Rev Chil Nutr 2020; 47(4): 561-567.

http://dx.doi.org/10.4067/S0717-75182020000400561

Artículo Original / Original Article

Physicochemical characterization and microbiological analysis of *Oligosarcus robustus* raw fish meat and development a fish hamburger

Caracterización físico-química y análisis microbiológico de la carne cruda de pescado *Oligosarcus robustus* y desarrollo de una hamburguesa de pescado

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Este trabajo fue recibido el 25 de junio de 2019.
Aceptado con modificaciones: 29 de marzo de 2020.
Aceptado para ser publicado: 01 de abril de 2020.

ABSTRACT

This study aimed to evaluate the microbiological, physicochemical and fatty acid profile of the of "Tambica" (Oligosarcus robustus) raw fish meat and develop and characterize a fish burger. The fish burger was subjected to a sensory analysis. The raw fish meat showed a high content of moisture (82.3%) and minerals (3.1%), a low content of fat (1.5%) and a considerable protein content (13.1%). The raw fish showed a high count of positive coagulase Staphylococcus. Tambica lipid fraction was composed of 41.9% unsaturated and 58.2% saturated fatty acids. Palmitic acid and oleic acid were the major fatty acids in the raw meat fish. The fish burger was well accepted by sensory analysis.

Keywords: Burger; Fatty acids; Oligosarcus robustus; Microbiology; Sensory analysis; Staphylococcus.

RESUMEN

Este estudio tuvo como objetivo evaluar el perfil microbiológico, fisicoquímico y de ácidos grasos de la carne de pescado cruda "Tambica" (Oligosarcus robustus); y desarrollar y caracterizar una hamburguesa de pescado. La hamburguesa de pescado fue sometida a análisis sensorial. La carne de pescado cruda mostró un alto contenido de humedad (82,3%) y minerales (3,1%), bajo contenido de grasa (1,5%) y un contenido de proteína considerable (13,1%). El pescado crudo mostró un recuento alto de Staphylococcus coagulasa positivo. La fracción lipídica de Tambica estaba compuesta por un 41,9% de ácidos grasos insaturados y 58,2% de ácidos grasos saturados. El ácido palmítico y el ácido oleico fueron los principales ácidos grasos en el pescado de carne cruda. La hamburguesa de pescado fue bien aceptada por el análisis sensorial.

Palabras clave: Ácidos grasos; Análisis sensorial; Hamburguesa; Microbiología; Oligosarcus robustus; Staphylococcus.

INTRODUCTION

The population concern about eating healthy has increased, mainly in relation to protein consumption. Fish meat stands out among other foods with high protein content due to the presence of several essential amino acids. Moreover, fish is easily digestible due to its lower collagen fiber content and is an important source of unsaturated fatty acids that are known to reduce the incidence of neurological and cardiovascular diseases[1,2].

Understanding the physicochemical and microbiological composition of new species of fish is essential in order to standardize fish-based products, providing economic and technological support for the development of new products with market potential. It is common in the food industry to have different uses of different fish cuts in order to optimize use of raw material and reduce costs. Less noble cuts of this food matrix can be used to produce new product formulations with added value. This fact has stimulated development of new technologies aimed at the optimization of fish with low commercial value[3,4,5].

Oligosarcus robustus, known as Tambica, tambicu, dentudo or peixe-cachorro, belongs to the *Characidae* family.

It is a tropical climate fish found in the coastal waters of Rio Grande do Sul. *Oligosarcus robustus* is widely distributed in the coastal lagoon system and occupies a trophic level of predatory species in the food chain indicating that *Oligosarcus robustus* meat can be potentially suitable for human consumption[6]. In this context, this study aimed to evaluate the microbiological, physicochemical and fatty acid profile of *Oligosarcus robustus* species meat. In addition, a hamburger produced with this fish meat was developed and characterized in terms of physicochemical, microbiological and sensory analysis.

MATERIAL AND METHODS

Fish samples

Fifteen samples of *Oligosarcus robustus* were purchased from local fishermen in the southern region of Rio Grande do Sul. Samples were washed in drinking water, eviscerated and processed in fillets and fillet steaks. Samples were packed in sterile flexible polyethylene packages, frozen and kept at -18 °C until analysis. Fish samples were thawed under refrigeration temperature (≤ 7 °C) before analysis and 25.0 g of the fish meat were cut and homogenized with salt water (0.850% of NaCl) in Stomacker. Microbiological and physicochemical analysis was done in triplicate.

