International Journal of Food Science and Agriculture, 2025, 9(2), 42-48
https://www.hillpublisher.com/journals/jsfa/
ISSN Online: 2578-3475
ISSN Print: 2578-3467

Technological Quality and Proximate Composition of Ostrich Meat (Struthio Camelus Australis) Reared in Captivity on Natural Pasture in North Benin

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How to cite this paper: Tougan P. Ulbad, Tokou Abdoul-Razack, Le Cornec Michel, Thewis André. (2025). Technological Quality and Proximate Composition of Ostrich Meat (Struthio Camelus Australis) Reared in Captivity on Natural Pasture in North Benin. *International Journal of Food Science and Agriculture*, 9(2), 42-48.
DOI: 10.26855/ijfsa.2025.06.001

Received: April 26, 2025
Accepted: May 24, 2025
Published: June 20, 2025

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Abstract

Ostrich meat is one of the main unconventional meat resources produced in captivity in North Benin for food security and tourism. This meat is gaining popularity among consumers in the North of Benin. The study aimed to analyze the carcass yield and technological properties of the meat of ostriches reared on natural pasture at Tatagtou farm of Dassarie in Benin. The muscles M. fibularis longus of 5 ostriches were sampled and used for the analyses. The carcass yield, ultimate pH (pH24), L* (White index), a* (Redness), b* (Yellowness), hue value, chroma value, drip loss, cooking loss, water holding capacity and texture (N/mm) of the sampled muscles were determined according the required ISO standards. Statistical Analysis System was used for data analysis. The study revealed that the carcass yield of the ostriches was on average 74.47%. The pH24 was 6.07. The luminance, the red index, and the meat yellow index were respectively 37.5, 18.78, and 8.15. The drip loss, the cooking losses, and the water holding capacity were respectively 1.94%, 29.2%, and 31.05%. The hue and chroma values of the raw meat and the texture of the cooked meat were, respectively, 2.16, 20.47, and 3.95 N/mm. The contents in dry matter, crude protein, crude fat, and ash of the sampled ostrich meat were, respectively, 25.3g/100g, 22.1g/100g, 1.37g/100g, and 1.17g/100g of raw matter. Overall, ostrich meat has several technological assets and may be promoted for food security and nutrition.

Keywords

Benin; ostrich meat; processing attributes; nutritional quality

1. Introduction

Meat quality is the key factor that affects meat acceptability, in which technological properties are very important parameters. The main issues related to red meat consumption are higher concentration of cholesterol, artheosclorosis, and cardiovascular diseases. Therefore, the preference for low-fat, nutritious, and tasty meats was recommended for consumption [1, 2]. The health problems related to red meat consumption can be limited by ostrich meat, intake recognized as healthy. Ostrich meat is classified as a dietary source of animal protein with excellent nutritional values and is consumed worldwide [3-5].

In Benin, the development of ostrich farming on natural pasture promotes ostrich meat and eggs in the country. Moreover, there is an increasing concern over healthy non-conventional food resources. However, scientific data

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on ostrich meat quality, processing, and preservation abilities is still limited until now. What are the quality characteristics and processing abilities of raw ostrich meat produced on natural pasture in North Benin? That is the research question of the study.

The aim of the study was to assess the carcass yield, technological quality, and nutritional properties of the meat of ostriches reared on natural pasture at Tatagtou farm of Dassarie in Benin. Specifically, it was to:

- Determine the carcass yield and technological characteristics of ostriches reared on natural pasture at Tatagtou farm of Dassarie in Benin;
- Evaluate the proximate composition of the meat of ostriches reared on natural pasture at Tatagtou farm of Dassarie in Benin.

