Carcass and meat characterization of “yacare overo” (*Caiman latirostris*) and “yacare negro” *(Caiman yacare)*

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Recebido para publicação: 13/01/2004
Aprovado para publicação: 23/08/2007

Abstract

Ten caimans (*Caiman latirostris* and *Caiman yacare)* of different length and live weight were slaughtered to assess carcass yield and meat quality traits. Carcass yield was 54% while meat portion was the 62%. The carcass meat/bone ratio was approximately 1,51 while the 6,4% corresponded to the fat depots, mostly visceral depots. The tail cut represented the 27,4% of the carcass weight and it was composed 21,9% by meat and the 5,5% of bone. The meat tail pH *postsmortem* value (6,88 ±0,22) fell up to 6,49 (±0,23), 24 hs after slaughtering and 5,85 (±0,12) after thawing. Cooking losses were low (<0,3%) and the Warner Bratzler shear force had values lower than 3kg. The raw tail color analyses characterized the meat as luminous (L*= 67,7) and pale (C*= 5,5). While the fat content changed significantly depending on the live weight (2,5-29,8%DM), the protein content was relatively constant and around the 65% of dry matter. From the total intramuscular fatty acid content of tail meat, the 41,4 % were satured, the 39,1% were monounsatured and the 10,7% were polyunsatured, with a n-6/n-3 ratio near the optimum (3,16 *vs* 4). The oleic acid was the most important FA followed by the palmitic, stearic and linoleic acids. Among the unsatured FA, the levels of essential FA as araquidonic (4,34) and n-3 derived family were important (EPA= 0,76 and DHA= 0,57). Another positive nutritional characteristic was the high level of CLA (1,87%FAtot).

Key words:
Caiman. Captivity.
Carcass quality.
Meat quality.

Introduction

The main objective of caiman breeding is to obtain skins to industrialize as high-quality fashion leatherworks. However, the production of caiman meat for human consumption could be an interesting alternative to increase the farmer’s income from this activity. At the present time, natives from the north of Argentine consume caiman meat regularly.

Despite that numerous published works show a worldwide interest in classifying meat from different animal species [1,2,3,4,5,6,7,8], there is no national data about carcass and meat qualitative characteristics of caiman (*Caiman latirostris* and *Caiman yacare*).

Meat pH has a direct relationship with the water holding capacity, which is assumed as an essential qualitative parameter from an economical, technological and sensorial point of view.[9] During consumption, the perception of meat tenderness altogether with juiciness determine the customer satisfaction with the product and the repetition of the purchase. As there is no possibility of assessing the tenderness in advance, purchase is supported on colour characteristics, price, presentation and some previous knowledge of the product.

From a nutritional point of view, there are several epidemiological studies that prove the positive relationship of dietary saturated fatty acids and low density lipoprotein cholesterol (LDL-cholesterol) with the incidence of coronary diseases. However, monounsaturated fatty acids and some polyunsaturated, particularly n-3 ones have a positive effect on human health because their preventive activity on cardiovascular diseases and certain cancers.[10] The importance of polyunsaturated n-6 and n-3 derived family (proper neural development, modulation of eicosanoids synthesis, decreasing the risk of atherosclerosis, thrombosis, stroke, certain cancers, immune disorders, triglycerides and blood high density lipoprotein cholesterol, HDL-cholesterol) is known since the '50s; and the recommended level of n-6/n-3 ratio is near 4:1.[11]

Foods that contain animal fat as dairy products, meat products and sea fish are rich sources of conjugated linoleic acids (CLA).[12,13] The CLA are a mixture of positional and geometric linoleic acid isomers, of which the C18:2 (9, 11) and C18:2 (10, 12) are predominant.[14,15] Several researches have reported that CLA have different benefical effects including anticancerous properties [14,15,16,17,18,19], prevention of atherosclerosis, stimulation of immune responses against atherosclerosis [20], increase in the activity of growth promotors [12] and reduction of body fat [21]. The mechanism of modulation of carcinogenesis by CLA is not yet understood, but may be related to its antioxidative properties.

