscles, respectively. The nonessential amino acids were in the range of 33,66-35,64% in the breast and 37,85-38,79 in the thigh muscles, respectively.

Among the essential amino acids in the breast muscle, the lysine level was the highest: from 7,57 ± 0,16 to 7,98 ± 0,09, followed by that of leucine: 7,21 ± 0,15 to 7,68 ± 0,09 and arginine: 6,90 ± 0,14 to 7,32 ± 0,08%. The breast muscle of guinea-fowls is a good source of methionine: 4,92 ± 0,10 – 5,16 ± 0,06%, depending on the sex of the birds.

The nonessential amino acids in the thigh muscle were presented with the highest percentage again by lysine: 7,75 ± 0,12 to 7,88 ± 0,07, followed by arginine: 6,82 ± 0,10 – 7,06 ± 0,07 and leucine: 6,65 ± 0,10 – 6,83 ± 0,06%. The thigh meat of the species is relatively poor in the sulfur-containing amino acid methionine: 4,15± 0.06 – 4,32 ±0.04%, compared to the breast muscle. Similar results were reported by **Starkova E.** (2016) and **Franco and Lorenzo** (2013).

Among the nonessential amino acids, the highest percentages were established for glutamine and asparagine both in the breast and thigh muscle: 11,45±0,24 to 12,37±0,14 of glutamine and 8,66±0.10 – 12,37±0.14% of asparagine in the breast muscle and 12,00±0.18 – 12,27±0.11% of glutamine and 8,12±0.12 – 8,31±0.08% of asparagine in the thigh muscle, respectively.

In the present study we confirmed the results obtained by **Starkova E.** (2016) in her experiments with pheasants, guinea-fowls, quails, wild turkeys and common and rock partridges that the breast muscle, in

comparison to the thigh muscle, is characterised by higher levels of both essential and non-essential amino acids.

The **EAAs/ NAAs** proportion was higher for breast (0,6) versus 0,55 in thigh muscle and does not depend on the sex.

Tabl. 1. Amino acid profile of guinea-fowl (*Numida meleagris*) meat

	ГРЪНА МУСКУЛАТУРА/BREAST MUSCLE	
AMINOACIDS, %	*MALES, n=4*	*FEMALES, n=4*
ESSENTIAL AAs		
Tre	4,13 ± 0,05a	3,92 ± 0,08
Met	5,16 ± 0,06a	4,92 ± 0,10b
Val	2,51 ± 0,03ac	2,27 ± 0,05c
Ile	4,51 ± 0 ,05a	4,27 ± 0,09
Ley	7,68 ± 0,09ac	7,21 ± 0,15bc
Phe	3,67 ± 0,04	3,49 ± 0,07
Lys	7,98 ± 0,09	7,57 ± 0,16
Tyr	2,96 ± 0,30	2,77 ± 0,06b
His	6,06 ± 0,07ac	5,70 ± 0,12bc
Arg	7,32 ± 0,08ac	6,90 ± 0,14c
Cys	1,70 ± 0,02a	1,64 ± 0,03b
TOTAL EAAs	53,68	50,66
EAAs/ NAAs proportion	0,60	0,60
NONESSENTIAL AAs		
Asp	8,66 ± 0,10ac	12,37 ± 0,14bc
Ser	3,44 ± 0,04	3,28 ± 0,07
Glu	12,37 ± 0,14c	11,45 ± 0,24bc
Pro	3,55 ± 0,40a	3,33 ± 0,07b
Gly	3,86 ± 0,04a	3,79 ± 0,08b
Ala	3,76 ± 0,04a	3,59 ± 0,07b
TOTAL NAAs	35,64	33,66
TOTAL AAs	89,32	84,32
	БЕДРЕНА МУСКУЛАТУРА/THIGH MUSCLE	
ESSENTIAL AAs	*MALES, n=4*	*FEMALES, n=4*
Tre	3,67 ± 0,05a	3,65 ± 0,14
Met	4,15 ± 0,06a	4,32 ± 0,04b
Val	2,13 ± 0,03a	2,21 ± 0,02
Ile	4,18 ± 0,06a	4,22 ± 0,04
Ley	6,65 ± 0,10a	6,83 ± 0,06
Phe	3,58 ± 0,05	3,60 ± 0,03
Lys	7,75 ± 0,12	7,88 ± 0,07
Tyr	2,83 ± 0,04	2,95 ± 0,03b
His	3,11 ± 0,05 ac	3,30 ± 0,03bc
Arg	6,82 ± 0,10a	7,06 ± 0,07
Cys	1,40 ± 0,02 ac	1,47 ± 0,01bc
TOTAL EAAs	46,27	47,49
EAAs/ NAAs proportion	0,55	0,55
NONESSENTIAL AAs		
Asp	8,12 ± 0,12a	8,31 ± 0,08b
Ser	3,30 ± 0,05	3,40 ± 0,03
Glu	12,00 ± 0,18	12,27 ± 0,11b
Pro	4,71 ± 0,07a	4,84 ± 0,04b
Gly	4,78 ± 0,07a	4,79 ± 0,04b
Ala	4,94 ± 0,07 ac	5,18 ± 0,05bc
TOTAL NAAs	37,85	38,79
TOTAL AAs	84,12	86,28