2. Methods

2.1 Study area

The current research was carried out at the ostrich farm Tatagtou of Dassarie, located in the North-West of Benin (Figure 1), and secondarily in the laboratory of Nutrition and Food Sciences of the Faculty of Agronomy /University of Parakou in Benin and at Gembloux Agro-Bio Tech/University of Liège in Belgium. This ostrich farm is located in the Department of Atacora, district of Dassari, in the Municipality of Materi. The farm is bounded on the North side by the village of Nagassega, on the South by the village of Dassari, on the East by the inter-state road N°3, and to the West by the village of Pountchitega. The climate of this region is Sudano-Guinean with a unimodal rainfall regime with two distinct seasons. The dry season usually extends from November to April. The dry season is characterized by the continental harmattan (November to February) and a period of overheating (from March to April). The maximum daily temperature varies between 34 and 40°C. Rainfall covers the months of May to October. The average annual rainfall is 1000 mm/year.

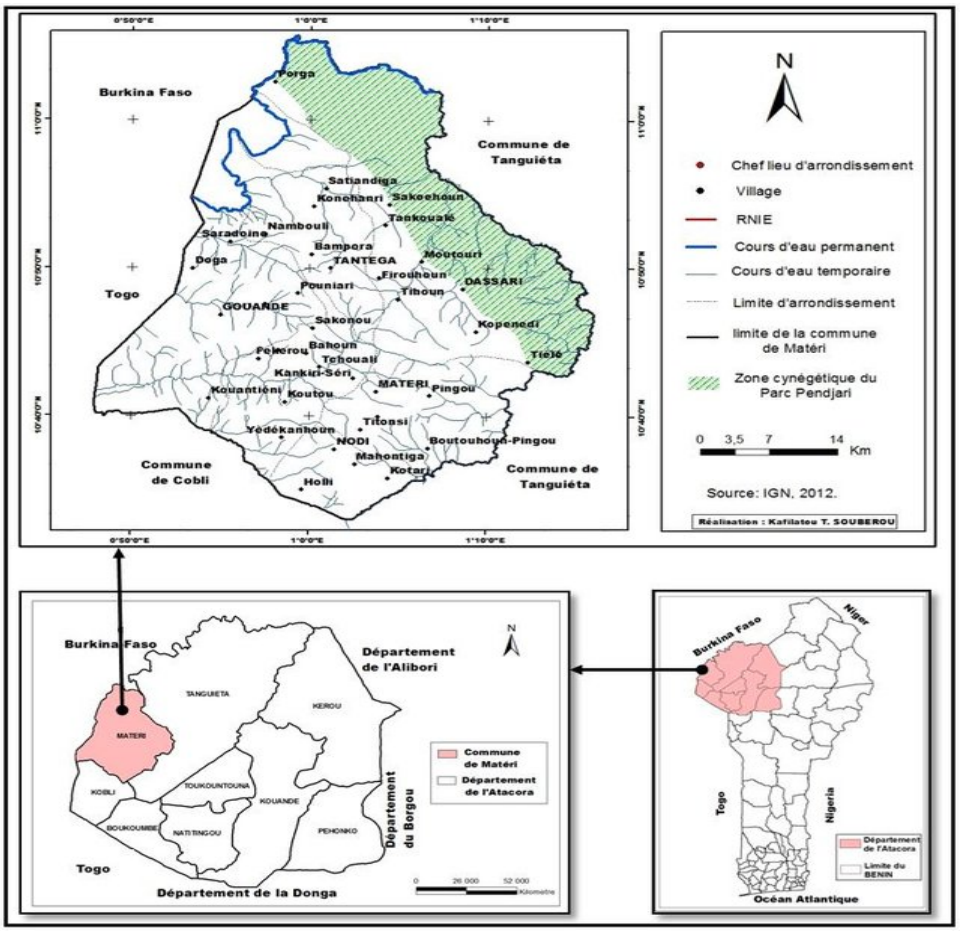

Figure 1. Study area.

2.2 Ostrich rearing and slaughtering process

The ostriches were reared in captivity under a semi-intensive breeding system on natural pasture (Figure 2) at Tatagtou farm in Dassarie. The environmental conditions were identical for each animal. The rearing conditions met the requirements of the Animal Welfare Code of Practice [1, 6]. They were fed ad libitum using conventional feeds (Table 1), taking into account their dietary needs by age-type and natural pasture available within their parks. Water is permanently available ad libitum for the birds.