From a commercial point of view, caimans have to be slaughtered when they reach approximately 1 to 1,3 m long and near 4 kg live weight; length is related to the skin size demanded by the industry. In these animals, ventral wide skin is 1/3 of the length, i.e., more than 30 cm. It is important to take into account that growth is relatively fast until 1 m length, being reduced afterwards and accompanied by a significant increase of food intake.

At the present time, caimans in Province of Santa Fe (east of Argentina) are slaughtered at 2 kg of live weight. Three of these animals of 80 cm length (which yields skins of 26-28 cm wide) are required to make a pair of shoes (PRADO,W. Proyecto de conservacion y uso sustentable de yacares en la Provincia de Chaco, Refugio de Vida Silvestre "El Cachapé". Comunicación personal. 2002).

This study aims to characterize some chemical and physical properties of caiman fresh meat to contribute to the integral utilization of caiman.

Material and Method

Production in Captivity: Breed and Nutrition

"Fundación Vida Silvestre Argentina" and "Cachapé" ranch (located at Province Chaco in the north of Argentine) started a joint venture project in 1996 to develop a sustainable production model aiming to the whole utilization of "yacaré overo" (*Caiman latirostris)* and "yacaré negro" (*Caiman yacaré).* This model was based in the caiman eggs collection from nature ("ranching")[22].

Caimans were breed under controlled temperature conditions in 3 x 4 m concrete pools with 10 cm of isolation poliuretyne foam on the floor, walls and the cover. Fifty percent of the pool area had 10 cm deep water and the other extreme fifty percent was dry. Water was changed every two days; no detersives no disinfectants products were used to clean. Solar panels associated to radiant crockery were used as a heating system; a wood steam boiler was used as an auxiliary system. Hibernation was prevented by keeping the temperature stable during all year around. This allows slaughtering animals for meat commercialization at any time of the year without influencing in the body composition because of the utilization of fat reserves.[22]

Breed average density was 10 animals/m^2 during the first life stages. For animals with more than 60 cm of total length, density decreases up to 6 animals/m^2.[22, 23]

During March 1998 animals were fed every other day a mixed diet containing treated bovine meat, viscera and vitamin supplement (70 g of commercial vitamin supplement each 5 kg of mixture). In July 1999 this mixture was changed for an intermediate diet of 5 kg of treated bovine meat (21% lipids) supplementated with bovine liver (10 g/kg of meat) and vitaminic-mineral complex (20 g/kg of meat); this complex contained calcium carbonate (7g/kg of meat), organic calcium (20 g/kg of meat) and vitamin E (60 UI/kg of meat). During the last stage of breed (March to November 2001), animals were fed with a finishing diet composed for 2/3 parts of meat and bone meal and 1/3 parts of treated meat. Commercial vitaminic-mineral complex wax added as 100g every 5 kg of mixture.

Slaughtering and Analitical Determinations

For physico-chemical determinations, 10 male caimans between 32 and 44 month of age were used. Animals were slaughtered in slaughter house inside the ranch by a cut in the neck after insensibilizing the nerves connected with the spinal cord by introducing a wire. The head and extremities were removed after bleeding and dressing the carcass. The slaughtering was carried out under strict sanitary conditions. Meat pH was determined at 4, 12 and 24 hs *post mortem*. Carcasses were weighed and frozen (-24 Celsius degree) for 25 days.

Frozen caiman carcasses were thawed at 4 Celsius degree during 24h, tail samples were collected and then derived for commercial dissection.

Three pH (peacameter Orion mod. 230A with a special electrode for meat) and colour (Colorimeter Minolta CR 300, CIE L*a*b*) determinations were made on tails. Cooking losses were determined on 2,5 cm wide tail portions; the samples were weighted, pocketed, cooked at 70°C for 50 minutes in a thermostatic water bath, and later water cooled during 40 minutes before re weighting for loss determinations. Warner Bratzler hardness was measured on 2 cooked samples (1 cm^2 diameter) using the INSTRON (4442 model) instrument.