Hamburgers preparation

Oligosarcus robustus meat was used to prepare hamburgers. The following ingredients were used for hamburgers preparation: water (2%), garlic powder (0.3%), corn starch (3%), antioxidant ascorbic acid (0.15%), dehydrated onion (0.6%), dehydrated chives (0.3%), monosodium glutamate (0.1%), soybean oil (2.5%), fish meat (86.5%), pepper (0.1%), *textured soy protein (2.0%), sodium chloride (7%) and dehydrated parsley (0.3%). Fish meat was first ground using a blender, followed by manual homogenization (*using latex gloves) under low temperature with the addition of ice to prevent oxidation and microbial growth. Seasonings were added to flavor the burger. Textured soy protein was added to increase cohesion between ingredients. The mixture was allowed to rest for 20 min in the refrigerator, for binding and formation of the three-dimensional network of proteins. The hamburgers were molded in disposable Petri dishes, closed hermetically in sealed containers and stored in a freezer (at -18 °C). Physicochemical, microbiological and sensorial analysis of the final product was done in triplicate.

Physicochemical analysis

Determination of moisture and protein, lipid and ash content was performed according to AOAC.[7] Moisture was determined by placing 10 g of the sample at 105 ºC for the removal of humidity and volatile compounds until constant weight. Protein content, expressed as total nitrogen, was determined by the Kjeldahl method. Samples were first digested in concentrated sulfuric acid, after which they were distilled with sodium hydroxide (50.0%) releasing ammonium that was titrated with solution of HCl (0.1N) using phenolphthalein as indicator. Fatty acid content was determined using Soxhlet extraction. Results were expressed as % of lipids. For ash content determination, samples were held for 24 h at 105 ºC and then at 550-570 ºC until their color changed to grey. Total energetic value of *Oligosarcus robustus* was calculated using the following conversion factors: carbohydrates 4.00 kcal/g, proteins 4 kcal/g and lipids 9 kcal/g.

Fatty acid determination

After lipid extraction, 45 mg of the obtained oil was used, soon after the removal of the solvents. The samples were derivatized according to Hartman and Lago[8], which consists of weighing 30 mg of the lipids in a capped test tube, followed by the addition of 500 µL of 0.1 N KOH in methanol, the mixture being kept in bain-marie at 60 °C for 90 minutes. Subsequently, 1.5 mL of 1 $mol.L^{-1}$ H_2SO_4 is added, the sample being maintained again at 60 °C for 90 minutes. After cooling, 4 mL of HPLC grade n-hexane is added, the tubes are vigorously shaken and phase separation is expected. An aliquot of the n-hexane phase, which contains the fatty acid methyl esters, was collected into a vial, which was injected into a Perkin Elmer Clarus gas chromatograph equipped with a FID detector and Carbowax ID 20 M column of 0.25 µm and dimensions 30 mx 0.25 mm, coated with polyethylene glycol. The initial column temperature was 90 °C, maintained for 1 minute, linearly increased from 12 °C per minute to 160 °C, maintained for 3.50 minutes, followed by a linear increment of 12 °C per minute to the temperature of 190 ºC, then linear increase of 15 °C per minute until 230 °C, which was maintained for 15 minutes. The injector was maintained at 230 °C and the detector was maintained at 250 °C. Nitrogen was used as the entrainment gas at 1.50 $mL.min^{-1}$. Fatty acids were identified by comparison with the retention times of methyl esters containing caproic, caprylic, caproleic, caproleic, lauric, dodecenoic, myristic, myristoleic, palmitic, palmitoleic, margiric, heptadecenoic, stearic, oleic, linoleic, linolenic, arachidic, gadoleic, eicosadienoic, eicosatrienoic, tetraenoic, lignoceric and nerve (Sigma Chemicals Co., St. Louis, USA). The results were expressed as relative percentage of fatty acids.

Microbiological analysis

Microbiological analysis was performed according to the methodology of the American Public Health Association (APHA) with modifications[9]. For determination of thermotolerant coliforms, sulfite reducing *Clostridium*, positive coagulase *Staphylococcus* and *Pseudomonas* samples were aseptically weighted (25 g), mixed with peptonated water (225 mL, 0.100%) and diluted down to 10^{-3}. *Salmonella* was evaluated in the 25 g of samples mixed with 225 mL of peptonated buffered water.

