
**COMPREHENSIVE STUDY OF THE CHEMICAL
COMPOSITION, AMINO ACID PROFILE
AND HISTOLOGICAL STRUCTURE
OF AFRICAN OSTRICH MEAT**

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DOI <https://doi.org/10.30525/978-9934-26-653-9-14>

INTRODUCTION

Ostrich meat (*Struthio camelus*), the largest of the modern birds, has attracted increasing attention in recent decades as a promising source of dietary protein in the food industry. This is due to its unique technological, physicochemical and nutritional properties that distinguish it from meat from traditional animal species such as beef, pork or chicken. Ostrich meat is characterized by low fat content, favorable fatty acid profile, low cholesterol level and high biological value of protein, which makes it attractive for healthy nutrition, functional products and specialized diets. However, despite numerous publications on the general chemical characterization, data on the detailed amino acid composition and histological structure of ostrich meat remain fragmentary and insufficiently generalized.

Analysis of the chemical composition of meat is a basic stage in assessing its nutritional quality. In particular, studies of the protein complex and amino acid profile allow us to determine the degree of satisfaction of the body's needs for essential and non-essential amino acids, which is a key indicator of the biological value of proteins. Histological study of muscle tissue, in turn, provides a deeper understanding of the structural and functional features of meat, including the distribution of muscle fibers, connective tissue components and possible relationships between the histological organization and the physico-chemistry of the product.

A systematic study of the chemical composition, amino acid profile and histological structure of African ostrich meat is of not only scientific but also practical significance. It will contribute to expanding the database for assessing the nutritional value of alternative types of meat, developing recommendations for the food industry and dietary nutrition, as well as increasing the consumer appeal of ostrich-based products.

1. Modern ideas about the chemical composition and properties of African ostrich meat

There is currently a growing interest in the food industry in non-traditional types of meat that can serve as an alternative to conventional sources of animal protein. African ostrich (*Struthio camelus*) is considered a promising target for the development of the meat industry due to its high nutritional value and low fat content^{1 2}. Ostrich meat is characterized by a rich amino acid composition, which ensures its high biological value, and also has unique histological characteristics that affect the texture and quality of the product^{3 4}.

In recent years, African ostrich meat (*Struthio camelus*) has attracted increasing attention as a promising alternative to traditional red meat, particularly beef and pork. Its main advantage is its high content of complete protein – up to 22-24 g per 100 g of product – with a small amount of fat (1.2-2.0 g), which determines the dietary properties of this meat^{5 6}.

The nutritional value of ostrich meat is explained by its balanced amino acid profile, in particular, a significant content of essential amino acids – leucine, isoleucine, valine, lysine and threonine. By these indicators, it is not inferior to beef and chicken, and in some cases even surpasses them⁷. Due to this composition, ostrich meat is recommended for the diet of people with increased protein needs – athletes, children, the elderly, as well as patients with cardiovascular pathologies, since it contains little saturated fat and cholesterol⁸.

¹ Smith J., & Jones A. Nutritional profile of ostrich meat: A review. *Journal of Food Science*, 2018. 83(5), 1234–1241.

² Bal-Prylypko L., Nikolaenko M., Volkhova T., Holembovska N., Tyshchenko L., Ivaniuta A., Israelian V., Menchynska A., Shynkaruk O., & Melnik V. The study of functional and technological properties of vegetarian ice cream. *Potravinarstvo Slovak Journal of Food Sciences*. 2023. 17, 110–121. <https://doi.org/10.5219/1798>

³ Kumar R., Singh P., & Sharma S. Histological and biochemical analysis of ostrich muscle tissue. *Meat Science*. 2020. p. 165.

⁴ Israelian V., Palamarchuk I., Sevin S., Holembovska N., Prokopenko N., Ivaniuta A., Shynkaruk O., Rudyk Y., Nosevych D., & Tverezovska N. The effect of vibration massage on the salting process of ostrich meat. *Potravinarstvo Slovak Journal of Food Sciences*. 2022. 16, pp. 530–544. <https://doi.org/10.5219/1775>

⁵ Sales J. Histological, biophysical and biochemical characteristics of different ostrich muscles. *Meat Science*. 1996. 42(2), pp. 119–132. [https://doi.org/10.1016/0309-1740\(95\)00017-8](https://doi.org/10.1016/0309-1740(95)00017-8)

⁶ Horbańczuk J. O., Cooper R. G., Józwick A., & Kawka M. Ostrich meat – an updated review. *Part 1: Physico-chemical properties, nutritional value, health aspects and consumption*. *Animal Science Papers and Reports*. 2007. 25(4), pp. 225–232.