Meat removed from the skeleton was homogenized in a Waring blender and analyzed by the methods of the A.O.A.C[24] for moisture, fat, protein (N x 6,25) and ash. Methyl esters of fatty acids were obtained by the method of Folch, Lees and Stanley[25] and prepared by 0.5M KOH/methanol and HCl/methanol water solution reactions. Esters were separated on a Shimadzu GC-14B gas chromatograph equipped with a flame ionization detector and a fused silica capillary column (Ulbon HR-SS-10 (0,32 I.D.x 50 mL); Helium was used as a carrier gas. Working conditions were: initial temperature=170°C, final temperature= 220°C, injector and detector temperatures= 250°C. Esters were identified by comparison of their retention times with those of known standards (Sigma Chemical Co.).

Results and Discussion

Carcass Characterization

Slaughter weight, carcass yield and percentage of commercial cuts are presented in table 1. Caimans were slaughtered at 1,65 kg (± 0,341 kg) with 80,5 cm length and had a carcass yield of 54 %. These data is in agreement with other animal species, particularly, with the 56.5 % carcass yield of *Crocodylus niloticus* (crocodile) at 140 cm length.[4] The carcass meat/bone ratio was 1,51 while fat depots reached near 6,4%, mainly located in the visceral region.

The carcass meat/bone ratio was lower than that reported by Hoffman, Fisher and Sales[4] for the crocodile (2,3:1) and those of other warm-blooded animal species (rabbit 5:1; broiler 4,80:1; lamb 3,34:1)[3,5,7] this may be because of the high incidence of bone tissue in early age since these caiman slaughtering weights corresponded to the 13% of the weight at mature sexual age.

From the commercial dissection resulted that the ribs and the tail are the most significant portions, adding 61,6% of the carcass; the richest portion in meat content was the tail with the 21,9% (175 ± 47 g) of total carcass meat (495 ± 123 g), followed by the ribs with the 18,9% (155 ± 70 g) and the legs with the l 9,9% (76 ± 18 g). These data were similar to those reported by Hoffman, Fisher and Sales[4] who detailed that crocodile tail is sold as transversal slices

Table 1 - Fresh weight, carcass yield and cutting up of slaughter caiman carcass

Parameters	Means and standard devaitions
Fresh weight(1) (g)	897,3 ± 204
Hot carcass yield (%)	54,1 ± 2,1
Thaw weight(2) (g)	796 ±167
Carcass muscle (% thaw weight)	62,0 ±3,9
Carcass bone (% thaw weight)	28,1 ± 2,8
Cuts (% thaw weight)	
- Nape	10,3
- Shoulder blade	5,8
- Ribs	34,2
- Leg	12,6
- Tail	27,4

(1) Carcass weight without skin, viscera and head. (2) Thaw carcass weight after 25 days of freezing

(10-15 mm thick) to high-price restaurants while the rest of the carcass is boned and the meat is commercialized as low price *paté*, or it is reutilized in the same farm.

pH and Physical Characteristics

Samples of caiman tails had pH final values (Table 2) near neutrality in the first hours after slaughtering following by a slow fall of pH values up to 24 h after slaughtering (6,5), and reached normal values (5,3-5,9) after thawing. These pH values agree with those reported for the crocodile, which data ranged, from 7,26 to 6,67 and 6,28 at 4, 24 and 48hs *postmortem*.[4] Because pH value continued falling, the time required to rise the minimum could not be established.

Table 2 - Some qualitative traits of caiman tail meat.

