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Consumption dynamics of bullfrog (*Lithobates catesbeianus*) in three segments of the Mexican population

Dinámicas de consumo de rana toro (*Lithobates catesbeianus*) en segmentos de la población mexicana

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ABSTRACT

Market dynamics and consumption of bullfrog are studied through social network users, stratified non-probability sampling was carried out, for convenience, 22 states of the Mexican Republic, 4 geographical zones of the country, it was directed at segments of the population classified as socioeconomic strata A/B, C+C, target population N=33,840,657 n=385 respondents, reliability 95 %, standard error 5 %, a semi-structured questionnaire was applied on the Google Forms platform (2019) using Facebook and WhatsApp social networks. 25.7 % of respondents are between 20 and 30 years old, 29.6 % between 31 and 40 years old, 26.5 % between 41 and 50 years old, 6.9% between 51 and 60 years of age and only 4.4 % are over 60 years old, only 14% were unaware that the frog is edible, 58.1 % would accept tasting frog meat, 16 % would not accept, 39.5 % would like to find meat from frog in commercial establishments. The most important characteristic is quality and packaging (29.2 %), including cooking recipes (27.1 %), nutritional information (16.9 %), and price (14.1 %), the potential of social networks for the realization of these is demonstrated studies.

Keywords: bullfrog, meat, social media, marketing.

RESUMEN

Se estudiaron dinámicas de mercado y consumo de rana toro a través de usuarios de redes sociales, se realizó muestreo no probabilístico estratificado, por conveniencia en 22 estados de la República Mexicana, 4 zonas geográficas del país, fue dirigido a segmentos de la población clasificados como estratos socioeconómicos A/B, C+C, población objetivo N= 33,840,657 n=385 encuestados confiabilidad 95 %, error estándar 5%, se aplicó cuestionario semiestructurado en plataforma Formularios Google (2019) utilizando redes sociales Facebook y WhatsApp. El 25.7 % de los encuestados se encuentra entre los 20 y 30 años de edad, el 29.6 % entre 31 y 40 años de edad, el 26.5 % entre los 41 y 50 años de edad, el 6.9 % entre los 51 y 60 años de edad y solo el 4.4% cuenta con más de 60 años de edad, el 14% desconocía que la rana es comestible, el 58.1% aceptaría degustar carne de rana, 16% no aceptaría, al 39.5% le gustaría encontrar carne de rana en establecimientos comerciales. La característica más importante es la

calidad y el empaque (29.2 %), incluir recetas de cocina (27.1 %), información nutricional (16.9%), precio (14.1 %), se demuestra el potencial de las redes sociales para la realización de estos estudios.

Palabras Clave: rana toro, carne, redes sociales, comercialización, mercado.

INTRODUCTION

Fishing and aquaculture contribute significantly to food security worldwide, through the supply of fish and shellfish to meet the growing domestic demand, where per capita consumption is 12.8 kilograms per year, representing an important means of subsistence for more than 290 thousand families of fishermen throughout the country. In 2011, the aquaculture and fishing production was 1.6 million tons of live weight, 2.5% higher than that obtained in 2010, due to the higher catches of sardines, which represent 41% of the national production; in addition to the increase in the capture and cultivation of shrimp (SAGARPA, 2012).

Aquaculture includes micro and macro organisms, unicellular and multicellular, plants (micro and macro algae) and vertebrate and invertebrate animals, such as rotifers, crustaceans, mollusks, fish, amphibians, reptiles, birds and mammals. Aquaculture is normally considered as fish production because it is the most extensive and known, however, there are more than 570 known species with productive potential surpassing agriculture, livestock and forestry together (FAO, 2018).

Mexico, is considered among the main countries in aquaculture production in America, it is projected in the medium term, as a world power in the activity, because in recent years the average growth rate has been 15% per year, reaching in 2016, and historical figures of 337 thousand tons of aquaculture production, which represents 22% of the country's fishing activity. The fishing and aquaculture sector in Mexico is represented by a total of 20,407 economic units out of a total of 4,230,745, which represents a participation of 0.0568% (INEGI, 2014). According to the System of National Accounts, activities related to agriculture, livestock, forestry and fishing represented 4.11% of the total gross domestic product GDP in 1993. In 2000, after the crisis of the late 1990s. In the nineties, the figure was 3.79% and in the previous periods, during and after the crisis, said participation pointed to 3.75, 3.83 and 3.90%, respectively, which would indicate in the first instance that the effects were not so serious for the aquaculture activity.

