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Review

CARCASS CHARACTERISTICS, NUTRITIONAL VALUE AND SAFETY OF CROCODILE MEAT

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ABSTRACT

In the last few years, the European Union has reported increased imports of fresh, chilled or frozen meat, including crocodile meat. Industry has been developing and has invested largely in its efforts to improve quality and increase meat yield by innovating its methods of farming, feeding and carcass processing. The reason, on the one hand, is the fact that crocodile meat is perceived not only as "exotic" and "adventure", but also as dietary and healthy, with high nutritional value, due to its low fat and sodium content and high protein percentage. The approximate composition of *Crocodylus niloticus* meat shows protein levels of 15.7-22.08%. In the other species *Crocodylus pororsus*, *Caiman yacare*, *Alligator mississippiensis* and *Caiman latirostrisis* the average amount of protein is 20-21%, making it a food rich in protein, such as chicken, pork, lamb and beef. Crocodile meat contains high levels of monounsaturated fatty acids (MUFA) – between 33.2% and 51.3% and saturated fatty acids (SFA) – between 26.0% and 41.4%. It is quite delicate, with low cohesiveness, high elasticity and tenderness. It is juicy, without the presence of connective tissue with an intense taste and an almost imperceptible aroma. Iron, magnesium and sodium levels in crocodile meat are lower than those in beef and chicken. The low sodium content is another indication of the health benefits of crocodile meat. The paper dwells on the qualitative characteristics of crocodile meat, focusing on its safety as a product for human consumption and presents data about by-products obtained from crocodiles used in ancient and modern medicine, beneficially affecting human health.

Key words: crocodile meat, nutritional value, meat composition

INTRODUCTION

In recent years, crocodile farms have been a fast-growing industry sector, making profits not only from the hide trade. At the dawn of the business, crocodile meat was considered a secondary and less valuable product, but now the demand for it is growing. This is proven by the fact that only one crocodile farm in South Africa can process annually more than 20,000 specimens, and the entire production of meat from them is marketed in many countries of Europe and the Far East (1). Confirmation about that is also the increased import of fresh, chilled or frozen meat and edible reptile by-products, including crocodile meat, from countries outside the European Union (EU). This upward trend has led to a more than 50% growth in the imported quantities between 2007 and 2017. According to the Eurostat reference database, the average annual EU import of such products reaches almost 100 tons. (2). Trade statistics show that the main imports of reptile meat into the EU are from South Africa, the United States and Zimbabwe with a total value increasing from €80,000 in 2002 to €475,000 in 2005. The majority of trade is either imported or exported via Belgium, France, Germany, the Netherlands or the United Kingdom (3). In this regard, the European Union (EU) has created a legislative framework specifically targeting meat from reptiles, including crocodilian species. This commodity is expected to gain a certain share of the EU market in the coming years (2). According to Commission

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Implementing Regulation (EU) 2021/405, the term "reptile meat" refers to the edible parts, processed or not, obtained from farmed reptiles belonging to the species *Alligator mississippiensis*, *Crocodylus johnstoni*, *Crocodylus niloticus*, *Crocodylus porosus*, *Timon lepidus*, *Python reticulatus*, *Python molurus bivittatus* or *Pelodiscus sinensis*. These reptiles comply with the requirements set out in Regulation (EU) 2015/2283, included in the Union list of novel foods (4).

Industry has been improving and has invested largely in its efforts to enhance quality and increase meat yield by upgrading its methods of farming, feeding and carcass handling (1). The reason, on the one hand, is the fact that crocodile meat is perceived not only as "exotic" and "adventure", but also as dietary and healthy, with high nutritional value, due to its low fat and sodium content and high protein percentage.

In addition, we are faced with the problem of limited land resources needed to raise farm animals. The forecast to reach 10.5 billion people by 2050 confronts humanity with the impossibility of being able to satisfy its needs for meat. In this spirit, the inclusion of exotic meats as a complement to traditional ones is becoming increasingly meaningful (5). Apart from this, there is the issue of food security in many developing countries. Researchers suggest that raising native wild animal species as a source of protein has the potential to alleviate this problem (6, 7). Reptiles would also be the optimal choice as a meat source for humans because of their low energy needs and ability to reproduce quickly. These distinctive characteristics, combined with the significant market demand for secondary products such as their skin, make reptiles ideal candidates for human exploitation (6, 8).