Differences are significant at P≤0.05, between: a – males/breast-thigh, b – females/breast-thigh, c - males/females/breast/, d – males/females/thigh/.

The content of the major biogenic trace elements in guinea-fowl meat is presented in **Tabl. 2**. Guinea-fowl muscle is very rich in potassium – 317,94 ± 0,34 to 324,81 ± 0,88 in the breast and 330,55 ± 0,27 – 332,31 ± 0,56 mg/100 g in the thigh muscle, which was confirmed in the studies of other authors (**Bernacki Z. et al**., 2012, **slism.com**). The levels of that biogenic oligo-element were significantly higher in the thigh muscle of both sexes. High levels of iron were found in the meat from those farm birds: from 10,90 to 12,67 mg/kg in the breast and from 16,84 to 18,92 mg/kg in the thigh muscle, depending on the sex, the differences being statistically significant in terms of both the sex of the birds and the muscle type. The thigh meat was characterized by a high zinc content of 21,51 to 22,34 versus 7,98 -9,18 mg/kg in the breast muscle, depending on the sex of the birds. The phosphorus content varied within a very narrow range (0,25-0,26 in the thigh muscle and 0,27-0,28% in the breast muscle) and it was not significantly influenced by the sex of the birds.

Tabl. 2. Major biogenic trace element content in guinea-fowl (*Numida meleagris*) meat

	BREAST MUSCLE	
	MALES, n=4	*FEMALES, n=4*
K, mg/100 g	317,94 ± 0,34ac	324,81 ± 0,88bc
P, %	0,28 ± 0,01	0,27 ± 0,01
Fe, mg/kg	12,67 ± 0,42ac	10,90 ± 0,35bc
Zn, mg/kg	7,98 ± 0,28a	9,18 ± 0,48b
	THIGH MUSCLE	
	MALES, n=4	*FEMALES n=4*
K, mg/100 g	330,55 ± 0,27ac	332,31 ± 0,56bc
P, %	0,26 ± 0,04	0,25 ± 0,03
Fe, mg/kg	18,92 ± 0,33ac	16,84 ± 0,38bc
Zn, mg/kg	21,51 ± 0,20a	22,34 ± 0,34b

a, b – mean values of the traits in the columns differ significantly between muscle types (P≤0.05)
c – mean values of the in the traits in rows differ significantly between sexes (P≤0.05)

CONCLUSIONS

Meat of the studied avian species is an excellent source of the first limiting essential amino acid lysine, but it is relatively poor in the sulfur-containing amino acid methionine, and especially the thigh muscle.

The **EAAs/ NAAs** proportion was higher for breast (0,6) versus 0,55 in thigh muscle and does not depend on the sex of guineas.

Guinea-fowl meat is characterized by its high content of some of the most important biogenic trace elements: potassium, phosphorus, iron and zinc, thus becoming an important factor in the prevention of iron-deficiency anemia, skin diseases and diseases of the metabolism and of the nervous system.

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