Mexico is one of the countries with the lowest annual consumption of aquaculture products per capita, worldwide consumption is 7 to 9 kg, while the world average consumption is 18.6 kg (Platas, 2014). The current demand is satisfied by importing from China 50% of Tilapia consumed, 70,000 tons per year of whole tilapia and 30,000 tons of frozen and fresh fillet of tilapia. Besides; for 2013, an export to Mexico of 127,000 tons of Basa fillet (*Pangasius hypothalmus*) is reported in Vietnam. With the above, Mexico is ranked as the second largest importer of tilapia and base in the world, only after the United States, but the latter has three times the number of inhabitants and a much higher purchasing power than Mexico. Although Mexico exports yellow and blue fin tuna, sardines and shrimp

among other minors. If Mexico wants to reach world consumption and substitute imports, it must at least increase its production of the main species by more than 10 times. The foregoing considering that the national potential is feasible in the short and medium term (Beltran, 2017).

In Mexico, the intensive production of Bullfrog (*Lithobates catesbeianus*) is an aquaculture activity that in recent years has gained relevance due to its growing internal demand and the export of specimens for research, teaching and food. In part of the Mexican highlands that includes Jalisco, Aguascalientes and Zacatecas states, the federal government has encouraged sustainable aquaculture and fishing production, the National Commission of Aquaculture and Fisheries (CONAPESCA, according its acronyms in Spanish) promotes bullfrog breeding as a viable production alternative in the territory national (CONAPESCA, 2015). Jalisco state had during 2015 an export production that reached 20 t of bullfrog (SEDER, 2015), while for 2016 the production of this species was estimated at 23.5 tons and for 2017 the production amounted to 26 t. However, ranchers from Michoacán state with a production of almost 60 tons per year, increase their economy, through the cultivation of bullfrogs, strengthening the generation of jobs in this sector of the entity (CONAPESCA, 2017).

Currently, the commercialization of bullfrog in the region depends on an oligopoly of buyers who determine the price of the live bullfrog, for the export process, while there is no data that determines the market possibilities within the national territory, of frog for supply in consumer markets each producer struggles daily to market their product locally and regionally, one of the problems observed is that producers use the same marketing channels, most of them market their production to the local market, they sell their production to companies dedicated to export, depending on 90% of these two marketing channels, only 10% of producers market their product in their own restaurants or on-site sales stands. Producers in Zacatecas state report that one of the main problems is the local marketing of the product, due to the cultural non-existence of frog consumption in the population of those areas. On the other hand, in Jalisco, Aguascalientes and Zacatecas states, only 3 producers that represent 9.67% of the total producers in this region have slaughter rooms with technical specifications in food safety, not finding sanitary certifications in any of the cases by the authorities in the field (Islas et al., 2018).

In Mexico there are 74.3 million internet users, where 65.8% are 6 years of age and older. 51.5% of internet users are women and 48.5% are men. A growth of 4.2 percentage points is observed compared to what was reported in 2017, when 71.3 million users were registered. Of the total internet user population, the group between 25 and 34 years old is the one that registers the highest proportion of Internet users, women in this age range represent 10.4% and men 9.8%. On the other hand, the population 55 years and older is the one that uses the internet the least, registering figures of 4.1% for women and 4.0% for men. The three main activities of internet users in 2018 were: entertainment (90.5%),

communication (90.3%) and obtaining information (86.9%) (Hurtado, 2019). The geographical analysis indicates that the internet use is an urban phenomenon, since 73.1% of the total urban population are users of this service which contrasts with the 40.6% of the connected population in rural areas. In Mexico, there are 18.3 million households that have Internet through a fixed or mobile connection, 52.9% of the national total, which means an increase of 2 percentage points compared to 2017, when the number of connected households was 50.9% (INEGI, 2019).

According to Hurtado (2019), the habits of internet users in Mexico, in the territory there are 82.7 million users, of which almost 77 million have WhatsApp, that is, 93 percent. In Mexico, 52.5% of WhatsApp users use the social network between two and four hours a day on average, while 17% stay more than 6 hours. The present study supports the hypothesis that in Mexico social networks can be an effective means of knowing consumer and market trends in emerging products, having great potential for their dissemination.