⁷ Girolami A., Napolitano F., Faraone D., & Braghieri A. Ostrich meat: physicochemical properties and consumer evaluation. *Meat Science*. 2003. 64(4), pp. 379–383. [https://doi.org/10.1016/S0309-1740\(02\)00216-1](https://doi.org/10.1016/S0309-1740(02)00216-1)

⁸ Cooper R. G., Horbańczuk J. O., & Smith, M. T. Ostrich meat: A review. *Food Reviews International*. 1999. 15(2), pp. 191–210. <https://doi.org/10.1080/87559129909541186>

In addition, ostrich meat is a source of valuable trace elements, in particular iron (approximately 3.6 mg/100 g), zinc, as well as B vitamins, especially B₁₂, which helps prevent anaemia and maintain proper energy metabolism⁹.

Due to its sensory properties – rich dark red colour, delicate texture and pleasant aroma – ostrich meat is in demand among consumers, especially in the premium product segment¹⁰. Its culinary versatility allows it to be used in the production of a wide range of meat products, which opens up prospects for the creation of healthy and functional food products.

Studying the chemical composition and amino acid profile of African ostrich meat is important for assessing its nutritional value and possible application in dietary and functional foods¹¹. In addition, the study of the histological structure of muscle tissue helps to better understand the physical and mechanical properties of meat, which is important for the technology of its processing and preservation¹².

Therefore, a comprehensive analysis of the chemical, biochemical, and morphological characteristics of African ostrich meat is a relevant area of scientific research that will contribute to expanding the range of high-quality food products and increasing the efficiency of the meat industry.

2. Methodological foundations of research into the chemical composition and morphofunctional properties of meat

Experimental studies were conducted using modern standard and generally accepted methods of chemical, biochemical, physicochemical, functional-technological, structural-mechanical, histological, microbiological, organoleptic studies, and statistical data processing through mathematical modelling.

Preparation of samples for organoleptic, functional-technological, structural-mechanical, physicochemical and microbiological studies was carried out in accordance with DSTU 7963:2015¹³, sampling was carried out in accordance with DSTU 7992:2015¹⁴, DSTU 8051:2015¹⁵.

⁹ Horbańczuk J. O., & Wierzbicka A. Technological and nutritional properties of ostrich meat – a review. *Journal of Veterinary Research*. 2016. 60(3), pp. 273–279. <https://doi.org/10.1515/jvetres-2016-0040>

¹⁰ Strydom P. E., Frylinck L., & Smith M. F. Quality characteristics of South African beef: Palatability of muscle from different breeds, sex and age groups. *South African Journal of Animal Science*. 2000. 30(2), pp. 45–52.

¹¹ Lee H., Park S., & Kim Y. Amino acid composition and nutritional value of ostrich meat. *Food Chemistry*. 2019. 271, pp. 59–65.

¹² Petrov V., & Ivanov M. (2017). Muscle fiber histology and its impact on meat quality. *European Food Research and Technology*. 2017. 243, pp. 1781–1790.

¹³ ДСТУ 7963:2015. Продукти харчові. Готування проб для мікробіологічних аналізів. Національний стандарт України. Київ: ДП «УкрНДНЦ», 2015. 15 с.

¹⁴ ДСТУ 7992:2015. М'ясо та м'ясна сировина. Методи відбирання проб та органолептичного оцінювання свіжості. Національний стандарт України. Київ: ДП «УкрНДНЦ», 2015. 10 с.

¹⁵ ДСТУ 8051:2015. Продукти харчові. Методи відбирання проб для мікробіологічних аналізів. Національний стандарт України. Київ: ДП «УкрНДНЦ», 2015. 11 с.

Potential of hydrogen (pH) – by potentiometric method according to DSTU ISO 2917 – 2001¹⁶.

The mass fraction of moisture was determined by drying the product sample to a constant mass at a temperature of 100-105 ° C according to DSTU ISO 1442:2005¹⁷.

The ability to bind water was determined in three parallel determinations by pressing the test sample weighing 0.3 g with a load weighing 1 kg, sorption of water released under pressure by filter paper and determination of the amount of separated water by the area of a wet spot on filter paper according to the method.

The study of water-holding capacity was carried out by centrifugation.

The plasticity indicator was determined by pressing the sample after determining its ability to retain moisture. The area of a wet spot left by the test sample on filter paper (internal spot) was used for calculation.

The mass fraction of ash was determined by the gravimetric method after mineralization of the product sample in a muffle furnace at a temperature of 500-600 °C according to DSTU ISO 936:2008¹⁸.

The mass fraction of protein was determined according to DSTU ISO 937:2005 based on the mass fraction of total nitrogen according to the Kjeldahl method¹⁹.