If in Europe, as well as in other countries outside the Continent, crocodile meat is not so popular, being perceived as atypical and exotic, in South Africa there are many farms and restaurants that offer both locals and tourists crocodile dishes and specialties, including paté, kebab, sausages, smoked crocodile carpaccio and many more (9).

Several species of crocodiles are farmed worldwide (Nile crocodile (*Crocodylus niloticus*), freshwater crocodile (*Crocodylus johnstoni*), Siamese crocodile (*Crocodylus siamensis*), (*Crocodylus acutus*), saltwater crocodile (*Crocodylus porosus*), alligator (*Alligator mississippiensis*) and caiman (*Caiman yacare*) (10). The Nile crocodile (*Crocodylus niloticus*) originates from Africa and is farmed in many countries such as Egypt, Madagascar, Kenya, Zimbabwe, Tanzania, Seychelles, Comoros, South Africa, Israel, Indonesia, France, Japan, United Kingdom and Spain. Saltwater crocodile (*Crocodylus porosus*) is farmed in Australia, Papua New Guinea and Thailand, while the freshwater crocodile (*Crocodylus johnstoni*) – in Australia. The Siamese crocodile (*Crocodylus siamensis*) is farmed in Thailand and Cambodia, while in North America the alligator (*Alligator mississippiensis*) is usually farmed in the southern states of the USA – Georgia, Florida, Texas and Louisiana (5, 10).

Against this background, however, there is still no systematic and more detailed data regarding the nutritional composition, benefits and risks for humans when consuming crocodile meat. The likely reason for this is the very few studies addressing these aspects. The available data, some of which date back to 30 years ago, can somewhat cast light on the gaps and we may assume that they are conclusive, rather than used for comparing and speculating. Therefore, the present paper examines the qualitative characteristics of crocodile meat, focusing on its safety as a product for human consumption and presents data on beneficial by-products obtained from crocodiles.

CARCASS CHARACTERISTICS

The carcass characteristics and slaughter yield in crocodilian species have several aspects. The pelting of skin as the most valuable raw material in these animals affects the meat yield, the number of commercial cuts, etc. The desire to separate the skin from the carcass intact, without defects undoubtedly impacts the commercial quality of meat and its quantity (8). On the other hand, meat intended for human consumption, especially for export, is obtained mainly from the tail. The other muscles of the carcass can also be separated from the bones and offered as a lower value product or returned as food for the crocodiles (11). There are only a few studies providing information about the carcass characteristics of the crocodilian species. Hoffman et al. (11) presented the data from a study on 7 crocodiles aged 33-34 months with live weight of 8316 ± 618.0 g. of the *C. niloticus* species. The animals were from a farm in South Africa. The average value of slaughter

weight reached 56.5%. The slaughtered carcasses were divided into 4 parts (tail, limbs, neck and carcass). The yield of pure meat from the tail reached 63.3%, and the value of the skin as part of the live weight was 20%. The overall dressing percentage in 5 caimans (*Caiman crocodilus*) reached 55,38±1,8%. The animals were of different sex, wild ones, with an approximate length of 139,40±16,32 cm and weight of 28,04±11,06 kg. The carcass parts, including neck, pectoral girdle, chest, pelvic limbs and tail accounted for 69.05% of the carcass weight, and the authors noted that it was the tail that yielded the largest amount of pure meat due to the high meat-to-bone ratio of 6.43 (8). In another study by Cossu et al. (12) the data were similar, and the authors reported dressing percentage values of 54.00% in 10 caimans (*Caiman latirostrisis* and *Caiman yacare*). The animals were of different length and weight. The obtained meat equaled 62% of the carcass. The tail made up 27.4% of the carcass weight, of which 21.9% was pure meat and 5.5% was bone.

