

## FROG MEAT IN SPECIAL DIETS: POTENTIAL FOR USE AS A FUNCTIONAL FOOD

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### ABSTRACT

Frog meat is a highly digestible food, which justifies its use in special diets. The aim of this study was to evaluate the potential for use of frog meat in hospital diets and in diets recommended by physicians, in addition to promoting its consumption. Interviews were performed at hospitals and medical offices in Rio de Janeiro (RJ, Brazil). The survey identified that 72% of interviewed - physicians, nutritionists, and staff responsible for hospital kitchens - do not know the nutritional properties of frog meat, and 50% believe there are difficulties in its use and highlighted the little availability of the product in the market and its high price. Frog meat is considered a healthy food, but the importance of its use and forms of preparation must be divulged.

**Keywords:** therapeutic applications; hospital diets; *Lithobates catesbeianus*; food allergy

## CARNE DE RÃ EM DIETAS ESPECIAIS: POTENCIAL DE UTILIZAÇÃO COMO ALIMENTO FUNCIONAL

### RESUMO

A carne de rã apresenta alta digestibilidade evidenciando a importância da utilização em dietas especiais. O objetivo do estudo foi avaliar o potencial da utilização da carne de rã nas dietas hospitalares e em dietas recomendadas pelos médicos e ainda promover o consumo. Foram realizadas entrevistas em hospitais e consultórios da cidade do Rio de Janeiro (RJ, Brasil). A pesquisa identificou que 72% dos entrevistados - médicos, nutricionistas e responsáveis por cozinhas hospitalares - não conhecem as características nutricionais da carne, e 50% acredita que há dificuldades na sua utilização e destacou a falta de disponibilidade no mercado e o preço elevado do produto. A carne de rã é considerada um alimento saudável, mas a importância da utilização e as formas de preparo precisam ser divulgadas.

**Palavras-chave:** aplicações terapêuticas; dietas hospitalares; *Lithobates catesbeianus*; alergia alimentar

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## INTRODUCTION

*Lithobates catesbeianus* (= *Rana catesbeiana*), the bullfrog, is the most largely sold and produced frog species in Brazil. Its production performance and high meat quality highlight the potential of this product as a healthy food (PAIXÃO and BRESSAN, 2009).

The nutritional quality of frog meat is proved by its adequate amino acid balance and low lipid percentage, which make it an excellent option for low-calorie diets (CASALI *et al.*, 2005; PIRES *et al.*, 2006; NÓBREGA *et al.*, 2007).

The reason for purchasing frog meat is related to its functional use and health benefits at 45% points of sale; flavor, texture, and quality of meat are reasons declared by 86% of frog meat consumers, but 63% of these complain about the price. Seventy percent (70%) of this product is sold whole, eviscerated, and frozen. Retailers indicate that the product has problems related to value perception, causing its price to be viewed as high in 38% of cases. Restrictions regarding appearance and esthetical prejudice by consumers amount to 36% (WEICHERT *et al.*, 2007).

The use of frog meat is recommended in diets aimed at fighting cholesterol, obesity, arterial hypertension; and for the treatment of gastrointestinal disorders in diets of athletes, convalescents, growing children, or children allergic to animal protein (MELLO *et al.*, 2006; NÓBREGA *et al.*, 2007). Frog meat has been recommended for the treatment of gastrointestinal diseases, allergies, and in diets with sodium, fat, and calorie restrictions. The amino acid profile of this meat has a chemical score greater than 1.0 and has no essential amino acid limitations (PAIXÃO and BRESSAN, 2009).

Consumption of frog meat has increased in the last few years. Global total production of aquatic animals from aquaculture in 2014 amounted to 73.8 million tonnes, with an estimated first-sale value of US\$ 160.2 billion. The production of other aquatic animals including frogs amounted to 7.3 million tonnes, with an estimated sale value of US\$ 3.7 billion (FAO, 2016).