Thermotolerant coliforms enumeration was done by the Most Probable Number (MPN) technique. The presumptive analysis of coliforms was carried out in Sodium Lauryl Sulphate Broth (SLS) after incubation at 35 ºC for 48 hours. The thermotolerant coliforms enumeration was performed in *Escherichia coli* broth (EC) after incubation at 45.5 ºC for 24 hours. The results were expressed in MPN g^{-1}.

Sulphite reducing *Clostridium* enumeration was done by transferring 1 mL of sample to Petry dishes (n= 2) containing tryptose-sulphite-cycloserine agar double layer (plus 1% of agar and 4% of D-cycloserine). The plates were inverted and conditioned in anaerobiosis at 46 ºC for 24/48 h. Colonies with characteristic black color were counted.

The analysis of positive-coagulase *staphylococci* was carried out by inoculation of serial dilutions, in Baird-Parker Agar supplemented with egg yolk emulsion and potassium tellurite. Plates were incubated at 37 °C for 48 h. Colonies were enumerated and at least five colonies that presented typical morphology and five that presented atypical morphology were incubated for 24 h in brain heart infusion (BHI) broth and submitted to free coagulase test. Results were expressed in $CFU.g^{-1}$.

Pseudomonas spp. enumeration was done by the surface seeding method in *Pseudomonas* Agar Base medium supplemented with CFC-CAT FD 0366. Plates were incubated for 48 h at 30 ºC. Results were expressed in $CFU.g^{-1}$.

Sensorial evaluation

This work was submitted and approved by the ethics committee in research with human beings of the Faculty of Medicine of the Federal University of Pelotas. The sensory panel was composed of 50 graduate students, professors and/or employees of the Federal University of Pelotas who agreed to participate in the evaluation signed a free and informed consent form previously approved by the ethics committee.

The hamburger obtained from *Oligosarcus robustus* meat was analyzed using two tests: acceptance and attitude. Acceptance and attitude were evaluated using 9-point hedonic scale and 7 point attitude scale, respectively.

Statistical analysis

Statistical analysis of the phytochemical composition and microbiological was performed by Student's t-test ($p < 0.05$) and the Pearson correlation analysis was performed for sensorial attributes and purchase intention in the Statistica 7.0 program (Statsoft, USA).

RESULTS

Physicochemical analysis

Physicochemical parameters of the *Oligosarcus robustus* fish and hamburger are presented in the table 1. The total caloric value of *Oligosarcus robustus* fish and hamburger were 32.8 kcal/100 g and the 77 kcal/100 g, respectively.

Fatty acid profile

Fatty acids, present in fish meat and other foods, are important for human nutrition, especially the unsaturated ones. According to table 2, *Oligosarcus robustus* contained the following essential fatty acids: linoleic (C18:2), linolenic (C18:3), eicosapentaenoic (EPA; C20:5) and docosahexaenoic (DHA; C22:6).

Table 1. Physicochemical composition of *Oligosarcus robustus* meat and *Oligosarcus robustus* hamburger.

Assay	*Oligosarcus robustus*	Hamburger
Moisture	82.3%a	78.6% b
Protein	13.1%a	14.9%b
Lipids	1.5%a	2.9%b
Ash	3.1%a	3.6%a

Means followed by different letters in the same line are significantly different by the t-test ($p<0.05$).

Table 2. Fatty acid profile of *Oligosarcus robustus*.

Fatty acids	*Oligosarcus robustus* (%)
C6	1.0
C8	0.0
C10	0.0
C12	0.1
C12:1	0.1
C13	0.2
C14	3.3
C14:1	0.0
C15	1.1
C15:1	0.1
C16	44.1
C16:1	3.9
C17	1.6
C17:1	0.0
C18	6.0
C18:1	21.3
C18:1t*	6.1
C18:2	4.6
C18:3	0.1
C18:3t*	1.5
C20:1	0.1
C20:2	0.0
C20:3	0.0
C20:4	0.0
C20:5	0.3
C21:0	0.1
C22	0.2
C22:1	0.2
C22:2	0.1
C22:6	2.0
C23	0.2
C24	0.3
C24:1	1.5
Total saturated	58.2
Total unsaturated	41.9

* t – trans

Microbiological analysis

Microbiological analysis of the *Oligosarcus robustus* raw meat and hamburger product was carried out with the aim of determining if the microbial load originated from the raw material and/or the contamination occurred during processing. Results of the determination of coagulase-positive *Staphylococcus*, reducing sulphite *Clostridium*, thermotolerant *Coliforms*, *Pseudomonas* spp and *Salmonella* spp. of *Oligosarcus robustus* fish and hamburger are presented in the table 3.