The mass fraction of total fat content was determined by the Soxhlet method, which consists in extracting fat from the sample with a solvent, drying the sample, weighing and by the difference between the weighing before and after extraction according to DSTU 8380:2015²⁰.

The amino acid composition of proteins was determined by ion-exchange chromatography.

Sample preparation was carried out by acid hydrolysis, free amino acids were extracted with diluted hydrochloric acid, precipitated with sulfosalicylic acid and separated by filtration.

The content of nitrogenous extractive substances was determined by chromatographic method on a Kupol 55 chromatograph.

Structural changes in muscle tissue were studied by histological method. For this purpose, histological sections were prepared, which were

¹⁶ DSTU ISO 2917-2001. М'ясо та м'ясні продукти. Визначення рН (Контрольний метод). *Національний стандарт України*. Київ: ДП «УкрНДНЦ», 2001. 10 с.

¹⁷ DSTU ISO 1442:2005. М'ясо та м'ясні продукти. Метод визначення вмісту вологи. *Національний стандарт України*. Київ: ДП «УкрНДНЦ», 2005. 9 с.

¹⁸ DSTU ISO 936:2008. М'ясо та м'ясні продукти. Метод визначення масової частки загальної золи. *Національний стандарт України*. Київ: ДП «УкрНДНЦ», 2008. 10 с.

¹⁹ DSTU ISO 937:2005. М'ясо та м'ясні продукти. Визначення вмісту азоту *Національний стандарт України*. Київ: ДП «УкрНДНЦ», 2005. 11 с.

²⁰ DSTU 8380:2015. М'ясо та м'ясні продукти. Метод вимірювання масової частки жиру. *Національний стандарт України*. Київ: ДП «УкрНДНЦ», 2015. 10 с.

subsequently stained. The purpose of staining the sections is to differentiate the tissue structures of cells in them that have the ability to perceive certain dyes (to be stained in a certain color). For this, the sections are stained with Ehrlich's hematoxylin – 3 – 4 minutes. Washed in tap water to remove residual hematoxylin for 2 minutes. Then the sections are immersed in a 1% solution of hydrochloric acid until the sections acquire a pink colour and transferred to aqueous ammonia to neutralize hydrochloric acid until they acquire a blue colour. After that, they are washed in tap water for 2 minutes and stained with 1% aqueous eosin solution for 1 minute, rinsed and dehydrated in 2 portions of 96% ethyl alcohol – each portion for 1 minute. Then the sections are transferred to carbol-xylene, for clarification and disinfection of the sections for 1 minute, and then to xylene for another 1 minute, and the sections are embedded in glycerin-gelatin ^{21 22}.

Computer modelling, data processing and graphing were performed using Microsoft Excel for Windows 2010.

The results of the experimental studies were processed using mathematical statistics. The experimental data was analysed using the Data Analysis in Microsoft Excel. Each experiment was performed with a minimum of three to five repetitions. The acquired results were subjected to standard processing methods and are presented as average values and standard errors of the mean (\pm SEM). Statistical results were assessed using the Student's t-test, with differences considered significant at $p \leq 0,95$.

3. Comprehensive assessment of the chemical composition, biological value, and functional and technological properties of African ostrich meat

Ostrich meat is characterized by a rich chemical composition and contains all the necessary substances for the growth, development and maintenance of normal vital activity of the human body. It is known that the chemical composition of this meat partly depends on the conditions of keeping birds and the quality of their feed. Therefore, for clarity, the results we obtained were compared with the data of other researchers. The chemical composition of ostrich meat of Ukrainian production is given in comparison with the reference indicators of traditional types of domestic meat raw materials, which are characterized by high nutritional value (table 1).

²¹ ДСТУ 7353:2013. М'ясо. Методологія гістологічного визначення свіжості та ступеня витримки. Національний стандарт України. Київ: ДП «УкрНДНЦ», 2013. 13 с.

²² Хомич В.Т., Баль-Прилипо Л.В. Мікροструктурний аналіз м'яса та м'ясопродуктів: навчальний посібник. Київ: Видавничий центр НУБіП України. 2018. 114 с.

Table 1

Comparative analysis of the general chemical composition of ostrich meat and traditional meat raw materials (n =3, p ≤ 0,95)

Type of raw material	Content, %				Cholesterol, mg/100 g of meat	Energy value, Kcal
	moisture	protein	fat	ash		
Ostrich meat*	75.4±2.16	22.5±1.84	0.90±0.03	1.10±0.01	43.0±3.8	98.2
Ostrich meat	76.6	20.7	1.10	1.10	65.0	93.0
Broiler chicken meat	75.3	20.6	2.60	0.90	60.0	106
Turkey meat	74.1	21.6	2.10	1.10	70.0	110
Veal	77.5	20.4	0.90	1.10	80.0	90
Beef	73.7	21.0	4.20	1.00	70.0	121
Pork bacon	54.2	17.0	27.8	1.00	60.0	318

Note * – own data

From the data in Table 1, it can be seen that African ostrich meat is not inferior in protein content to traditional types of high-quality meat raw materials, while it contains the smallest amount of intramuscular fat, which determines the relatively low energy value of the product.