For the *Alligator mississippiensis* species with a length of 1400 mm, dressing percentage of 63,3% was reported. In the same study the tail, limbs and carcass comprised 21.1, 8.3 and 27.2%, respectively, of the alligator live weight, while the skin accounted for as little as 15% (13).

In male *Caiman yacare* specimens with live weight of 19.4 kg, Romanelli and de Felicio (14) established slaughter weight of 11.55 kg and yield of 59,5%. The same percentage with insignificant difference, for the same species, was reported by Medeiros et al. (15) as well – 59.70%. The data obtained from the different studies are given in **Table 1.**

Table 1. *Comparison of dressing percentage, tail and skin percentage of different crocodilian species.*

Species	Dressing %	Tail%	Skin %	Reference
C. niloticus	56.5%	33% carcass weight	20% of the live weight	*Hoffman et. al., (2000)*
C. yacare	59,5%	90.25% (meat from the tail)	17.57% of the live weight	*Romanelli and de Felicio (1999)*
Alligator mississippiensis	63,3%	21,1% of the live weight	15% of the live weight	*Moody, et. al., (1981)*
C. latirostrisis* and *C. yacare	54,00%	27,4% carcass weight 21,9% (meat from the tail)	nd*	*Cossu et al., (2007)*
Caiman crocodilus	55,38±1,8%	28.32 ± 4.50% carcass weight	nd*	*Dolly and Tardieu, (2023)*
Caiman yacare	59,7%	19% carcass weight (Tail fillet)	20,2% of the live weight	*Medeiros et al., (2021)*

*nd=no data

Meat quality

Chemical composition

Crocodile meat from *Crocodilus niloticus* has water content of 67.2% in the dorsal part of the tail to 75.9% in the shoulder muscles according to Cernikova et al. (10). In the area where the water content is the lowest (below 70%), the authors reported the highest percentage of fat (above 10%). The amount of water in meat greatly affects its colour, texture and taste. In addition, there is an inverse relationship between the fat and water content of meat. The higher the moisture percentage, the lower the fat content and vice versa (16). In the same crocodile species, Hoffman et. al. (11) found 71.64% and, as in the above-mentioned study, the highest values of fat were reported in the tail, although its muscles were not analysed in separate areas, but as a whole. Huang et al. (17) made a physico-chemical analysis of caiman meat (*Caiman crocodilus*) also obtained from different parts of the carcass (anterior and posterior ventral muscles, anterior and posterior dorsal muscles, pelvic and thoracic limbs,

anterior and posterior part of the tail). The moisture content was 77 - 78%. The highest values were recorded in the forelimb and hindlimb regions, 77.7% and 78.2%, respectively, and the lowest at 76.9% in the rear of the tail. The results of studies by other authors also resemble the aforementioned (18, 19, 20). Water is considered to constitute about 75% of meat weight and has a strong influence on colour, texture and the surface look (21).

The approximate composition of *C. niloticus* meat showed protein levels of 15,7-22,08% (10, 11). In the other species *C. pororsus, C. yacare, A. mississippiensis* and *C. latirostrisis* the average protein amount was 20-21%. It should be noted that in some of the studies the meat was obtained from different parts of the carcass (ventral and dorsal part of the tail, shoulders, neck, cheeks, fore and hind limbs, etc.) and different values of these indicators have been reported, accordingly. Although they vary according to the species, sex, weight of animals and different parts of the muscles, it can be claimed that crocodile meat is a protein-rich food and is relatively equal to that of chicken, pork and lamb and beef, as can be seen from **Table 2** as well.