Sensory evaluation

The sensorial panel was composed of 82% women and 18% men. Their ages were: under 25 of age (64%), between 26 and 40 (28% were), and over 40 (8%). Their occupation was undergraduate students (74%), students (4%), teachers (6%) and employees (16%) of Federal University of Pelotas, Brazil. Panelist fish consumption habits varied as follows: 42% consumed very little fish (less than 1x/month), 40% consumed occasionally (1x/month), 8% consumed moderately (1x/week) and only 10% consumed twice a week or more. Thus the panel of judges was a homogeneous group, composed predominantly of female undergraduate students under 25 years old, who consumed fish occasionally (1x/month) or rarely (less than 1/month). Results of acceptance analysis of *Oligosarcus robustus* hamburger are presented in table 4.

The Tambica burger presented good scores for appearance, odor and flavor. Results of these 3 attributes ranged from 7.46 to 7.72, and the product was classified between the terms "I really liked" and "I liked it a lot". The texture attribute score was 4.56, which is very close to the rejection limit[10].

Oligosarcus robustus is a fish with a considerable amount of fishbone, although it was easy to filet. Comments of the panel suggest that the *Oligosarcus robustus* hamburger should be more thoroughly ground and homogenized in order to reduce fishbone residue. Overall, the *Oligosarcus robustus* hamburger was positively accepted.

The results of purchase intention are shown in table 5. The highest scores obtained for *Oligosarcus robustus* burger were 4 and 5, which correspond to "would buy occasionally" and "would buy frequently", respectively.

Pearson correlation analysis shows a correlation between flavor attributes and intention to buy (r= 0.73 ($p<0.001$).

Table 3. Coagulase-positive *Staphylococcus, Salmonella* spp., reducing sulphite *Clostridium*, thermotolerant *Coliforms* and *Pseudomonas* spp. in *Oligosarcus robustus* fish and hamburger.

Analysis	Fish	Hamburger	Legislation***
Coagulase positive *Staphylococcus* (CFU/g)**	$2.2x10^{3a}$	$5.4x10^{3b}$	10^3
Salmonella spp. (in 25g)	absent	absent	absent
Reducing sulphite *Clostridium* (CFU.g^{-1})**	$< 0.3^a$	$< 0.3^a$	$3x10^{3}$*
Thermotolerant *Coliformes* (MPN.g^{-1})**	$1.8x10^{2a}$	$0.3x10^{1b}$	$5x10^{3}$*
Pseudomonas spp. (CFU.g^{-1})**	$8.7x10^{2a}$	$1.2x10^{3b}$	–

* Only for burgers; ** Average of enumerations; *** Resolution RDC n.12 of January 2, 2001, Brazil (Brasil, 2001) Equal letters in the same line mean that there was no statistical difference. Different letters mean that there was a significant difference at the 5% level.

Table 4. Mean and standard deviations of the judges' scores for the *Oligosarcus robustus* hamburger acceptance test.

Attributes	Mean and Standard deviation
Appearance	7.46 ± 0.95
Odour	7.72 ± 0.83
Flavour	7.56 ± 1.10
Texture	4.56 ± 1.48

Table 5. Percentage of purchase intention of *Oligosarcus robustus* burger.

Scores	Purchase intention (%)
Would never buy (1)	3
Would buy very rarely (2)	4
Would rarely buy (3)	11
Would occasionally buy (4)	29
Would buy often (5)	28
Would buy very often (6)	12
Would buy Always (7)	13

DISCUSSION

Physicochemical analysis

The physicochemical and microbiological composition of *Oligosarcus robustus* was unknown up to now. In a general way, the chemical composition of fish is similar to poultry, beef and pork meat. The moisture content of *Oligosarcus robustus* was 82.3%, which is within the range expected for fish. The lipid content was 1.5%. According to Silva and Chamul[11], fish can be classified based on fat content: fatty fish (>10% fat), moderately fat fish (5-10% fat) and lean fish (<5.0% fat). Thus, *Oligosarcus robustus* can be classified as a lean fish. The *Oligosarcus robustus* burger had a significantly higher percentage of lipids (2.9%) and lower moisture (78.6%) than *Oligosarcus robustus* fish meat, this difference is due to the ingredients used for the formulation of hamburger, especially soybean oil and sodium chloride, and water loss during hamburger processing.