Particular attention is drawn to the cholesterol content in ostrich meat, which, as a comparative analysis has shown, can vary significantly. These results are also confirmed by foreign research data. Some publications report a low cholesterol level – from 30.4 to 37.8 mg per 100 g of meat. At the same time, other researchers indicate fluctuations in cholesterol content in the range from 49.0 to 71.1 mg per 100 g.

It is known that one of the main indicators of the biological value of meat is the content and ratio of amino acids that are part of it. The results of our research in comparison with literature data are given in Table 2.

Table 2

Amino acid composition of meat proteins, mg per 100 g of product (n = 3, p ≤ 0,95)

Name of amino acids	Ostrich meat*	Ostrich meat
Essential amino acids:	10080	8770
Valine	1200±36.3	910
Isoleucine	1000±22.1	970
Leucine	1960±39.9	1600
Lysine	2000±42.3	2200
Methionine+Cystine	950±28.8	690
Threonine	1150±31.9	890

Continuation of table 2

Phenylalanine +Tyrosine	1820±486	1510
Tryptophan	Traces	-
Non-essential amino acids:	11820	10820
Alanine	1350±41.1	960
Arginine	1400±523	1410
Histidine	500±16.6	800
Proline	1100±40.4	700
Serin	950±32.2	740
Glutamic acid	3350±72.6	3630
Aspartic acid	2200±48.1	1910

Note * – own data

According to our results, the content of essential and non-essential amino acids in ostrich meat differs from the data given in the literature. This may be due to differences in feeding rations and the physiological state of the bird.

The comparative analysis shows that in terms of the content of such amino acids as leucine, threonine, lysine, methionine, isoleucine, valine, cystine, alanine and glutamic acid, ostrich meat is not inferior to traditional types of meat products (Table 3).

Table 3

Comparative analysis of the amino acid composition of ostrich meat and traditional meat raw materials (n =3, p ≤ 0,95)

Amino acid	Content, g / 100 g of meat					
	Raw material		Broiler chickens	Turkey	Beef	Pork
	Ostrich meat*	Ostrich meat				
Leucine	1.96±399	1.60	1.50	1.82	1.62	1.54
Isoleucine	1.00±22.1	0.97	0.76	1.03	0.94	0.97
Valine	1.20±36.3	0.91	0.95	1.02	1.15	1.13
Threonine	1.15±31.9	0.89	0.85	0.96	0.88	0.96
Lysine	2.00±42.3	2.20	1.70	1.93	1.74	1.63
Methionine + Cystine	0.95±28.8	0.64	0.72	0.62	0.90	0.76
Phenylalanine + Tyrosine	1.82±48.6	1.51	1.38	1.56	1.70	1.51
Tryptophan	traces	-	0.32	0.35	0.27	0.27
Histidine	0.50±16.6	0.80	0.57	0.44	0.77	0.77
Arginine	1.40±52.3	1.41	1.28	1.40	1.30	1.22
Alanine	1.35±41.1	0.96	1.24	1.32	1.36	1.21
Serin	0.95±32.2	0.74	0.86	0.86	0.90	0.73

Continuation of table 3

Glutamic acid	3.35±72.6	3.63	3.12	3.71	3.60	3.39
Aspartic acid	2.20±48.1	1.91	1.83	2.10	2.3	1.90
Glycine	0.97±26.4	0.67	1.35	1.31	0.88	0.86
Proline	1.10±40.4	0.70	0.96	0.91	0.66	0.53

Note * – own data

An important indicator of the biological value of proteins is the correspondence of the content of essential amino acids to the ideal protein (Table 4).

Table 4

Assessment of the compliance of the amino acid composition of ostrich meat with the ideal protein with the FAO/WHO scale, g/100 g of protein (n =3, p < 0,95)

Amino acid	Raw material		Ideal protein according to FAO/WHO
	Ostrich meat*	Ostrich meat	
Valine	5.3	4.38	3.90
Isoleucine	4.4	4.67	3.00
Leucine	8.7	7.72	5.90
Methionine+Cystine	4.2	3.69	2.20
Threonine	5.1	4.30	2.30
Phenylalanine+Tyrosine	8.1	7.30	3.80
Tryptophan	Traces	-	6.00
Lysine	9.0	10.64	4.50
Total	44.80	42.70	31.6

Note * – own data

As shown in Table 4, the total content of essential amino acids in ostrich meat protein exceeds their amount in the "ideal" protein. At the same time, the tryptophan index is lower, which indicates its limiting role. At the same time, the meat contains an increased content of such important amino acids for the body as leucine, methionine + cystine, threonine, phenylalanine + tyrosine and lysine.