Tail muscles	Means and standard deviations
- pH 4 hs post-slaughtering	6,88 ± 0,22
- pH 12 hs post-slaughtering	6,64 ± 0,28
- pH 24 hs post-slaughtering	6,49 ± 0,23
- pH in thaw meat	5,84 ± 0,12
-Color(1) L*	67,74 ± 3,38
a*	4,68 ± 0,93
b*	0,46 ± 0,97
C*	5,49 ± 1,01
- Cooking losses (%)	0,26 ± 0,02
- WB shear force(kgf)	2,46 ± 0,29

(1) L*= Luminosity (white= 100, black= 0); a*= red index (red= positive; green= negative); b*= yellow index (yellow= positive; blue= negative); C*=Saturation, (C*=0, grey).

Cooking loss under standard conditions (< to 0,3%) were lower than reported by Hoffman, Fisher and Sales[4] for crocodile tail. Although the standard conditions were similar, in those analysis the authors used the whole tail while in the present work, only 2,5 cm depth portions were used. Similar values were observed in rabbits (0,33-0,35)[1].

Color analysis qualified the raw meat as luminous (L*= 68), pale (low value of saturation parameter; C*= 5,5) and lightly pink (a*= 4,7). Luminous (L*) values resulted higher than those of other animal species while the rest of the chromatic parameters were similar to those obtained in rabbits (C* 5,4-6,3)[1] but different from those reported for broilers specially for the yellow index (a*= 1,8; b*=7,19; C*= 8,15)[2].

With respect to the WB values, the meat from the caiman´s tail could be considered as a 'tender meat' with instrumental values lower than 3 kg (1 cm diameter test sample), slightly higher than those of rabbits (2,0-2,5 kg)[1] and lower than the broiler values (3,5-4 kg)[26]; comparatively, crocodile meat needed 4,35 kg but it was measured using 1,27 cm diameter test samples [4].

Chemical Composition and Nutritional Quality

The caiman tail meat (Table 3) had a protein concentration of 65,3 %dm, a relatively constant value, and a lipid content influenced by the animals´ live weight (Y (weight, g)= $-6x10^{-5}X^2+0,21X-158,2$; R^2= 0,49; X= % of fat) with a middle value of around 17 %dm while the ash content was 3,9 %dm. With the exception of fat and water content, the results were lower than those reported for crocodile tail meat[4] and alligator meat[6]; differences may be due to the different age of slaughtered animals and to feeding system in captivity versus natural environment.

There were seven fatty acids (FA) that accounted for over 90% of the total FA (Table 4). These were palmitic (C16:0) and stearic (C18:0) as satured FA, palmitoleic (C16:1) and oleic (C18:1n9) as monounsatured FA, linoleic (C18:2n6), araquidonic (C20:4n6) and linolenic (C18:3n3) as polyunsatured FA. The other FA were present at concentrations lower than 2,5%. The concentration of unsatured FA was higher than the satured fatty acids. Near 50% of unsatured fatty acids were monounsatured while the poliunsatured FA showed a n6/n3 ratio (3,16) near the optimun of 4 by the USA Health Department[11]. Within the polyunsatured FA group, the markedly high level of the essential FA (araquidonic= 4,34) and n-3 FA (EPA= 0,76 and DHA= 0,57) is a good reason to reccomend caiman meat consumption because these FA are difficult to obtain from other kind of foods. The fatty acid composition of caiman meat is similar to the fish meat (SFA: 29%; MUFA: 37%; PUFA: 34%; n-6/n-3: 3)[8,27]. According to Hoffman, Fisher and Sales[4] and Mitchell, Reed and Houlihan[28], also found in meat high levels of oleic, palmitic and linolei acids and high levels of PUFA, mainly araquidonic acid.[28] Data from caiman FA are consistent with the data of 'wild' animals. [29]

To these positive qualitative characteristics of the tail intramuscular fat, the high content of CLA (%FAtot) has to be added. It is higher than the CLA level

Table 3 - Proximate composition of caiman tail meat

Tail meat	Means and standard deviations
- Dry matter (dm; %)	26,0 ± 3,39
- Fat (%dm)	16,9 ± 9,8
- Protein (%dm)	65,3 ± 7,2
- Ash (%dm)	3,87 ± 0,42