Frog meat lovers are attracted not only by its taste, but mainly by its nutritional properties, and the benefits of this product are evident when

compared with the main types of meat consumed in Brazil (NÓBREGA *et al.*, 2007). It features characteristics of lean meat (0.3% lipids), with the advantage of most of them being constituted of polyunsaturated fatty acids, mainly linoleic and arachidonic acids (NOLL and LINDAU, 1987).

Frog meat can be used by patients with calcium deficiency and osteoporosis, as it contains a high amount of calcium available for absorption by the organism, similarly to the calcium present in milk. As such, it is a food alternative for lactose-intolerant patients, given its higher protein content as compared with milk and beef (PAIXÃO and BRESSAN, 2009).

It is common for hospitalized patients to have special nutritional needs due to metabolic disorders and malnutrition caused by their emotional state or by the disease. A nutritional therapy should be administered safely and be accepted by the patient, since it will compromise his/her nutritional and physiopathological state (LEITE *et al.*, 2005).

This study aimed to identify the potential for use of frog meat in hospital meals as well as in special diets as per recommendation of physicians and nutritionists, and, based on the surveyed data, to promote the use of frog meat by developing and distributing informative material initially at medical offices and hospitals that participated in the study and later at health institutes.

## MATERIAL AND METHODS

Fifty-three professionals in the health area, consisting of 46 physicians and seven nutritionists, were interviewed in medical offices of the south, west, and north regions of Rio de Janeiro (RJ, Brazil), between September and October 2015. At the public hospitals, we interviewed five professionals responsible for the hospital kitchens, three of which were nutritionists. For the interviews, we used two structured questionnaires with open- and closed-ended questions. Questionnaires were divided into three dimensions. The first of these questionnaires was used in the interviews with the professionals working at hospital kitchens, including 16 questions. The following dimensions were present: 1 - knowledge about the nutritional importance of

frog meat; 2 - diets used at the hospital; and 3 - use of frog meat in hospital kitchens. The second questionnaire was applied in interviews for specialists in the gastroenterology, pediatrics, pediatric surgery, endocrinology, general practice, nutrology, and nutrition areas, comprising the following three different dimensions, with 17 questions: 1 - knowledge about the nutritional importance of frog meat; 2 - use of special diets by patients; 3 - potential of use of frog meat in hospital diets and as a functional food.

The criterion for inclusion of the study subjects was the acceptance of professionals in the health area to participate in the study. Those who agreed to participate signed the informed consent form. The project was approved by the Ethics Committee in Research with Human Beings (UNISUAM, CAAE n°. 48349015.0.0000.5235).

Descriptive statistics was adopted for the evaluation of the data collected during the interviews, using Excel 2013 software. Results were expressed in percentage values and represented in graphs.

For the cluster analysis by the hierarchical method, the data were standardized, Euclidean distance coefficient was adopted, and the Single Linkage method (COOLEY and LOHNES, 1971) was employed as the cluster analysis strategy, using Statistica software 2007.

The obtained qualitative data were used to complement the quantitative data (MINAYO and SANCHES, 1993).

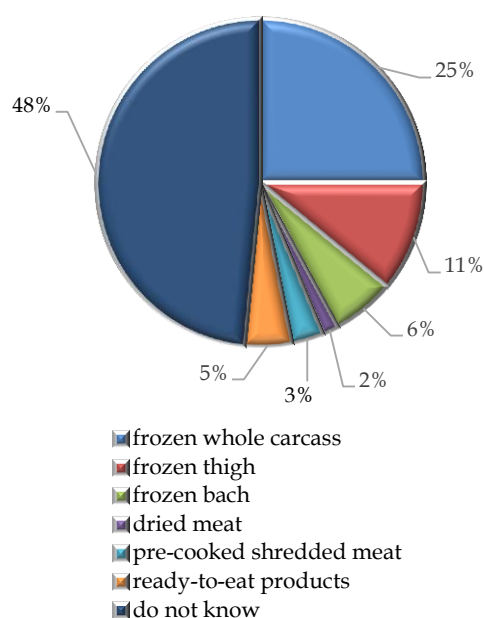
## RESULTS

As regards the consumption of frog meat, of the 53 health professionals interviewed, only 13% declared to have consumed or consume it.