Leucine plays a key role in protecting muscle tissue, is a source of energy, promotes the regeneration of bone, skin, and muscle tissue, and also reduces blood glucose levels and stimulates the secretion of growth hormone.

Valine is essential for muscle metabolism, repairing damaged tissue, and maintaining nitrogen balance in the body. It can also serve as a source of energy

for muscles. However, excessive amounts of valine can cause symptoms such as paresthesia (a tingling sensation on the skin)²³.

Lysine is important for proper bone formation, children's growth, calcium absorption, and for maintaining nitrogen metabolism in adults. It is involved in the synthesis of antibodies, hormones, enzymes, collagen formation, and tissue regeneration processes.

Threonine ensures normal protein metabolism, necessary for the synthesis of collagen and elastin, supports liver function and participates in fat metabolism²⁴. Thus, the ratio of essential amino acids in ostrich meat indicates its high biological value.

Additionally, protein components were evaluated according to such indicators as biological value, coefficient of variation of amino acid score, utilisation coefficient of amino acid composition, as well as the level of “excess content” of essential amino acids (Table 5).

Table 5

Indicators of the biological value of ostrich meat proteins

Indicator	Ostrich meat*	Ostrich meat
Potential biological value (PBV) of protein, %	94.64	80.16
Coefficient of difference of amino acid score, %	5.36	19.84
The utilisation coefficient of the amino acid composition of the protein U, fraction one.	0.80	0.75
Comparative excess coefficient σ , g/100 g of reference protein	8.87	-

Note * – own data

The calculated coefficient of difference of amino acid score showed that 5.36% of essential amino acids are deficient. This indicates a certain imbalance of essential amino acids in the muscle tissue of the studied ostrich meat. This is also indicated by the relatively low value of the the utilisation coefficient of the amino acid composition of the protein U, which is 0.80. For comparison, the reference value is 1.0, which indicates a high level of protein balance.

The coefficient of comparative excess of amino acid composition characterizes the number of essential amino acids that are not absorbed by the body in the composition of such an amount of protein of the studied product, which is equivalent to 100 g of reference protein. For ostrich meat, this figure is

²³ Ципріяні В.І. Гігієна харчування з основами нутриціології: підручник 2-ге видання. К.: 2007. Медицина. 544 с.

²⁴ Voitsekhovska L. U., Starchevoi O. M., Lyzova V. Yu., Bashkirova A. K. The effect of collagenase on the quality of beef ham products. *Bulletin of Agricultural Science*. 2007. No. 12. pp. 64-67

only 8.87 g/100 g of protein, which indicates a good balance of its amino acid composition and confirms the high quality of this raw material as a source of essential amino acids.

Given that the body fully absorbs protein only if the correct ratio of essential amino acids is present, ostrich meat can be an effective basis for the production of meat products. It is advisable to combine it with other ingredients to improve the amino acid balance of the finished product.

It is also worth considering the presence of relatively stable nitrogenous extractive substances in the meat – carnosine, anserine, carnitine, creatine and taurine. They not only form the taste and aromatic characteristics of meat products, but also have important biological significance. Determining their content in African ostrich meat allows for a deeper assessment of its nutritional value.

The results obtained in comparison with reference data on traditional types of meat of farm animals are given in Table 6 ²⁵.

Analyzing the data in Table 6, it can be concluded that in terms of the content of nitrogenous extractive substances such as carnosine, carnitine, creatine and taurine, ostrich meat is not inferior, and in some cases even surpasses the meat of traditional farm animals, in particular beef, pork and horse meat.

Table 6

Comparative analysis of the content of nitrogenous extractive substances (n =3, p<0.95)

Extractive substances	Type of raw material	
	Ostrich meat, g/100 g of meat	Traditional farm animal species, g/100 g of meat
Carnosine	184±3.17	100-300
Anserine	20.8±1.04	90-150
Carnitine	35.2±2.12	20-50
Creatine	428±5.14	200-550
Taurine	117±4.08	30-150

Considering the above indicators, it can be noted that African ostrich meat, in terms of nutritional, in particular biological value, is not only a full-fledged alternative, but also exceeds in a number of parameters the high-quality meat raw materials traditionally used in nutrition in our country. In terms of its chemical composition, ostrich meat is closest to white poultry meat, which, as is known, belongs to dietary products.