Studies that aim to evaluate the nutritional profile of *Oligosarcus robustus* and its products are few. We observed, however, a lower protein content of the raw fish and burger compared to other freshwater fish from Brazil[12,13]. This difference can be due to the thawing step that may have promoted the reduction of the protein fraction by the loss of exudate (i.e., loss of meat juice). The higher percentage of protein in the hamburger is due to the addition of textured soy protein to the formulation. Borba *et al*[14]. reported a protein content of 14.6% in a chicken hamburger and 18.3% in a beef hamburger. The *Oligosarcus robustus* burger showed a very close or superior nutritional value compared to more noble protein sources such as chicken and beef. The addition of soy protein increased protein content and improved the nutritional characteristics of the product.

The lipid content in the hamburger was higher than that found in raw meat, this was expected due to the addition of the ingredients of the formulation. When compared to hamburgers from other protein sources such as meat and chicken[14], the Oligosarcus hamburger has less content, showing the benefit of consuming fish hamburgers compared to other meats. A study by Tonet et al that aimed to evaluate tilapia burgers found lipid content varying between 2.2 and 3.0%, a result similar to that reported in our study[15], On the other hand, this value was superior to the *Albula vulpes* burgers that presented 1.5% lipids composition[16].

Fish composition is mainly water, protein, lipids and minerals (ash). The ash results found for *Oligosarcus robustus* (3,1%) and the fish hamburger (3.6%) were within the range reported in the difference ($p>0.05$). The mineral content of the raw material (fish) was maintained despite the addition of salts, such as sodium chloride, to the hamburger. Fish meat is considered a source of minerals, mainly calcium and iron, and also has reasonable amounts of sodium, potassium, manganese, copper, cobalt, zinc, iron and iodine. According to the *Oligosarcus robustus* physicochemical results, this fish can be considered a source of low-fat protein. The hamburger obtained from this fish has maintained important nutritional characteristics of the raw material, representing an alternative use of this fish meat. This product adds value to a fish of low commercial value, which otherwise would become waste without being consumed, representing nutritional losses and, to some extent, environmental pollution.

Fatty acid profile

Palmitic (C:16, saturated fatty acid) and oleic (C18:1, unsaturated fatty acid) acids were the predominant fatty acids in *Oligosarcus robustus*, with 44.1% and 27.4%, respectively. Palmitic acid is one of the most widespread fatty acids in nature and the most common saturated fatty acid in the human diet. This fatty acid is used in the cosmetic industry for creams and shaving foam formulations due to its excellent detergency and foaming properties[17,18]. Oleic acid is typically present in foods in substantial amounts and its importance for the human diet has been the subject of numerous studies, mainly because this compound influences brain development and triggers neuronal differentiation, especially in infants[19].

Unsaturated fatty acid content in *Oligosarcus robustus* was approximately 41.9%, with unsaturated omega 3 families (n-3: 3.5%) lower than omega 6 (n-6: 4.6%), which is in agreement with the literature data for freshwater fish. The daily intake of EPA + DHA, recommended for healthy individuals, is between 250 and 500 mg. Based on this recommendation, consumption of a 100g Oligosarcus burger would result in 18.4% of the EPA recommendation and 9.2% of the DHA recommendation, whereas in a 100g raw Oligosarcus fillet it would provide 9% of the EPA recommendation and 4.5% of the recommendation of DHA. Amount of these fatty acids varies greatly due to environmental factors and the size of the animals[20,21,22,23].

Freshwater fish appears to have greater capacity for lipid chain elongation and desaturation (formation of double bonds) than saltwater fish, using mainly linolenic (18: 3n - 3) and linoleic (18: 2n - 6) acids as substrates. Different health benefits were described for polyunsaturated fatty acids including reduction of cholesterol levels, action on nerve cells, reduction of risk of coronary heart disease and arteriosclerosis, action on inflammatory processes, control of hypertension, maintenance of ideal weight through appetite control, and reduction of postpartum depression rate and promotion of the fetus brain development in pregnant women[22,24].

Microbiological analysis

The National Agency of Sanitary Surveillance (ANVISA) of the Brazilian Ministry of Health is the body that regulates microbiological standards in food. The resolution RDC No. 12 of January 2, 2001, recommends the absence of *Salmonella* spp. in 25.0 g of sample and limits the amount of coagulase-positive *Staphylococcus/g* of fish by 10^3 CFU.g^{-1} in fish "*in natura*" (fresh or frozen and not to be eaten raw) and their products (hamburger or similar)[25].