The objective of this study is to carry out a diagnosis on the dynamics of preference and consumption of bullfrog meat in the selected population segments in Mexico and to explore the market possibilities for the producers of the central highlands of our country through social networks conducting an analysis of results, which allows us to consider the importance of informing citizens about the benefits of consuming bullfrog meat, thus deriving another high-quality protein diet alternative, highlighting the importance of knowing the areas of opportunity that present aquaculture products for frog producers in the central highlands of Mexico and their dissemination through social networks, which allow to know the possibilities of creating marketing channels for aquaculture products from Mexico arid zones.

METHODOLOGY

The sample distribution was carried out from a stratified non-probability sampling with proportional allocation, for convenience, in 22 states of the Mexican Republic, in 4 geographical areas of the country. For the purposes of this study, they were designated as a). Northern zone that included Baja California, Baja California Sur, Chihuahua, Coahuila and Nuevo León states; b). Central western zone that included Aguascalientes, Jalisco, Guanajuato, San Luis Potosí, Michoacán and Nayarit states; c). Central zone that included Querétaro, Mexico, Mexico City, Morelos, Puebla, Hidalgo states; d). South-southeast zone that included Oaxaca, Tabasco, Campeche, Yucatán and Quintana Roo states.

The study was directed to population segments of each state classified by the Mexican Association of Market Research Agencies (AMAI, according its acronyms in Spanish) as socioeconomic level A/B, C+C, which have the following description: The socioeconomic level A/B is made up mainly (82%) of households in which the head of the family has

professional studies. 98% of these households have fixed Internet in the home, it is the level that invests the most in education (13% of its expenditure) and also the one that spends the least proportion on food (25%), at this level only 7.6 belongs % of the country's population. At level C+, 89% of households at this level have one or more transport vehicles and 91% have fixed internet access at home. A little less than a third (31%) of their spending is allocated to food and what is allocated (5%) to footwear and clothing, is very homogeneous with other levels, 13.7% of the population belongs to this socioeconomic level population of the country and level C, which is a socioeconomic level where 81% of households at this level have a head of household with higher than primary education and 73% have a fixed Internet connection at home. Of the total expenditures at this level, 35% are allocated to food and 9% to education (AMAI, 2018) (Figure 1).

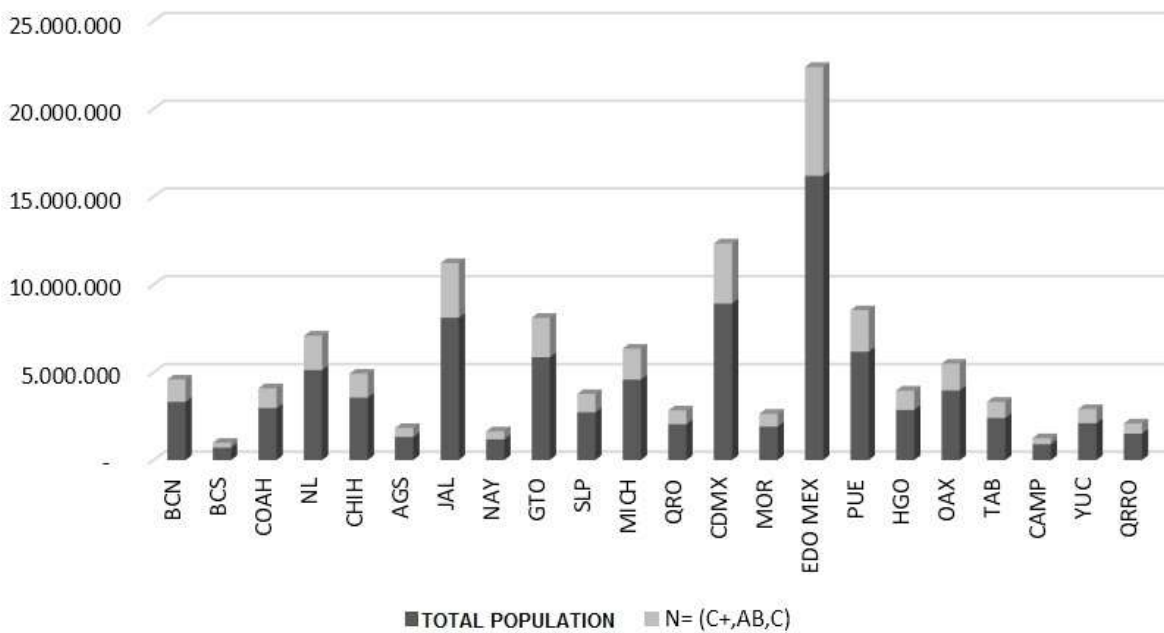


Figure 1. Population segments of socioeconomic level A/B, C+ C in each federative entity with respect to its total population