Table 4 - Intramuscular fatty acid composition of caiman tail meat

Fatty acids	% Fatot
C12:0	0,08
C14:0	2,31
C14:1	0,30
C15:0	0,55
C15:1	0,37
C16:0	21,85
C16:1	2,72
C17:0	1,07
C17:1	0,82
C18:0	15,36
C18:1	34,92
C18:2	8,40
C18:3	3,32
C20:1	0,07
C20:2	0,17
C20:4	4,34
C24:0	0,14
C20:5 EPA	0,76
C22:6 DHA	0,57
CLA(1)	1,87
Satured(2)	41,36
Monounsatured(3)	39,21
Polyunsatured(4)	19,42
n-6/n-3	3,16

(1) CLA= Conjugated of linoleic acid;
(2) Satured FA=C12:0+C14:0+C15:0+C16:0+C17:0+C18:0+C20:0+C22:0;
(3) Monounsatured FA= C14:1+C15:1+C16:1+C17:1+C18:1;
(4) Polyunsatured FA= C18:2+C18:3+C20:2+C20:4+C20:5 (EPA)+C22:6 (DHA).

found in milk (0,98), bovine loin (0,65-1), lamb (1,20), pig (0,12), rabbit (0,11), poultry (0,15) and turkey (0,20).[13]

Conclusions

These findings have shown that caiman meat seems to be an important commercial subproduct with economical value as alternative meat. Because of the nutritive and healthy high quality properties, the caiman meat will be offered to 'premiun' markets as occurs with crocodile and alligator meat.

The physical analysis of young caiman tail meat, under good pre and post slaughter practices, characterized this meat as luminous, pale and lightly pink; tender and with reduced cooking water losses. From the nutritional point of view, this meat has the advantage of possessing a high UFA/SFA ratio, high level of CLA, essential fatty acids like linolenic and linolenic and the derived n-6 family (araquidonic acid) and n-3 family (EPA and DHA).

The qualitative characteristics observed in the tail caiman meat resulted favorable and often superior to other traditional consumption alternative meat. Further work needs to be done to evaluate the rest of qualitative and nutritional parameters as well as the other portions of caiman carcass.

Carcaça e qualidade da carne dez jacarés (*Caiman latirostris* ou jacaré — de-papo amarelo e *Caiman jacaré)*

Resumo

Dez jacarés (*Caiman latirostris* ou jacaré –de-papo amarelo e *Caiman jacaré)* de diferentes comprimentos e pesos vivos foram carneados com o fim de determinar valores de rendimento de carcaça e qualidade da carne. O rendimento de carcaça foi de 54% correspondendo um 62% a porção cárnea. A relação Carne/Osso da carcaça se estimou em aproximadamente 1,51 enquanto que 6,4% correspondeu a depósitos gordurosos, fundamentalmente periviscerais. O rabo representou 27,4% do peso de carcaça estando composta por 21,9% de carne e 5,5% de osso. O valor de pH post mortem, 6,88 ± 0,22 medido no rabo, decresceu até 6,49 ± 0,23 às 24h e 5,85 ± 0,12 logo de descongelamento. As perdas de cocção se contiveram (<0,3%) e a dureza Warner Bratzler mostrou valores inferiores a 3 kg. A análise da cor da carne crua permite caracterizá-la como una carne luminosa (L*=67,7) e clara (C*= 5,5). Enquanto que o conteúdo gorduroso variou significativamente em função do peso (2,5-29,8%MS), a porcentagem protéica foi relativamente constante e próxima a 65%MS. Do total de ácidos gorduroso do rabo, 41,4% foram saturados, 39,1% monoinsaturados e 10,7% poliinsaturados, com uma relação n-6/n-3 próxima a ótimo (3,16). O ácido gorduroso foi o predominante seguido pelos ácidos palmítico, esteárico y linoléico. Dentro dos insaturados, foi elevado o conteúdo de ácidos gordurosos essenciáis= araquidônico (4,34) e família n-3 (EPA=0,76 e DHA=0,57); a esta característica nutritiva positiva se soma o alto conteúdo em CLA (1,87%Agtot).