Concerning the knowledge of the nutritional properties of frog meat compared with other meats, 28% of medical professionals and nutritionists revealed to have some, while 5% of the personnel responsible for the kitchens were positive for this question.

As for the responses related to knowledge about the forms most commonly found in the market (Figure 1). Frozen whole carcass stood out,

for 25% of respondents; frozen thigh among 11% of the interviewees; frozen back, 6%; ready-to-eat products, 5%; pre-cooked shredded meat, 3%; and dried meat, 2%. Among the participants, 48% are unfamiliar with the forms of the product available in the market.

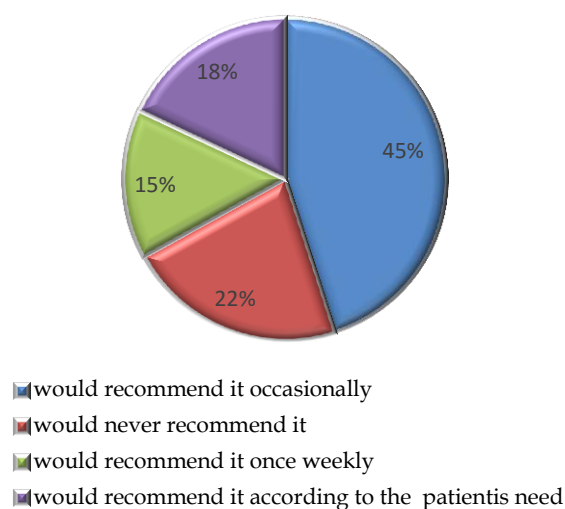


**Figure 1.** Most commonly found forms of frog meat sold in the market, according to interviewed physicians, nutritionists, and hospital kitchen staff.

Fifty-three percent (53%) of the physicians, nutritionists, and hospital kitchen staff claimed to not know the benefits of frog meat; by contrast, 29% believe it may be a great option for people with food allergies. Fourteen percent (14%) consider it a great choice for low-lipid and low-sodium diets; 2% believe it improves serum values; and 2% responded it improves the quality of life.

Results found for the Special Diets dimension (Figure 2) indicate recommendation of frog meat in patient diets by physicians and nutritionists.

When respondents were questioned if they had ever prescribed frog meat to allergic patients or those with other pathologies, 9% of them declared they already had; 2% did not answer to this question; and 89% had never prescribed frog meat.



**Figure 2.** Recommendation of use of frog meat, according to interviewed physicians and nutritionists.

Regarding the knowledge of other professionals that prescribe frog meat, 26% know professionals who do it; 71% do not; and 3% did not respond.

Considering frog meat as an option for the hospital menu, 80% of the kitchen staff believe this would be a great option, and despite considering it a great option, 50% believe there are difficulties introducing this component in the menu.

The interviewed physicians and nutritionists were also questioned about their opinion on the introduction of frog meat in hospitals, and 92% of them believed it is difficult due to lack of information about the meat, high prices, the cultural factor, unfamiliarity with its preparation, difficulty finding the product, or food prejudice.

The acceptability of use of frog meat in the hospital environment involves several factors like culture, the product's taste, dissemination, and accessibility in the market. According to our results, 47% of respondents would accept the use of frog meat; 46% would not; and 7% did not answer to this question. The price of frog meat was one of the most mentioned responses by the interviewees in general (97%).

According to the choice of the respondents, in an order of preference, in the purchase of ready- or semi-ready-to-eat products, the pap made of

frog meat for post-infants was the first choice, followed by pre-cooked shredded frog meat; in third place was the dried frog meat soup with legumes; lastly, "sous vide" based on frog meat was the fourth preferred item. Two respondents suggested roasted frog meat and seasoned frog thigh.