Thirty (30) uniform primary samples of muscles *M. fibularis longus* were combined to produce 5 composite samples from 5 Ostriches of 42 weeks old slaughtered for the study. The sampled muscles, *M. fibularis longus*, were used for the technological and nutritional analysis.

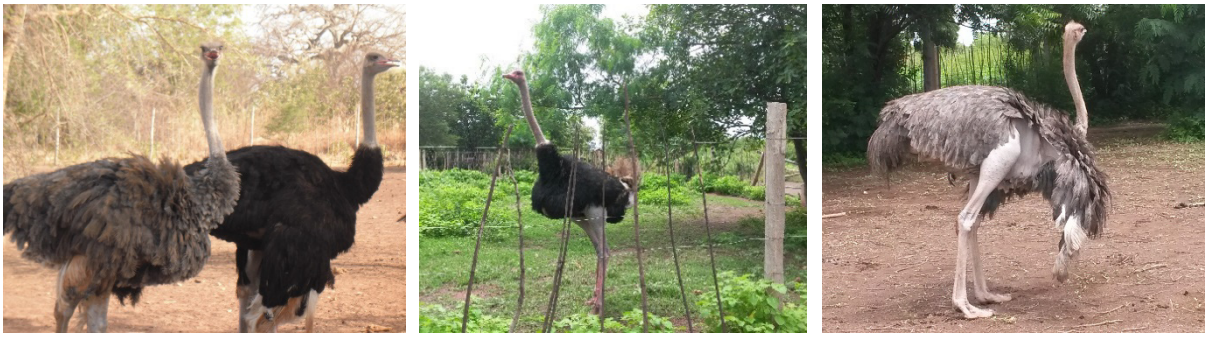

Figure 2. Ostriches are in free range on the ranch.

Table 1. Diet composition

Raw materials	Reproductive diet (kg)	Growth diet (Kg)	Starter diet (Kg)
Corn	48	20	20
Cotton meal	7	6	8
Soybean meal	7	7	13
Palm kernel meal	0	15	0
Corn bran	5	18	23.9
Wheat bran	0	0	8
Fishmeal	8.8	8	8
Palm oil	3	0	3
Oyster shell	2	2	1
Na Cl	0.1	0.1	1
Iron sulphate	0.1	0	0.1
Wood chip	14	12	13
Rice bran	0	9.9	0
Complex of vitamins and minerals	5	2	1
Total	100	100	100

2.3 Evaluation of the carcass yield and the meat technological quality attributes

The carcass yield was evaluated by using the following formula [7]:

$$Carcass\ yield\ (\%) = \frac{Ostrich\ Carcass\ Weight}{Ostrich\ Live\ weight} \times 100$$

The technological quality attributes measured on the meat samples were the pH, color (L*, a*, and b*), the hue, the chroma, the drip loss, the cooking loss, the water holding capacity, and the texture (N).

The pH determination was performed at 24 hours after ostrich slaughtering in the muscles *M. iliofibularis* by using a Hanna pH-meter [8, 9]. This Hanna Instrument was equipped with a specialized probe for pH and temperature control.

The color of meat was analyzed through the determination of the White index (L*), the redness (a*) and the yellowness (b*) at 24 hours after ostrich slaughtering with a chromameter CR-410 according to the standard the International Commission on Illumination (L*, a*, b*) [8, 9]. Each color parameter was measured with 3 replicates.