According to the above, the population indices published by the (INEGI, 2017) were taken through the CUÉNTAME platform, from each selected state, reaching 88'356,808 inhabitants, the strata sample of socioeconomic levels A/B, C+ C for this study was N=33,840,657 based on maximum variances with a reliability of 95% and a standard error of 5%. The calculated sample was n=385 surveys.

In Figure 2, it is shown that for the segmentation of the study population and taking into account that stratification increases the precision of the sample and implies the deliberate use of different sample sizes for each stratum, in order to reduce the variance of each

stratum with respect to the mean of the sample, the proportion proposed by Kish (1995) and described by [Hernández et al. \(2008\)](#).

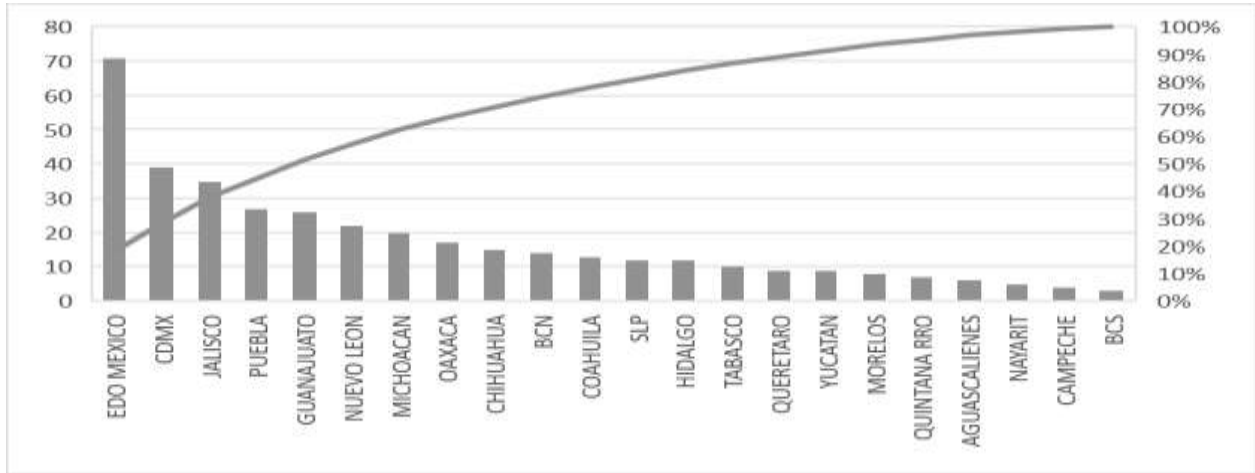


Figure 2. Stratified sampling in the 22 states where the study was carried out

An online questionnaire was applied to the population using the platform ([Formularios Google, 2019](#)) of the selected segments through social networks Facebook and WhatsApp, the previously applied instrument was piloted with 60 people locally, corrected and validated before its application in the studio. The data from the online questionnaires were retrieved into an Excel database for analysis.

The applied questionnaire consisted of 25 questions exploring the variables mentioned in Table 1.

RESULTS AND DISCUSSION

The results of the present study indicate that 25.7% of the surveyed population is between 20 and 30 years of age, 29.6% is between 31 and 40 years of age, 26.5% of the respondents are between 41 and 50 In the elderly, 6.9% of the population is between 51 and 60 years of age and only 4.4% is over 60 years of age. These results show the age distribution in the population segments studied that they have access to electronic devices and internet access and use of the social networks used for this study, this allows us to infer the segments by age that were accessed through social networks and the potential market segment for these products.