The obligatory microbiological analyzes recommended by this legislation for fish are coagulase-positive *Staphylococcus*

and *Salmonella* spp. However, Coliforms (at 45 °C), coagulase-positive *Staphylococcus* and *Salmonella* spp/25g of the product, are required for hamburgers. The Brazilian legislation does not establish limits for *Pseudomonas* spp.

Results of coagulase-positive *Staphylococcus* for all fish and hamburger samples are above the regulatory limit established by the Brazilian legislation (10^3 CFU.g^{-1})[25]. Bacterial counts are higher than in other studies[26,27]. This is probably due to inadequate handling of the fish from the time of capture until its final commercialization. In addition, the deficiency in the sanitization of equipment, manipulator hands and utensils used in the fish processing can be the origin of the contamination since these microorganisms are present at the human skin and in airways while fish is not their natural habitat.

Microbial load of raw material, which was above regulatory limits, is added to the microbial load of ingredients used for hamburger fabrication such as seasoning, which probably did not undergo a sterilization. Contamination at laboratory level can be discarded since the preparation of the hamburger product was carried out under controlled aseptic conditions. This result is of great concern considering that *Staphylococcus* genus is responsible for approximately 45.0% of the world's food intoxications.

Salmonella spp results showed that all samples (fish and hamburger) were in accordance with the Brazilian legislation (absence in 25.0 g food). The acceptable limit of sulphite Clostridium in foods such as hamburger is up to 3x10^{3} CFU.g-1 25. This microorganism was not detected in the analyzed samples.

There are no regulatory limits in Brazil for coliforms at 45 ºC in fish. Cell counts for this microorganism in all samples of *Oligosarcus robustus* fish were significantly ($p < 0.05$) higher compared to the hamburger. As hamburger was frozen, temperature may have caused cellular damage to coliforms. In addition, antimicrobial agents such as sodium chloride and garlic were added to the burger formulation.

Pseudomonas spp. can cause deterioration of fish due to their proteolytic enzymes. This effect is mainly observed in tropical fish, which is not correctly refrigerated and consequently has reduced shelf-life. The maximum limit for *Pseudomonas* spp. suggested by the International Commission on Microbiological Specifications for Foods[28] for psychotropic microorganisms is 106 CFU.g^{-1}. According to FAO, fishes with *Pseudomonas* spp. values above 107 CFU.g^{-1}, putrefied and/or deteriorate very rapidly[29]. *Oligosarcus robustus* fish and hamburger samples showed counts of *Pseudomonas* spp. below the maximum established by ICMSF and FAO. *Pseudomonas* spp. in raw fish or fish hamburgers is not regulated by the Brazilian law.

Results of microbiological analysis of fish samples indicate values above regulatory limits for coagulase-positive *Staphylococcus*. Thus, the microbiological monitoring of fish is very important, mainly for species with little known microbiological characteristics such as *Oligosarcus robustus*. This knowledge can minimize the risks and allow better use of raw material.

Sensory evaluation

The acceptability of the products is affected by the eating habits and preferences of the population. The burgers presented good acceptability in the parameters of appearance, taste and odor, results similar to those found in other studies that aimed to sensorially evaluate hamburgers of other fish, confirming the acceptance of this type of fish product[30,31,32]. The low acceptability found in the texture parameter is due to the presence of column residues, but despite this, the intention to buy (occasionally or often buy) *Oligosarcus robustus* burgers indicates a possibility of insertion of this on the market and may be an alternative to the population that seeks healthier and safer food for consumption, besides being a possibility of generating income for the local industry.

CONCLUSIONS

Oligosarcus robustus fish and *Oligosarcus robustus* hamburger composition was found to be in agreement with published results. In addition, *Oligosarcus robustus* meat has an adequate protein composition and low lipid content, considerable part of which are polyunsaturated fatty acids. Therefore, this fish can be included in the diet and can have other applications for example in cosmetic industry. Microbiological load was above the regulatory limit for coagulase-positive *Staphylococcus*. The *Oligosarcus robustus* burgers was accepted by the judges, indicating a product with market potential. *Oligosarcus robustus* hamburger represents an alternative use of this fish, as it maintains the nutritional characteristics of the raw material, adding value to a fish of low commercial significance, stimulating the production of this product by local anglers.

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