The hue and chroma values were estimated according to the formula of [10] given below.

$$Hue = \frac{1}{Tan\left(\frac{b*}{a*}\right)}$$

$$Chroma = \mathbf{(a^{*2} + b^{*2})^{1/2}}$$

The determination of drip loss of the ostrich meat and their cooking loss was performed according to the procedure used by Tougan et al. (2016). These processing abilities parameters were estimated as the weight loss expressed in percentage during the dripping and cooking process of the ostrich meat. The following equations were used for their estimation:

$$\textbf{\textit{Drip loss}}\ (\%) = \frac{\textbf{\textit{Weight loss during chilling}}}{\textbf{\textit{Initial fresh meat weight}}} \times 100$$

$$\textbf{Cooking loss}\ (\%) = \frac{\textbf{Weight loss during cooking}}{\textbf{Initial fresh meat weight}} \times 100$$

As for the water Holding Capacity of the ostrich meat, it was calculated by adding the drip loss to the cooking loss [8].

The texture was analyzed by Warner-Bratzler shear force measurements and by using a Texture analyzer (TAXT Plus, Lloyd Instrument). The Warner-Bratzler single-blade was used. The shear velocity was 200 mm/min. Each value was an average of at least 5 measurements.

2.4 Evaluation of the proximate composition of the meat

The proximate composition of the ostrich meat sampled was determined according to the recommended AOAC procedures [11]. The dry matter content was determined by kiln drying at 105°C until constant weight according to standard NF V 04-401 (2001). The total mineral content analysis was performed according to the procédure NF V 04-2018 (1989) [9]. The crude fat concentration was determined by petroleum ether extraction using a Soxhlet apparatus [9].

The crude protein content was evaluated by the Kjeldahl method according to the standard NF V04-211 of December 1971.

2.5 Statistical analysis

The data collected on ostrich meat technological quality were analyzed by descriptive statistics with the Statistical Analysis System software [12]. The means were calculated by using the procedure proc means of SAS.

3. Results

3.1 Carcass yield and technological quality attributes of ostrich meat produced on natural pasture

The carcass yield of the ostriches was on average 74.47%. About the processing abilities of the meat, the study revealed that pH recorded at 24 hours post-mortem was 6.07 (Table 2). The luminance or white index, the redness, and the yellowness of the meat were respectively 37.5, 18.78, and 8.15. The average value of the drip loss and the cooking loss of the meat were respectively of 1.94% and 29.2%. The value recorded for the water holding capacity of the meat was on average 31.05% (Table 2). The hue and chroma values of the raw meat and the texture of the cooked meat were, respectively, 2.16, 20.47, and 3.95 N/mm.

Table 2. Carcass yield and technological quality attributes of ostrich meat produced on natural pasture

Variables	Mean	Standard Error	Coefficient of Variation
Carcass yield	74.47	0.39	1.18
pH at 24 hours *post-mortem*	6.07	0.03	1.04
Luminance (L*)	37.5	0.27	1.61
Red index (a*)	18.78	0.11	1.32
Yelow index (b*)	8.15	0.08	2.25
Hue value	2.16	0.02	2.31
Chroma value	20.47	0.12	1.32
Drip loss (%)	1.94	0.05	6.26
Cooking loss (%)	29.2	0.21	1.57
Water holding capacity (%)	31.14	0.16	1.15
Texture (N/mm)	3.95	0.07	1.94

3.2 Proximate composition of the meat

The proximate composition of the ostrich meat produced on natural pasture in North Benin is given in Table 3. The content in dry matter of investigated ostrich meat was 25.3g/100g of raw matter. The crude protein content was 22.1g/100g of raw matter while the cude fat con-centration was 1.37g/100g of raw matter. The total ash content of ostrich meat was 1.17g/100g of raw matter.