Table 1. Variables taken into account for the study

Variables of social scope	Variables economic scope	Preferences and reasons for consuming meat	Product packaging variables
Place of residence	Entry	Chicken	Presentation features
Age group	Monthly expenditure	Fish	Packing weight
Family members	Income for Food	Beef	Prices
Access to social networks	Income for the purchase of meat	Pork	Weight
		Bullfrog	Nutritional content

Most of the 64.5% are families with 3-5 members, while 16.5% of the families have more than five members and another 16.5% are families with 1 to 2 members, 63.7% of the people surveyed allocate between 20 to 50% of their income to the feed purchase, 22.1% of those surveyed spend between 50 and 80% of their income on food and only 12.3%, which is the segment with the highest purchasing power, allocates less than 20% of their income to their food, most of the users of social networks who answered the questionnaire spend more than 50% of their income on food (Figure 3; panel A).

35.1% of the surveyed population allocates between 200 to 600 mx pesos for the purchase of meat of various types, 34% between 600 and 1000 mx pesos, 18.1 allocates between 1000 and 1500 for the purchase of meat and only 12.5 allocates more than 1500 pesos of their income from meat purchase of any type, these percentages represent the socioeconomic strata and the purchasing power of the surveyed segments (Figure 3; panel B).

In the question (From the following types of meat, indicate the order of preference for their consumption?), the type of meat consumed most frequently in 325 people surveyed is chicken meat, second in frequency of consumption is beef meat. Beef with 267 people surveyed, while pork is consumed frequently by 146 people surveyed, for bullfrog meat only 7 of the 385 people surveyed mention consuming frog meat frequently, while 112 people of the total respondents never have tasted frog meat and do not know its characteristics, this is consistent with the result of the question about the frequency of bullfrog consumption where 96.1% of the surveyed population says they eat frog meat between 0 and 1 time a year (Figure 4).

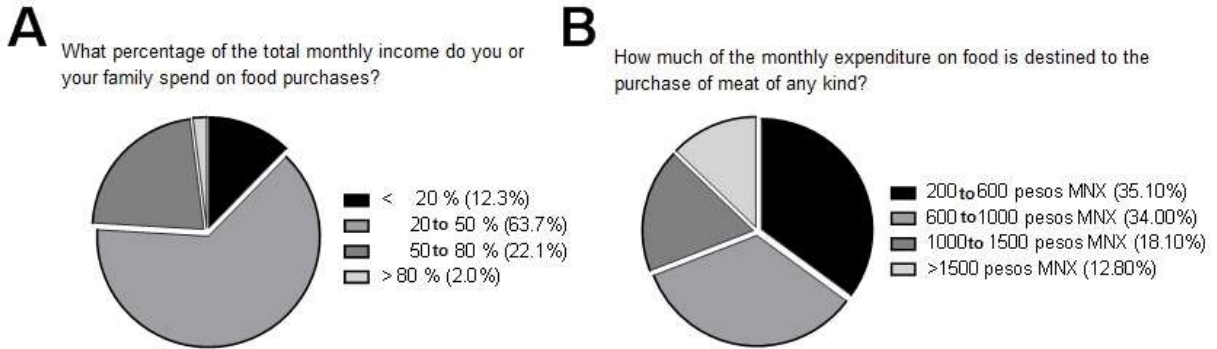


Figure 3. Panel A: Percentage of monthly income allocated to the purchase of food; panel B percentage of monthly expenditure for the purchase of meat

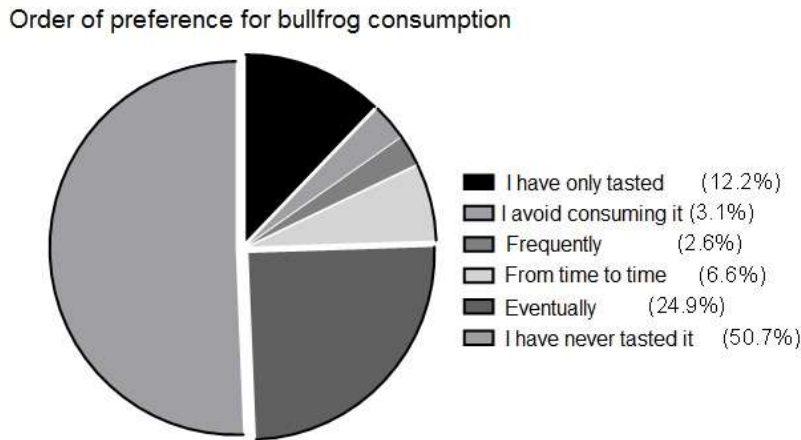


Figure 4. Order of preference for bullfrog consumption

It can be seen that only 14% of the respondents were unaware that the frog is edible, however, 58.1% of the people surveyed would agree to taste frog meat in any of its presentations, in contrast only 16% would not agree to eat frog and 25.6% might agree to eat this product. On the other hand, 29% of people do not consume frog meat because there is no information or advertising on this product, 47% say they are not used to its consumption, 17.6% mention that there is no availability in the market, this allows to see the potential that this type of product could have in the national market.