²⁵ Fedulova I., & Dragan A. Methodical approaches to the determination of intra productive prices on enterprises of meat processing industry. *Ukrainian Journal of Food Science*. 2015. 3(2), pp. 285-291. <https://dspace.nuft.edu.ua/server/api/core/bitstreams/5d9e06d2-e789-4743-b6a6-9061d7d2dea2/content#page=95>

Therefore, based on the conducted research, it can be stated that African ostrich meat is advisable to use as a raw material for the production of not only traditional meat products but also functional food products of a preventive nature – in particular, for the prevention of cardiovascular diseases, iron deficiency anaemia, and obesity.

Changes occurring in meat in the post-mortem period in different species of farm animals have a common mechanism but differ in duration. Meat in which these processes occur with deviations that affect its final properties is classified as PSE or DFD. The intensity of post-mortem processes is influenced, in particular, by the storage conditions of the products.

In particular, the solubility index of muscle proteins, especially myofibrillar proteins, can serve as an indicator of autolytic changes that determine the quality of meat raw materials. The state of protein components determines organoleptic properties, physicochemical characteristics, and functional and technological indicators, in particular, water-binding, water-holding, and fat-holding capacities²⁶.

According to the author²⁷, one of the characteristic features of ostrich meat is the rapid decrease in pH level in muscles after slaughter, as well as its relatively high final value after 24 hours. The initial pH level is approximately 7.2, and after 24 hours – about 6.0. In this case, in ostrich, the final pH value is reached already 2–6 hours after bleeding, while in pigs, sheep and cattle this process lasts 8–12, 24 and 36–48 hours, respectively, under similar conditions.

During our own experimental studies, it was found that 2 hours after slaughter, the pH level of ostrich meat fluctuates within 6.19–6.23, and after 24 hours of storage it decreases to 6.12. Starting from the second day, a gradual increase in this indicator is observed, which is probably associated with organic proteolysis of protein structures and an increase in the number of free polar and charged functional groups that are able to bind hydrogen ions (Figure 1).

Water is a natural component of meat and is present in it in a bound state, interacting with its structural components and forming stable structured systems. The forms and strength of the bond of water with the structural elements of tissues determine the ability of meat to retain a certain amount of moisture. The amount of bound water, as well as the nature of its distribution by form and bond strength, significantly affect the properties of meat, in particular its consistency.

²⁶ Israelyan V. M., & Shtonda O. A. *Bahatofunktsionalna dobavka dlia vyhotovlennia vyrobiv iz solenoho miasa* (Patent No. 134513, Ukraine). 2019. Ukrainian Institute of Intellectual Property <https://uapatents.com>

²⁷ Perederko L. P., & Stefuriak V. P. *Perspektyvy rozvedennia afrykanskyykh strausiv. Efektyvne ptakhivnytstvo*. 2011. (4), 34–37.

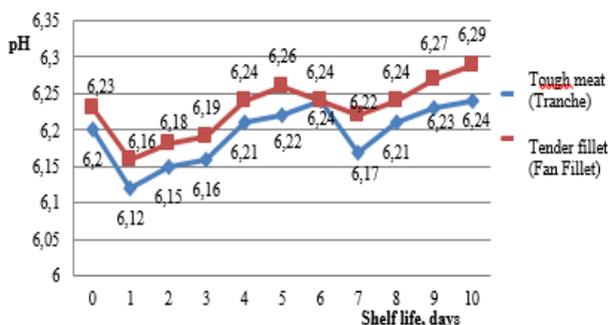


Fig. 1. Change in pH of ostrich meat depending on storage time

Since the main structural components of meat are muscle and connective tissue, it is their water-binding capacity that is of greatest practical importance. The main role in this process is played by proteins, which are the main structural material of tissues. The properties and state of proteins directly determine the ability of meat to bind and retain moisture.

During the meat ageing process, there is an increase in the hydration and solubility of muscle tissue proteins. This is due to the accumulation of free myosin, one of the most effective proteins in terms of its ability to bind moisture (Table 7, 8).

Table 7

Functional and technological indicators of changes in tough meat (Tranche) of ostrich meat in the storage process, $t = 4^{\circ}C$ ($n = 3, p \leq 0,95$)

Indicator	Shelf life, days					
	Freshly slaughtered meat	12 hours	24 hours	3 days	7 days	10 days
WBC, %	52.37±2.14	38.62±1.74	36.44±2.03	37.18±1.96	42.63±1.84	48.58±2.11
WHC, %	71.41±3.24	60.19±2.48	62.73±2.21	64.58±3.18	67.45±2.04	68.80±1.91
Plasticity, cm ² /kg	26.64±1.04	16.82±0.98	11.67±1.01	13.79±1.04	16.15±0.97	18.84±1.05

The results of the research showed that under refrigerated storage conditions ($t = 4^{\circ}C$) during 10 days of storage, there is an increase in water-binding capacity (WBC) and water-retaining capacity (WRC) in two types of meat. Thus, in tender fillet this indicator varies within 39.11–49.23%, while in tough meat – 38.62–48.58%.