Table 3. Proximate composition of ostrich meat produced on natural pasture in Benin

Variables	Mean	Standard Error	Variation Coefficient
Dry matter content (g/100g)	25.3	0.1	1.17
Crude protein content (g/100g)	22.1	0.03	7.26
Fat content (g/100g)	1.37	0.08	1.1
Ash content (g/100g)	1.2	0.01	1.17

4. Discussion

4.1 Carcass yield and technological quality attributes of ostrich meat produced on natural pasture

In the field of meat science, pH is one, the key indicators of preservation and processing abilities of meat products. It determines meat quality. In our study, ostrich meat pH recorded at 24 hours post-mortem is on average 6.07. According to [13], the value of pH recorded at 24 hours after slaughtering in ostrich meat allows for classifying it in the group of intermediate meat ([normal (pH < 5.8); high (pH > 6.2]). Some values of pH greater than 6.2 lead to darker ostrich meat and reduce its water-holding capacity. The pH value recorded herein is within this range of 5.8-6.2. [14] indicated that pH is positively correlated with water holding capacity. When the pH value decreases, the water holding capacity of the meat may also decrease as a correlated response. The value of pH found herein is ideal for ostrich meat processing. The variation and difference in pH values of ostrich meat in the literature can be due to other non-genetic factors. According to [15], the slaughtering process, deboning, bleeding, packaging, and storage conditions can affect the pH in ostrich meat.

Color is one of the most important and visible quality traits of the meat. This parameter is one of the main criteria of meat selection by the consumer. The result of the study revealed that the color of the ostrich meat of Benin was dark red. This observation complies with the findings of [14], who reported dark red color for ostrich meat. Similarly, [16] reported that the luminance of ostrich meat ranges from 27.4 to 34.4, the redness value ranges from 11.7 to 20.4, and the yellowness value from 6.0 to 9.3. The slight difference in the color parameters of ostrich meat among different studies can be due to the storage conditions. The dark-red color observed herein indicates the important

myoglobin content in ostrich meat of Benin. The results of our study comply with the findings [17]. This relatively important redness can be due to the old slaughtering age (42 Weeks) of the ostrich used for the study [18].

The luminance value, the redness, and the yellowness recorded for the ostrich meat herein indicate that it is a red meat close to cattle meat, in spite of the fact that ostrich is an avian resource. The value of pH24, the value of shear force, the value of drip loss, the value of cooking loss and water holding capacity of the ostrich meat showed that this unconventional avian resource can be processed into ground meat, patties and sausage or preserved by refrigeration, freezing, smoking, cooking in water, braising, roasting, and sun drying.

The water holding capacity (WHC) indicates the ability of the meat to maintain its juice during application of any external forces such as heating, mincing, or cutting [14]. In the current study, the values of the juice losses during dripping at 4°C, cooking and the value of WHC of the sampled ostrich meat are relatively low compared to those reported in indigenous chickens of Sahoue, Holli and Fulani ecotypes by [8, 9] and in indigenous cattle meat [19] (Salifou et al. 2012) raised in the same study area. This low juice loss obtained herein confirms the report of several authors [20, 16, 21, 22] who found that ostrich meat doesn't lose much juice during cooking. Furthermore, this low cooking loss of ostrich meat observed in the current study can explain its low texture. However, important cooking times of ostrich meat should be promote great juice loss and drier meat [23].

4.2 Proximate composition of ostrich meat produced on natural pasture

The dry matter content of 25.3% obtained herein is in the upper limit of 24.5-30.5 g/100 g reported for raw poultry and mammalian meat [24]. This compliance was also observed for crude protein content, fat content, and ash content.

The value of moisture, fat, ash, and protein contents recorded in this study are similar to those found by [25, 6, 26]. According to [27], Ostrich meat is characterized by 23-26 g/100g of dry matter, 18-22 g/100g of protein, and 1-4.5 g/100g of fat content [28, 29]. The values of protein content of ostrich meat found herein are similar to those reported for pork but higher than cattle meat and poultry [29, 30]. The fat concentration of ostrich meat recorded in this study is lower than the values reported for beef, pork, and poultry meat [30, 31]. The weak fat content and high protein content of ostrich meat justify its good dietary characteristics for human consumption.