The forms of preparation were ordered by degree of importance by the interviewees, considering their practicality and functionality, as follows: 1 - frog meat soup; 2 - shredded frog meat with sauce; frog protein baby bottle; and 4 - fried frog thighs. The following were suggested: 1 - roasted or grilled frog meat; and 2 - frog meat instant powder.

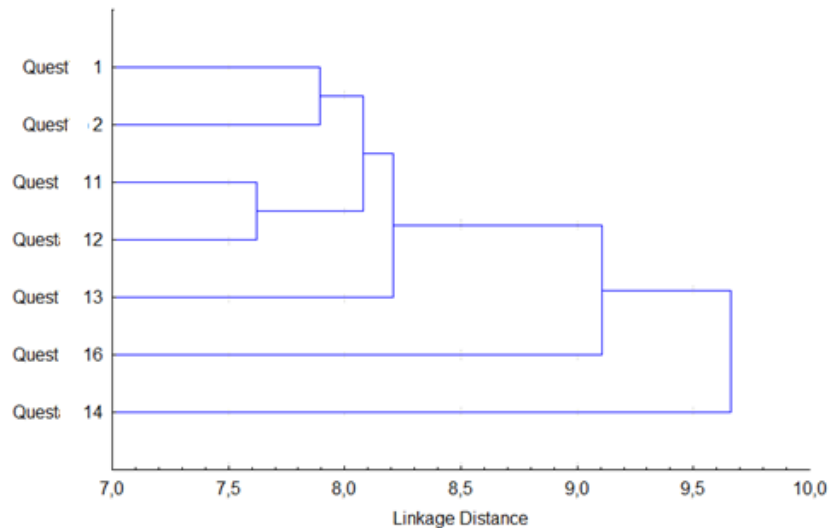
Clusters were formed based on the responses of the 53 participants, among physicians and nutritionists, for the following yes/no questions: 1 (Do you consume frog meat?); 2 (Do you know the superiority of the nutritional properties of frog meat compared with other meats?); 11 (Have you already prescribed the use of frog meat to an allergic patient or a patient with another disease?); 12 (Do you know any professionals who use frog meat in the treatment of patients requiring special diets?); 13 (Do you believe there are difficulties regarding the introduction of frog meat in hospital diets?); 14 (Do you, as a health professional, believe patients will have good acceptability regarding frog meat consumption?); and 16 (Do you believe the price of frog meat is a hindrance to its use by patients?). Questions 1 and 2 had similar responses, i.e., the opinion of respondents was similar. The same was true for questions 11 and 12. Questions 13, 14, and 16, however, had more discrepant results, i.e., participants were more heterogeneous (Figure 3).

The hierarchy of respondents indicates that three main big groups were formed according to their responses (Figure 4): a group formed by gastroenterologists, pediatricians, and pediatric surgeons (group C- number 1 until 11); a group formed by endocrinologists and pediatricians (group B- number 12 until 26); and a third group formed in its majority by nutritionists and general practitioners (group A- number 27 until 52).