Table 2. *Data about the nutritive value of meat from different reptile species compared to those from lamb, beef, chicken and salmon*

Species	Moisture %	Protein %	Fat %	References
Nile crocodile (*Crocodylus niloticus*)	71.64	22.08	6.23	*Hoffman et al., 2000 (11)*
Nile crocodile (*Crocodylus niloticus*)	67.2 - 75.9	18.5 - 15.7	6.12 - 0.83	*Cernikova et al., 2015 (10)*
Saltwater crocodile (*Crocodylus porosus*)	75.50	21.40	2.10	*Mitchell et al. 1995 (18)*
Caiman latirostrisis	77.15	20.54	0.80	*Simoncicni et al.,2020 (19)*
Yacare (*Caiman crocodilus yacare*)	75.2-77.1	19.4-24.4	0.29-4.2	*Domiguez et al., 2019 (5)*
American alligator (*Alligator mississippiensis)*	74.6 – 74.8	18.9 – 21.2	4.95 – 3.11	*Leak et al., 2003 (20)*
Mature ewes and lambs	72.69 – 75.11	18.76 – 20.73	5.46-3.69	*Junkuszew et al., 2020 (39)*
Beef, calf, loin, steak cuts, raw	72 - 74.8	20 - 21	4.5 - 7.3	*Ahmad et al., 2018 (16)*
Chicken	67.3	24.2	8.5	*Ahmad et al., 2018 (16)*
Salmon	65.4	19.9	13.6	*Uys, N., 2019*

Proteins in meat are divided based on their content of important amino acids as their building blocks. Although there are a total of one hundred and ninety known amino acids, only twenty are required for protein synthesis. Among these twenty, eight amino acids are considered essential because they cannot be naturally produced by the human body and, therefore, their intake has to be ensured through diet (22). From the available data on studies conducted on meat from different crocodile species, it can be concluded that most of the amino acids present in traditional meats are abundant. For example, Cernikova et al. (10) reported a 15.4–18.9% average value of total amino acid content in individual carcass parts of a Nile crocodile. As the most common, the authors indicate asparagine and glutamine acids, followed by lysine and leucine. In caiman meat, the predominant AAs were taurine, glycine, alanine and histidine. Among them, taurine accounted for 52.0–66.5% (98.3–181.8 mg/100 g) of the total AA content (17). The fat content of the data presented varies widely, from 6.23% in the tail of *Crocodylus niloticus* (11) to the lowest value found, less than 1% in the meat of *C. latirostrisis*. For the results concerning *C. niloticus*, it should be mentioned that the most fat has been reported in the tail region, which corresponds to the lower moisture levels in this region. Alligator meat has an average of 4% fat. In *Caiman crocodilus*

yacare, a wide range has also been found in terms of fat from 0.29% to 4.2%, which is explained by analyzing the different parts of the carcass, which, accordingly, have a different ratio of indicators.

Fatty acid composition

Determining the fatty acid composition of meat relates to the statement that fatty acids have a positive or negative effect on the prevention and treatment of a number of diseases. This is confirmed by the fact that SFAs increase the risk of developing multiple sclerosis (MS) and accelerate the progression of the disease, while PUFAs have a beneficial effect on MS patients. And since different foods can be sources of fatty acids, determining their specific fatty acid composition is important in order to determine their effect on the consumer health. This is especially true for foods rich in fatty acids (23). In this regard, it should be noted that crocodile meat contains high levels of monounsaturated fatty acids (MUFA) - between 33.2% and 51.3% and saturated fatty acids (SFA) - between 26.0% and 41.4%. The content of polyunsaturated fatty acids (PUFA) varies widely. For example, in *Alligator mississippiensis* and *Caiman crocodilus yacare* it is within 17,6-19,6%, while in *Crocodylus niloticus* meat PUFA are within the range of 10,7-38,1% (5). In *Caiman crocodilus* meat, according to Huang et al. (15), palmitic (20-24%), oleic (17-25%) and linoleic (16-18%) acids have the greatest amount. Between 8-11% is the established amount of stearic acid, while arachidonic acid is 4-8%. The *C. niloticus* tail meat has the greatest amount of oleic (43,1%) and palmitic (24,5%) acids. Stearic (9,9%) and linoleic (9,1%) acids are found in considerable amounts (11). The data reveal that the meat of the *C. porosus* and *C. johnstoni* species is rich in oleic (33,1%), palmitic (22,5%) and linoleic (15,2%) acids (24). Regarding the fatty acid composition of *C. latirostrisis* meat, Simoncini et al. (19) also found that the dominant fatty acids were oleic (29.95%), linoleic (28.13%) and palmitic (20.68%). The authors emphasized that the meat of that species had high levels of unsaturated fatty acids, the *n6*/*n3* ratio (omega6/omega3) reaching about 20%, while PUFA/MUFA=1.5%.