Table 8

**Functional and technological indicators of the change of tender fillet
(Fan Fillet) of ostrich meat in the storage process,
t = 4 ° C (n =3, p ≤ 0,95)**

Indicator	Shelf life, days					
	Freshly slaughtered meat	12 hours	24 hours	3 days	7 days	10 days
WBC, %	52.89±1.86	39.11±2.02	37.52±1.74	40.77±2.10	43.56±1.94	49.23±2.04
WHC, %	71.94±2.14	60.87±1.85	63.33±1.93	65.49±1.98	68.14±2.04	69.17±2.07
Plasticity, cm ² / kg	27.46±0.97	18.12±1.02	12.34±1.04	14.47±0.94	17.59±0.98	19.43±0.96

An important indicator of changes in the functional and technological properties of meat is its plasticity. The results of studies of freshly slaughtered meat and chilled ostrich meat samples showed that plasticity increases in both types of meat. In the freshly slaughtered state, tender fillet has high plasticity – 27.46 cm²/kg, while the WBC is 52.89%. In tough meat, the corresponding indicators are 26.64 cm²/kg and 52.37%. This is probably due to the absence of post-mortem stiffening.

On the first day of storage, the plasticity of the tender fillet (Fan Fillet) decreased by 44.9%, and tough meat (Tranche) by 43.8%.

The results obtained indicate the high water-binding capacity and plasticity of African ostrich meat, which makes it a promising raw material for the production of functional meat products.

4. Histological and morphological features of muscle tissue of ostrich meat

Thanks to histological research methods, it is possible to determine the type of meat (pork, beef, horse meat, rabbit meat, poultry meat), its freshness, stages of aging and changes that occur in meat during storage. To obtain reliable data on these issues, a thorough knowledge of the microstructure of meat components is necessary^{28, 29}.

In the microstructural study of ostrich muscle tissue, we found that the muscle fibres are straight or wavy. Transverse striation is well expressed, the nuclei of the fibres are rod-shaped, located under the sarcolemma in the form of chains. A similar arrangement of the nuclei is characteristic of the muscle tissue of red poultry meat (Figure 2 and 3).

²⁸ Ponomarov S. M. Morphofunctional changes in muscle tissue during storage of ostrich meat. *Bulletin of Agricultural Science*. 2015. (2), pp. 45–49.

²⁹ Kuzmin O. P. Dynamics of pH indicators of ostrich meat during refrigerated storage. *Technology of meat and meat products*, 2017. (3), pp. 12–16.

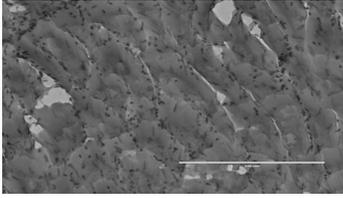


Fig. 2. Longitudinal histological section of ostrich meat at a magnification of 200um

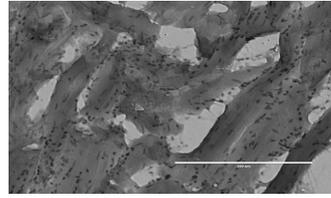


Fig. 3. Transverse histological section of ostrich meat at a magnification of 200um

Using low magnification of the microscope, variously shaped and sized voids can be observed in the endomysium and perimysium, with these areas appearing expanded. The areas of muscle fibres adjacent to the voids have noticeable depressions (Figure 4).

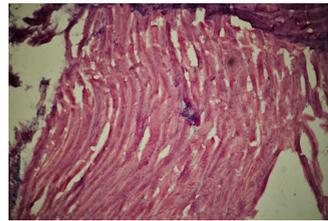
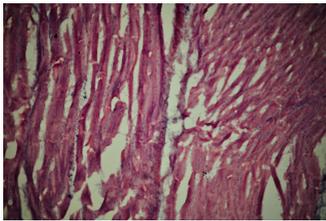


Fig. 4. Longitudinal histological section of ostrich meat with developed connective tissue

On a transverse histological section, muscle fibres are polygonal in shape, lying loosely relative to each other. Connective tissue layers are loose, lying freely (Figure 5). The microstructural analysis data allow ostrich meat to be compared with beef in terms of muscle fibre diameter, and with poultry meat in terms of the thickness of connective tissue layers.