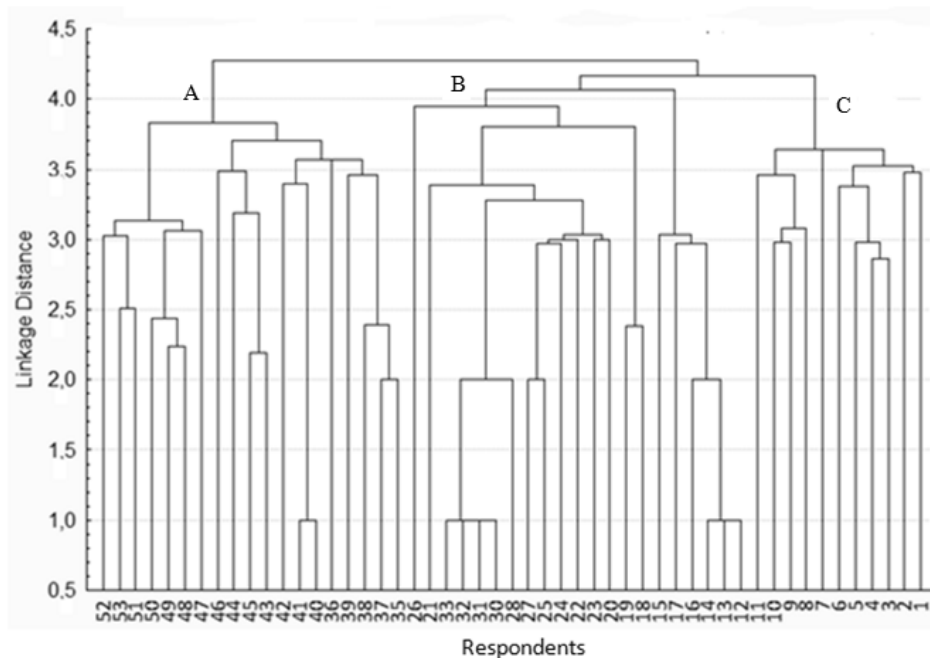
There is a large gap between the groups, there are those who know the benefits of the use of frog meat that respond in a similar way and those who

do not know. Considering distances and questions found in Figure 4, the lower the distance the greater the level of knowledge about frog meat and also the interviewees considered the high

possibility of rejection by the patients; and, the one that presents greater distance, represent less knowledge about the use of meat, but without rejection.



**Figure 3.** Dendrogram displaying the hierarchy of responses for questions about consumption and use of frog meat in specific diets



**Figure 4.** Dendrogram displaying the hierarchy of responses for questions about consumption and use of frog meat in specific diets, according to the 53 respondents (physicians and nutritionists). Number 1 until 11 (group C - formed by gastroenterologists, pediatricians, and pediatric surgeons); number 12 until 26 (group B - formed by endocrinologists and pediatricians); number 35 until 52 (group A - formed in its majority by nutritionists and general practitioners).

Results from this study were used as basis for the development of two informative brochures containing the nutritional properties of frog meat, its use as a functional food, and forms of preparation for special diets for children and adults. One brochure had a more technical language, aimed at health professionals, while the other had a more comprehensible language for frog meat consumers and potential consumers.

## DISCUSSION

Knowledge about frog meat confronts with the difficulty finding the product and the high cost, which hamper its consumption and access. These findings were already observed in the statements identified by interviewee number 27, E27 - (“[...] *I have already consumed and liked it, but this is not a habit.*”) and E26 (“[...] *but of difficult access both because of price and availability.*”). Interviewees also revealed knowledge about other forms of use of frog products: E21 - “[...] *frog oil is used in wound healing*”

WEICHERT *et al.* (2007) studied frog meat consumers in Rio de Janeiro (RJ, Brazil) and observed occasional consumption, by a specific social class. The low consumption of frog meat is due mainly to its high sale price and unfamiliarity with its benefits.

Many reports identified knowledge of the nutritional value and use in special diets by physicians and nutritionists, but the difficulty accessing the product was also mentioned: E1 - “[...] *Frog meat is healthy, as it is considered white meat, like chicken and rabbit.*”; E10 - “[...] *I prescribed frog meats at a time when it was difficult to purchase protein hydrolysate formulas.*”; E26 - “[...] *is a protein source of great quality, but of difficult access both because of price and availability.*”; E49 - “[...] *I only know of its low allergenic power and lipid concentration.*”; and E53 - “[...] *I know of its properties; it is the meat with the greatest value in the market, though little-publicized.*”

Food-allergic patients indicated the prescription of soy-based foods, hydrolysate formulas, and frog meat, and most reported that the best way to avoid allergies is to avoid the causative agent, adopting diets free of milk, peanut, lactose, and gluten.

The most prescribed foods for patients, according to physicians and nutritionists

participating in the study, were white meats like chicken and fish, followed by beef, milk derivatives, hydrolysate formulas, and egg.