Colour, tenderness and toughness of meat

In several studies, researchers have reported that the meat of various crocodile species is white or pale pink in colour. For *C. latirostrisis*, the data reveal that it is pale pink, opalescent (19). According to the results of Cernicova et al. (10), different muscle types have different colour. Thus, they found that meat was the lightest in the area of the dorsal tail, while it was the reddest in the area of the pectoral limbs in *C. niloticus*. Moody et al. (13) also reported similar results where the tail meat of *Alligator mississippiensis* was white to pale pink and that obtained from the limbs was darker due to the lower fat content at the expense of connective tissue and tendons.

For consumers, meat tenderness is a key factor in their selection. Tenderness is defined as the ease of cutting or chewing the meat, while texture refers more to meatiness, the presence of fat and the fine structure before or after chewing. Consumers have different perceptions of tenderness, which makes this meat indicator subjective. At the same time, cooking methods and temperature greatly affect it (25). In this regard, a sensory analysis of meat obtained from the tail of *C. niloticus* was made according to PN-ISO-6658:1998. Based on the results from the sensory analysis, it was noted that the meat was very delicate, with low cohesiveness, high elasticity and easy chewing. In addition, the expert jury evaluated it as very juicy, without the presence of connective tissue with an intense taste and almost imperceptible aroma (26). The results of Cernicova et al. (10) showed that in terms of toughness, the meat from the dorsal and ventral tail and the pelvic limbs of *C. niloticus* was the same. The lowest toughness value was reported for the neck area, and the highest one for the cheeks. For caiman meat, there are data that the parameters tenderness and luminosity were similar to those of traditional meats (19).

FOOD SAFETY OF CROCODILE MEAT

The European Food Safety Agency (EFSA) has published a statement by the Panel on Biological Hazards on the risks to humans associated with the consumption of reptile meat. This document states that public health concerns arise from the methods and locations of farming, feeding, veterinary care, slaughtering methods, processing and retailing practices of meat (3). In this regard, it is worth mentioning that the North Australian crocodile abattoirs have a HACCP system in place to control bacterial contamination including on the contact surfaces of walls, tables, equipment, clothing, etc. In South Africa, crocodile meat is processed and the same standards and requirements apply as for the production of red

meat. In the US, *Alligator mississippiensis* is slaughtered and processed in the same way as fish, because alligators are ectothermic and thus the risk of bacterial contamination is reduced. Processing facilities must also comply with standard health regulations for food intended for human consumption, notwithstanding that meat products are not subject to inspection before packaging. *C. niloticus* meat imported from Zimbabwe must meet established microbiological criteria (*total bacterial count <1 x 10^5 cfu/g; total coliform count <1 x 10^3 cfu/g; E. coli count <10 cfu/g; Salmonella zero*). In addition, all farms in Zimbabwe are subject to controls for *Trichinella*. Cockatoos and all unhatched crocodiles intended for import into South Africa are also examined. Health requirements for Australian slaughterhouses exporting meat are much stricter. In this regard, only *Australian Quarantine Inspection Service* (AQIS) approved facilities are allowed to export meat (27). Since crocodiles are mainly farmed for their skins and the meat is more of a by-product, the main danger stems from the fact that the processing of the carcasses aims to preserve the quality and integrity of the skin. The skin does not come off easily, carcasses are skinned slowly and carefully on a flat surface, which implies a high risk of contaminating the meat (28).