Palavras-chave:
Jacaré preto.
Jacaré oveiro.
Catividade.
Qualidade da carcaça.
Qualidade da carne.

References

1 BERNARDINI BATTAGLINI, M.; CASTELLINI, C.; LATTAIOLI, P. Rabbit carcass and meat quality effect of strain, rabbitry and age. **Italian Journal of Food Science,** v. 2, p. 157-166, 1994.

2 COSSU, M. E. et al. Utilización del grano entero de coriandro (*Coriandrum sativum L.*) en pollos parrilleros. Influencia sobre el sabor de la carne y composición de grasa intramuscular. **Revista Facultad de Agronomía. UBA,** v. 22, n. 1, p. 35-43, 2002.

3 FEHER, P. M.; SAUVANT, D.; DUMONT, B. L. Croissance et qualité des carcasses des chevreaux de boucherie. In: : JOURNÉES DE LA RECHERCHE OVINE ET CAPRINE^J2ÈMES CROISSANCE, ENGRAISSEMENT ET QUALITÉ DES CARCASSES, 1976, Paris. **Annales...**Paris: INRA-ITOVIC, 1976. 376 P.

4 HOFFMAN, L. C.; FISHER, P. P.; SALES, J. Carcass and meat characteristics of the Nile (Crocodylus niloticus). **Journal of the Science of Food and Agriculture**, v. 80, p. 390-396, 2000.

5 LATIF, S. et al. Influence of different genotypes on meat quality of chicken kept in intensive and extensive farming managements. **Acta Alimentaria**, v. 27, n. 1, p. 63-75, 1998.

6 MOODY, M. W.; COREIL, P.; RUTLEDGE, J. Alligator meat: an evaluation of a new seafood. In: ANIMAL TROPICAL AND SUBTROPICAL FISHERIES TECHNOLOGICAL CONFERENCE OF THE AMERICAS, 6., 1981, San Antonio, TX. **Proceedings**...1981. p. 158-160.

7 OUHAYOUN, J. La composition corporelle du lapin. Facteurs de variation. **INRA Production Animal**, v. 2, n. 3, p. 215-226, 1989.

8 POLI, B. M. et al. Caratteristiche chimiche e qualitá dei lipidi di pesci di diversa origine (tipo genetico, allevamento e cattura, acque normali o riscaldate). In CONVENIO INTERNAZIONALE: PARLIAMO DI ACQUACOLTURA. 1994, Italia. **Proceedings**... p.181-194.

9 SCHAEFER, A. et al. Critical post mortem pH and temeperature values in relation to drip loss in pork. In: INTERNATIONAL CONGRESS OF MEAT SCIENCE AND TECHNOLOGY, 2001, Polonia. **Proceedings**... v. 1, p. 206-207.

10 ULBRICH, T. V.; SOUTHAGE, D. A. T. Coronary heart disease: seven dietary factors. **Lancet**, v. 338, p. 985-992, 1991.

11 HOLMAN, R. Essential Fatty acids in health and disease. In: JORNADAS DE ACTUALIZACIÓN **LAS CARNES EN LA NUTRICIÓN Y SALUD HUMANA**, 1995, Buenos Aires, Argentina. **Anales...**Argentina: Academia Nacional de Medicina. 1995.

12 CHIN, S. F. Dietary sources of conjugated dienoic isomers of linoleic acid, a newly recognized class of anticarcinogens. **Journal of Food Composition Analisis,** v. 5, p. 185-197, 1992.