5. Conclusion

Briefly stated, this study identifies that ostrich meat has several technological assets and may be promoted for food security and nutrition. Its color (CIE L*, a*, b*) indicated that it is a red meat close to cattle meat, in spite of the fact that ostrich is an avian resource. The value of pH, shear force, the juice losses during dripping and cooking processes and the water holding capacity of the ostrich meat show that it can be processed into ground meat, patties, sausage and can be preserved by refrigeration, freezing, smoking, cooking in water, braising, roasting, and sun drying. Nutritionally, the low-fat content and high protein content of ostrich meat indicate its good dietary properties for human consumption.

Acknowledgements

The first author acknowledges the Elan Postdoctoral fellowship grant from ARES/CCD Belgium. This fellowship program has allowed the development of postdoctoral research on the characterization of local avian resources and products in Benin.

References

[1] Horbańczuk OK, Wierzbicka A. Technological and nutritional properties of ostrich, emu, and rhea meat quality. J Vet Res. 2016;60:279-86. doi:10.1515/jvetres-2016-0043.

[2] Brenesselova M, Korenekova B, Macanga J, Marcincak S, Jevinova P. Effect of vacuum packaging conditions on the quality, biochemical changes and the durability of ostrich meat. Meat Sci. 2015;101:42-7. doi:10.1016/j.meatsci.2014.11.003.

[3] Henry SGM, Abou-El-Hawa SH, Ramadan BR, Khalifa AHA. Nutritional Quality of Ostrich Meat, Edible Offal, and Fat Tissue. Assiut J Agric Sci. 2024;55(2):125-43.

[4] Malak NML. Chemical Composition, Deterioration Criteria and Microbiological Quality of Edible Ostrich Giblets. Egypt J Chem. 2023;66(13):1851-9.

[5] Abd El Rahman MAM, Khalifa AH, Ashour ASB. Carcass Characteristics, Physicochemical Properties and Nutritional Composition of Meat from two Wild Birds: Northern Pintail (Anas acuta) and Northern Shoveler (Spatula clypeata). Int J Curr

Microbiol App Sci. 2022;11(8):130-46.

[6] Horbańczuk OK, Wierzbicka A. Technological and nutritional properties of ostrich, emu, and rhea meat quality. J Vet Res. 2016;60:279-86. doi:10.1515/jvetres-2016-0043.

[7] Tougan PU, Bonou AG, Gbaguidi T, Koutinhouin GB, Ahounou S, Salifou CFA, et al. Influence of Feed Withdrawal Length on Carcass Traits and Technological Quality of Indigenous Chicken Meat Reared Under Traditional System in Benin. J World Poult Res. 2016;6(2):48-58.

[8] Tougan PU, Zannou MS, Dedjiho A, Domingo IA, Osseyi GE, Théwis A. Influence of the slaughtering process and the post-mortem maturation time on carcass and meat quality Sahoue chicken ecotype of Benin. Int J Innov Sci Res. 2023;67(1):1-14.

[9] Tougan PU, Dahouda M, Ahounou GS, Salifou CFA, Kpodekon MT, Mensah GA, et al. Effect of breeding mode, type of muscle and slaughter age on technological meat quality of local poultry population of Gallus gallus species of Benin. Int J Biosci. 2013;3(6):1-17.

[10] Hunt MC, Acton JC, Benedict RC, Calkins CR, Cornforth DP, Jeremiah LE, et al. Guidelines for meat color evaluation. 3rd ed. Chicago: American Meat Science Association; 1991.

[11] AOAC. Official Methods of Analysis. 17th ed. Rockville: AOAC International; 2016.

[12] SAS Institute. SAS/STAT User's guide. Version 6. 4th ed. Cary: SAS Institute; 2016.

[13] Majewska D, Jakubowska M, Ligocki M, Tarasewicz Z, Szczerbińska D, Karamucki T, et al. Physicochemical characteristics, proximate analysis and mineral composition of ostrich meat as influenced by muscle. Food Chem. 2009;117:207-11.

[14] Akram MB, Khan MI, Khalid S, Shoaib M, Hassan SA. Quality and Sensory Comparison of Ostrich and Goat Meat. SSR Inst Int J Life Sci. 2019;5:1-14.