In their natural environment, crocodiles have high resistance to bacterial infections. This is probably related to the antibacterial properties of tissues and serum described in various studies (29). Regarding the safety of meat as a product for human consumption, some risks must be considered. *Salmonella spp.* are normal intestinal inhabitants in most crocodiles (29). The percentage of intestinal carriage of *Salmonella spp.* ranges between 16–27%, and serotypes identified include *S. enterica subspecies enterica, salamae, arizonae* and *diarizonae* (30). In this respect, it is not surprising that a number of reports have communicated the isolation of Salmonella species from crocodile meat in an attempt to focus the attention of traders and consumers on this risk (29). On a farm in Australia, *Salmonella* was found in 16% of fresh crocodile carcasses, and in Zimbabwe in 20-33% of them. The serotype distribution shows a wide diversity of serovars in *S. enterica subsp. enterica, salamae* and *diarizonae*. Although most of them are not associated with human disease, it is worth noting that 40% or more of the isolates belong to *subsp. enterica*, which includes members potentially pathogenic to humans, e.g. *Salmonella Typhimurium* and *Salmonella Enteritidis*. (30).

In connection with the growing trend of increased consumption of reptile meat, it should be noted that they can also be a source of trichinellosis in humans (31). In 1995, *Trichinella* was first detected in farmed Nile crocodiles (*C. niloticus*) in Zimbabwe. A total of 256 out of 648 (39.1%) infested crocodiles were reported with muscle larvae. During this period, 29 farms in Zimbabwe were tested and 18 of them proved positive for *Trichinella*. The source of the disease was considered to be the meat from the slaughtered crocodiles, which was returned as food for the rest of the farm (30). Despite a *Trichinella* monitoring and control program in place, in 2002, in 11 (40.7%) of 27 farms in Zimbabwe the disease was re-established (30). Studies on the etiological agent revealed a new nonencapsulated species, *T. zimbabwensis*, which is invasive to both poikilothermic vertebrate species and mammals, including primates (30). Since crocodile meat is available for human consumption, the presence of Trichinella in this species represents a new potential zoonotic problem. However, there is no information on the epidemiology of this outbreak and it is not known whether the crocodile is an important host (32).

The European Union has established specific rules for the official control of *Trichinella* in meat. According to Annex III of Regulation (EC) No. 2075/2053, meat from reptiles is subject to inspection for the presence of *Trichinella*. Samples of 10 g of muscle tissue are taken from the predilection sites (masseter, pterygoid and intercostal muscles) (3).

According to reports, *Staphylococcus epidermidis Staphylococcus epidermidis* was found as a component of the intestinal microflora in a wild Nile crocodile. Additionally, in the *Caiman latirostris*, *Staphylococcus spp*. were present in 14.4% of all bacterial isolates found in the oral cavity and cloacae. *Staphylococcus spp.* have also been isolated in farmed crocodile meat, probably as a result of the contamination that occurs during slaughter and dressing procedures (33).

Mycobacterial infections are known to affect reptiles across all species. The most common mycobacteria found in reptiles are from the *Mycobacterium avium* complex, including species, such as *M. marinum, M. chelonae, M. fortuitum, M. smegmatis, M. haemophilum,* and *M. phlei*. Crocodiles raised on farms can become infected if they consume carcasses contaminated with these mycobacteria, leading to the development of either widespread or localized granulomatous lesions. Reptiles are unlikely to be infected by *M. bovis* and *M. tuberculosis* due to the specific temperature requirements needed for the growth of these bacteria. There have been no reported cases of humans contracting mycobacterial infections from consuming reptile meat (3).

Anisakid larvae can be discovered in various parts of fishes such as the gastrointestinal tract, pleuro-peritoneal cavity, liver, gonads, or muscles. These larvae are capable of infecting either their final hosts, like birds or mammals, or other fish-eating animals such as larger fishes, sea turtles, or crocodiles, which serve as potential hosts. There have been documented cases of *Contracaecum larvae* in crocodiles, suggesting that consuming raw or lightly cooked infected crocodile meat could lead to anisakiasis. The risk to humans is likely lower when crocodiles are raised in farms and are fed artificial food or frozen fishes that have been stored at temperatures below -20°C for over 24 hours (3).