Tenderness of meat is determined, among other things, by its morphology. Thus, histological studies of the microstructure have shown that ostrich meat is comparable to beef in terms of the diameter of muscle fibres and the density of connective tissue layers, which confirms its nutritional appeal. Poultry tissue differs from beef, primarily in that it has a significantly lower density of intramuscular perimysium and endomysium.

The tenderness of meat is largely determined by its morphological structure. Histological analysis of ostrich muscle tissue revealed that it is similar to beef in terms of the size of muscle fibres and the density of connective tissue layers

(endomysium and perimysium), which indicates the high nutritional appeal of this type of meat ³⁰. At the same time, ostrich muscle tissue has its own characteristics: compared to beef, the diameter of muscle fibres in ostrich meat is slightly smaller, and intramuscular connective tissue structures are less dense and thinner, which contributes to better tenderness of the product.

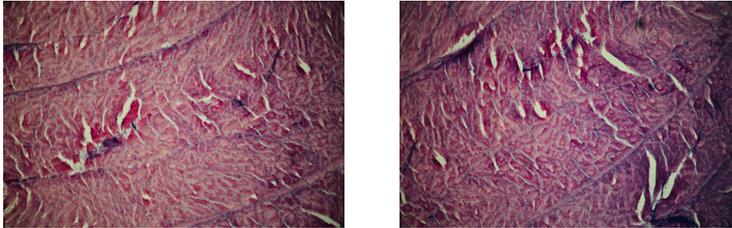


Fig. 5. Transverse histological section of ostrich meat with developed connective tissue

Compared to pork, which is characterized by an average size of muscle fibres and moderate expressiveness of connective tissue, ostrich meat is characterized by a more homogeneous structure and a smaller number of fat inclusions. Chicken meat has much thinner muscle fibres and poorly developed connective tissue layers, which makes it the most tender among the listed types of meat. However, ostrich meat has a denser texture compared to chicken, combining the properties of both red and white meat while maintaining high dietary value ³¹.

Thus, ostrich meat represents a morphologically justified alternative to conventional types of meat, offering not only tenderness but also high biological value and functional properties, which are essential for the production of meat products with enhanced nutritional value.

CONCLUSIONS

Studies have shown that African ostrich meat is a high-quality protein product with a valuable chemical and amino acid composition. Its high protein content (21.2–22.5%) and low fat content (1.2–2.0%) determine the dietary properties of this meat, which makes it suitable for diets of people with cardiovascular diseases, metabolic disorders, and overweight.

Analysis of the amino acid composition showed the presence of a wide

³⁰ Гагарін В. В. Характеристика фізико-хімічних властивостей страусино м'яса. Харків: Харківський державний університет харчування та торгівлі. 2019. с. 128.

³¹ Мельниченко С. М. Технологічні властивості м'ясних білків та їх вплив на якість продукції. Наукові праці ОНАХТ. 2020. 28(1), с. 98–103.

range of essential amino acids, in particular leucine, threonine, isoleucine, phenylalanine and valine, which are important for the physiological functioning of the body. The obtained amino acid score values indicate that ostrich meat proteins are able to fully meet the body's needs for essential amino acids, not inferior in this indicator to proteins from traditional types of meat.

The values of the amino acid composition utilisation coefficient, amino acid composition index, and biological value confirm the high quality of ostrich meat protein. Comparison with traditional types of meat demonstrated the advantages of ostrich meat in terms of amino acid balance, ease of digestion, and lower saturated fat content.

Given the results obtained, African ostrich meat can be recommended as a promising raw material for the production of functional, children's, sports and medical and preventive nutrition products. In the future, it is advisable to focus on studying the impact of technological processes on the preservation of its nutritional value, as well as the development of innovative food products based on this raw material.

SUMMARY

The work provides a comprehensive analysis of the chemical, amino acid composition and histological features of African ostrich meat of Ukrainian production compared to traditional types of meat raw materials (broiler chickens, turkey, beef, pork). The content of protein, fat, cholesterol, amino acids, as well as nitrogenous extractive substances (carnosine, anserine, carnitine, creatine, taurine) was investigated. Histological studies of ostrich muscle tissue were conducted, allowing for the assessment of its microscopic characteristics that influence the texture and quality of the meat. It is established that ostrich meat has a high biological value of protein, close to or higher than the "perfect" protein on the FAO/WHO scale, with a good amino acid profile and low fat and energy value. It is revealed that the amino acid composition and histological structure may vary depending on the conditions of keeping and feeding the bird. Ostrich meat is characterized as a dietary, high quality product that exceeds the traditional types of meat raw materials in a number of indicators. The results indicate the potential of using African ostrich meat for the production of both traditional and functional food products for preventive purposes.

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