13 FRISTCHE, J.; STEINHART, H. Amounts of conjugated linoleic acid (CLA) in German foods and evaluation of daily intake. **Z Lebesm Unters Forsch A**, v. 206, p. 77-82, 1998.

14 HA, Y. L.; GRIMM, N. K.; PARIZA, M. W. Newly recognized anticarcinogenic fatty acids: identification and quantification in natural and processed cheeses. **Journal of Agriculture Food Chemistry**, v. 37, p. 75-81, 1989.

15 IP, C. et al. Mammary cancer prevention by conjugated dienoi derivates of linoleic acid. **Cancer Research**, v. 51, p. 6118-6124, 1991.

16 IP, C. et al. Conjugated linoleic acid suppresses mammary carcinogenesis and proliferative activity of the mammary gland in the rat. **Cancer Research,** v. 54, p. 1212-1215, 1994.

17 FISHER, S. M. et al. Differential Effects of Dietary Linoleic Acid on Mouse Skin-Tumor Promotion and Mammary Carcinogenesis. **Cancer Research**, v. 52, p.2049s-2054s, 1992.

18 SHULTZ, T. D. et al. Inhibitory effect of conjugated dienoi derivates of linoleic acid and B-carotene on the *in vitro* growth of human cancer cells. **Cancer Lett**, v. 63, p. 125-133, 1992.

19 BELURY, M. A. Conjugated dienoic linoleate: a polyunsaturated fatty acid with unique chemoprotective properties. **Nutritional Review,** v. 53, p. 83-89, 1995.

20 LEE, K. N.; KRITCHESVSKY, D.; PARIZA, M. W. Conjugated linoleic acid and atherosclerosis in rabbits. **Atherosclerosis,** v. 108, p. 19-25, 1994.

21 PARIZA, M. W. et al. Conjugated linoleic acid (CLA) reduces body fat. **FASEB Journal,** v. 10, p. 3227, 1996.

22 BOLÓ BOLAÑO, E. et al. Conservation and Sustainable Use of the Broad Snouted Caiman (Caiman latirostris) and Yacaré (Caiman yacare) in Argentina. First ranching experience in Chaco province. In: REUNION de TRABAJO del GRUPO de ESPECIALISTAS EN CROCODILOS, 15., 2000, Varadero, Cuba. **Proceedings**...

23 BOLÓ BOLAÑO, E.; PRADO, W.; MORENO, D. Conservación y uso sustentable de yacarés overo (*Caiman latirostris*) y negro (*Caiman yacare*) en la provincia del Chaco. In: REUNION de la ASOCIACION HERPETOLOGICA ARGENTINA, 14., 2000. **Proceedings**...

24 A.O.A.C. **Official methods of analysis**. 14th. ed. Washington, DC: Association of Official Analytical Chemists, 1984.

25 FOLCH, J.; LEES, M.; STANLEY, G. H. S. A simple method for the isoaltion and purification of lipids from animal tissues. **Journal of Biological Chemistry**, v. 226, p. 497-509, 1957.

26 LYON, B. G.; LYON, C. E. Shear value ranges by Instron Warner-Bratzler and single-blade Allo-Kramer devices that correspond to sensory tenderness. **Poultry Science,** v. 70, p. 188-191, 1991.

27 CAGNETA, P. et al. Caratteristiche corporee e resa in parte edule di spigola proveniente da due diverse tipologie di allevamento. In: CONVENIO INTERNACIONAL: PARLIAMO DI ACQUACULTURA, 1994, Fosano, Italia. **Proceedings**...p. 237-244.

28 MITCHELL, G. E.; REED, A. W.; HOULIHAN, D. B. Composition of cocodrile meat (*Crocodylus porosus* and *Crocodylus johnstons*). **Food Australian**, v. 47, p. 221-224, 1995.

29 NAUGHTON, J. M.; O'DEA, K.; SINCLAIR, A. J. Animal foods in traditional aboriginal diets: polyunsatured and low in fat. **Lipids,** v. 21, p. 684, 1986.