SABRÁ (2015) informed that, at this office, frog meat was largely prescribed when a child had some sort of food allergy, in a diet known as “Professor Sabrá’s Diet A”, which consisted of rice cereal, frog meat protein, and rice oils, which are hypoallergenic foods. Today, the immune profile of patients can be evaluated by tests, which makes it possible to restrict specific foods in their diet. At present, extensively hydrolyzed proteins and amino acid formulas are also available.

The aim of the study by HILGER *et al.* (2004) was to investigate whether IgE antibodies of fish allergic persons cross-react with frog parvalbumin and to appreciate its clinical relevance and it concluded that the IgE cross-reactions described in this paper were directed from fish to frog and mainly from fish parvalbumin to frog parvalbumin  $\beta$ . A frog allergic patient whose case was published (HILGER *et al.*, 2002) reacted very specifically to the parvalbumin  $\alpha$  molecule of frog species from Indonesia to which he was allergic.

Studies have associated the digestibility of proteins to its immunogenic potential, OLIVEIRA *et al.* (2013) evaluated the impact of the thermal processing with high and low temperatures on the proteins structure of three types of foods. Cow’s milk proteins, for example, are less susceptible to thermal processing. Although frog meat ranked in between milk and beef as regards the thermal resistance of its constituent proteins, there is still much controversy in the literature as to whether or not it can be safely eaten by allergic patients. The consumption of other kinds of meat by genetically predisposed individuals has to be carefully handled and evaluated on an individual. Although frog meat is used successfully for patients with cow’s milk allergy, caution is advised since no meat can be considered totally hypoallergenic.

The survey applied to the staff in hospital kitchens showed that the most prescribed foods in the hospital environment were beef, chicken, fish, and dietary supplements. Concerning the foods that can be prescribed in hospital environments to replace breast milk after six months of life, respondents cited legumes, fruit, ground meats, and baby formulas (NAN, Nestogen, Aptamil).

Some participants questioned the superiority of frog meat for their unfamiliarity with publications addressing this product: E13 - “[...] *No doctor, nutritionist, or study/article has ever informed me about it.*”

A factor of extreme importance observed in the studies of SOUSA *et al.* (2011) was the identification of visits paid by a nutritionist to all beds at the moment the meals were served. The professional checked the diet prescriptions and the possibility of changes and adjustments. This question demonstrates concern with the patient's welfare and with providing nutritional quality according to his/her dietary needs.

Diet-related diseases, like diabetes and hypertension, have been increasingly reported (WORLD HEALTH ORGANIZATION, 1999). For this reason, human diets should be focused on the fragility and singularity of each patient, respecting their nutritional needs. The professionals interviewed in this study declared they prescribe or indicate low-lipid, low-sodium foods with low or no sugar. This demonstrates once again the potential increase of frog meat prescriptions.

Our study revealed a lack of access of these professionals to publications about the functional properties of frog meat, and also the need for disseminating these characteristics at medical centers and hospitals.

The informative brochures about the properties of frog meat, forms of preparation, and specific bibliography, developed based on the present study, will be available in printed and digital versions for health professionals and patients of medical offices and hospitals, aiming to disseminate the properties and benefits of frog meat consumption and also show that there are forms of preparation that can facilitate its acquisition for use in hospital kitchens. This material will also facilitate the access to more in-depth information about the importance of frog meat in special diets, as professionals will be able to access the articles through the bibliographic references.

## CONCLUSION

The study demonstrates that most of the health professionals interviewed do not know the nutritional characteristics of frog meat and its use as a functional food.

Lack of a consumption habit, high price, and lack of practicality in the preparation of frog meat compromise its choice as a foodstuff. For this reason, technologies should be developed to make the consumption of this meat more practical and also to broaden the availability of the product in the market.

With the dissemination of the functional properties of frog meat, the knowledge of professionals in the health area and of the population in general will be increased, and consequently so will the demand for the product. Therefore, the many links of the production chain will need to increase the availability and regularity of supply of this product to the market.

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