[15] Hoffman LC, Muller M, Cloete SWP, Brand M. Physical and sensory meat quality of South African Black ostriches (Struthio camelus var. domesticus), Zimbabwean Blue ostriches (Struthio camelus australis) and their hybrid. Meat Sci. 2008;79(2):365-74.

[16] Hoffman LC, Fisher P. Comparison of meat quality characteristics between young and old ostrich. Meat Sci. 2001;59:335-7.

[17] Balog A, Almeida PICL. Ostrich (Struthio camelus) carcass yield and meat quality parameters. Braz J Poult Sci. 2007;9(4):215-20.

[18] Joseph P, Suman SP, Beach CM, Steinke L, Fontaine M. Characterization of bison (Bison bison) myoglobin. Meat Sci. 2010;84(1):71-8.

[19] Salifou CFA, Dahouda M, Ahounou GS, Kassa SK, Tougan PU, Farougou S, et al. Evaluation of carcass traits of Lagunaire, Borgou and Zebu Fulani bulls raised on natural pasture in Benin. J Anim Plant Sci. 2012;22(4):857-71.

[20] Pollok KD, Hale DS, Miller RK, Angel R, Blue-Mclendon A, Baltmanis B, et al. Ostrich slaughter and by-product yields. Am Ostrich. 1997;4:31-5.

[21] Majewska D, Jakubowska M, Ligocki M, Tarasewicz Z, Szczerbińska D, Karamucki T, et al. Physicochemical characteristics, proximate analysis and mineral composition of ostrich meat as influenced by muscle. Food Chem. 2009;117(2):207-11.

[22] Girolami A, Marsico I, D'Andrea G, Braghieri A, Napolitano F, Cifuni GF. Fatty acid profile, cholesterol content and tenderness of ostrich meat as influenced by age at slaughter and muscle type. Meat Sci. 2003;64:309-15.

[23] Balog A, Mendes AA, Silva MC, Takahashi SE, Almeida Paz ICL, Komiyama CM. Composição mineral dos principais músculos de avestruz (Struthio camelus). In: Latin America Ratite Science Workshop; 2006; São Paulo, Brazil.

[24] Forrest JC, Aberle ED, Hedrick HB, Judge MD, Merkel RA. Principles of meat science. San Francisco: Freeman; 1975.

[25] Poławska E, Lisiak D, Jóźwik A, Pierzchała M, Strzałkowska N, Pomianowski J, et al. The effect of the diet supplementation with linseed and rapeseed on the physico-chemical and sensory characteristics of ostrich meat. Anim Sci Pap Rep. 2012;30:65-72.

[26] Al-Kalifa H, Al-Nasre A. Ostrich meat: production, quality parameters, and nutritional comparison to other types of meats. J Appl Poult Res. 2014;23:784-90.

[27] Brassó LD, Komlósi I. Studies on ostrich (Struthio camelus) meat - Review. Rev Cienc Agropecu. 2021;7(2):83-91.

[28] Poławska E, Marchewska J, Cooper R, Pomianowski J, Strzałkowska N, Horbańczuk J, et al. The ostrich meat - An updated review. II. Nutritive value. Anim Sci Pap Rep. 2011;29:89-97.

[29] Majewska D, Jakubowska M, Ligocki M, Tarasewicz Z, Szczerbińska D, Karamucki T, et al. Physicochemical characteristics, proximate analysis and mineral composition of ostrich meat as influenced by muscle. Food Chem. 2009;117:207-11.

[30] Bodnárné SE, Bodnár K. The main chemical composition parameters of pork (review). Rev Agric Rural Dev. 2012;1(2):534-40.

[31] Hamed H, Ma M, Damaka A, Elkhedir A, Jin G. Effect of Freeze and Re-freeze on Chemical Composition of Beef and Poultry Meat at Storage Period 4.5 Months (SP4.5). J Food Process Technol. 2019;10(5):1-12.