To our knowledge, there is no evidence in the scientific literature of the presence of residues of veterinary drugs in the tissues of reptiles whose meat is intended for human consumption.

Certain animal products, such as milk and eggs have long been recognized as strong food allergens, and meat allergy used to be rare. However, since the last 20 years or so, cases of proven allergy to meat from mammals and birds have become more common. IgE-mediated reactions to many different types of meat have been reported. The list includes beef, pork, lamb and poultry, but also kangaroo, whale, seal and crocodile (34). The first case of an allergic reaction to crocodile meat was described by Ballardini et al. (35). It concerns a 13-year-old male patient with severe IgE-mediated chicken meat allergy. When he latter tasted crocodile meat, he had an anaphylactic reaction. The main cross-reactive allergen was identified by molecular analysis as a specific type of α-parvalbumin found in crocodile meat. It showed significant sequence similarity to α-parvalbumin found in chicken meat. The authors caution that crocodile meat can be a potent food allergen and patients with chicken meat allergy should be advised not to consume meat from crocodile species.

BENEFITS

Crocodile products have been used in traditional Chinese medicine since the Ming Dynasty in the 16th century. For example, crocodile bile or dried crocodile meat have been administered as part of the treatment for many ailments. The consumption of crocodile meat in China is associated with beliefs that it strengthens the body, promotes longevity, relieves asthma and helps with a host of other ailments. The authors of a number of studies point out that the reason for the therapeutic effect of crocodile products is the specific intestinal microbiome of these reptiles (36).

Crocodile oil has been used for centuries by traditional healers and has proven effect in the treatment of skin diseases and even cancer (37). It is identical in composition to that of human skin. The differences are only in the percentage ratio between the individual components. For this reason, it can very rarely cause an allergic reaction and can be defined as a harmless product with strong anti-aging, antifungal and antibacterial properties. Crocodile oil contains saturated and unsaturated fatty acids. The benefits of applying crocodile oil include fading of freckles, treating acne scars and pimples, dark lines and wrinkles. It is also used as a therapy for dark shadows, sun spots and other discolorations. It makes the skin softer, brighter, more attractive and hydrated (38).

In Mexico, crocodile oil is used to treat asthma, pulmonary emphysema, flu, and persistent productive cough. In Madagascar, the oil is prescribed to assist the treatment of burns, skin ulcers and cancer. In Africa, crocodile oil is used to treat skin rash and for the healing of wounds (37).

Research onto the properties of crocodile blood began with the observation that crocodiles living in bacteria-rich environments rarely developed fatal infections. A number of research teams have reported antimicrobial, antiviral, anti-inflammatory, antioxidant, antitumor effects of crocodile blood (39).

In addition, the anti-amoebic properties of *C. palustris* serum can be mentioned, as well as an antibacterial compound in the blood known as crocosin, with activity against *Salmonella typhi* and *Staphylococcus aureus* (36).

CONCLUSION

Crocodile meat belongs to the category of exotic meats. However, it is a vital source of protein for a great part of the human population, especially those without the ability and means to raise animals for meat production. Although for Europe, being the richest continent, crocodile meat is not that popular, it is a sought-after and expensive product in Asia and some parts of North America. The crocodile farm business in Europe is still in a seed stage. Moreover, meat as a crocodile product is mostly neglected. These reptiles are farmed mainly for their skin, because it has a higher value, and the products from it are some of the most expensive. Carcass processing is focused on preserving the integrity of the skin rather than protecting the meat from contamination. These poor farming practices and practices for preparation of crocodile products pose high health risk to the consumer. However, crocodile meat trade has a serious economic potential that could support other industries and present new opportunities in certain regions.

One of the principal issues is the limited scientific research focused on the composition, nutritional value, benefits and risks of crocodile meat consumption. The available studies have been made on various species (crocodiles, caimans, alligators) farmed in different ways and under different conditions. The performed analyses either deal with different parts of the carcass or are focused only on a specific area. This is the reason why it is very hard to make a comparison between them, because different factors are involved in each study.

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