Regarding people's opinion about the consumption of frog meat, 21% consider that it is a healthy meat, 15.3% consider that it is a low-fat meat, 7.2% consider that it is a high-protein meat, 25.8 % consider the consumption of frog meat for its flavor and only 4.3% consider that they have a habit of eating frog meat. Both contexts infer that the lack of knowledge about the properties of frog meat means that the population does not consume this type of product regularly. The opinion expressed by the people surveyed in all the

states denotes the lack of promotion and dissemination of the characteristics of this product.

When exploring the reasons for not consuming bullfrog, only 1.6% of people habitually consume frog meat, while 48% of people are not used to its consumption, 29.4% do not have information on the benefits of frog meat, and even more so, 16.7% of people mention that there is no availability of the product in the market and only 1.9% of people mention that they do not consume the product due to its high cost. These results clearly define the area of opportunity for the management of product marketing and marketing channels in at least these 4 large regions of Mexico (Figure 5).

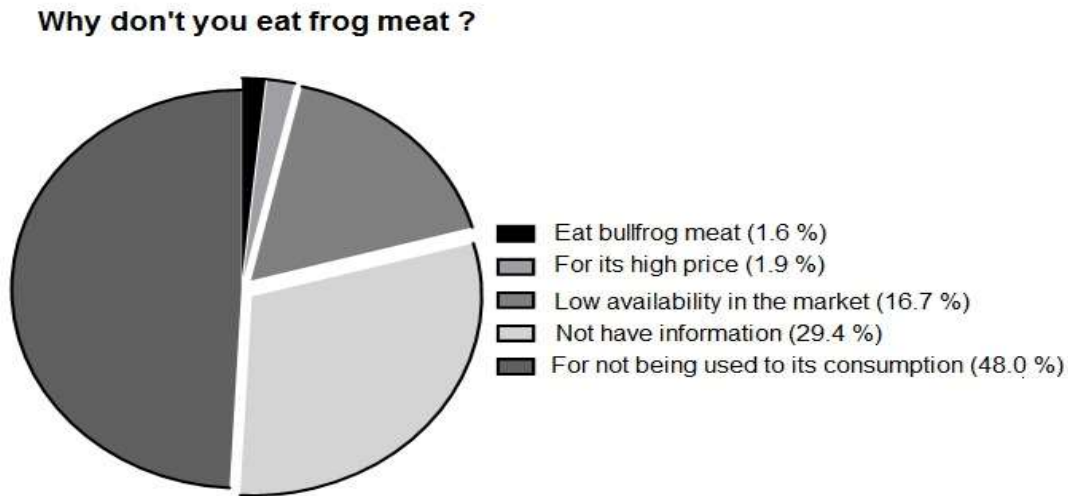


Figure 5. Reasons why the surveyed population does not consume frog meat

In another context, 39.5% of the surveyed population would like to find frog meat in commercial establishments such as restaurants, hotels and supermarkets, while only 9.5% would not like to find frog meat in these commercial establishments, 25.5% perhaps would like find frog meat in establishments and the rest another 25.5% is indifferent to finding frog meat in this type of establishment.

The results suggest that one of the most important characteristics for the people surveyed is the quality of the product and the packaging (29.2%), followed by the need to include in the packaging or product cooking recipes (27.1%), the nutritional information (16.9%), price (14.1%) and consider the possibility of offering prepared food to the public (7.8%).

For the commercialization of products, the presentations and characteristics demanded by consumers are very important, this study shows that there are preferences for fresh product over frozen product, the presentation of half-kilo packages in both frozen and fresh product is that of greater preference, the important possibility of having marinated flank-style presentations that can be attractive to the consumer is shown (Figure 6).

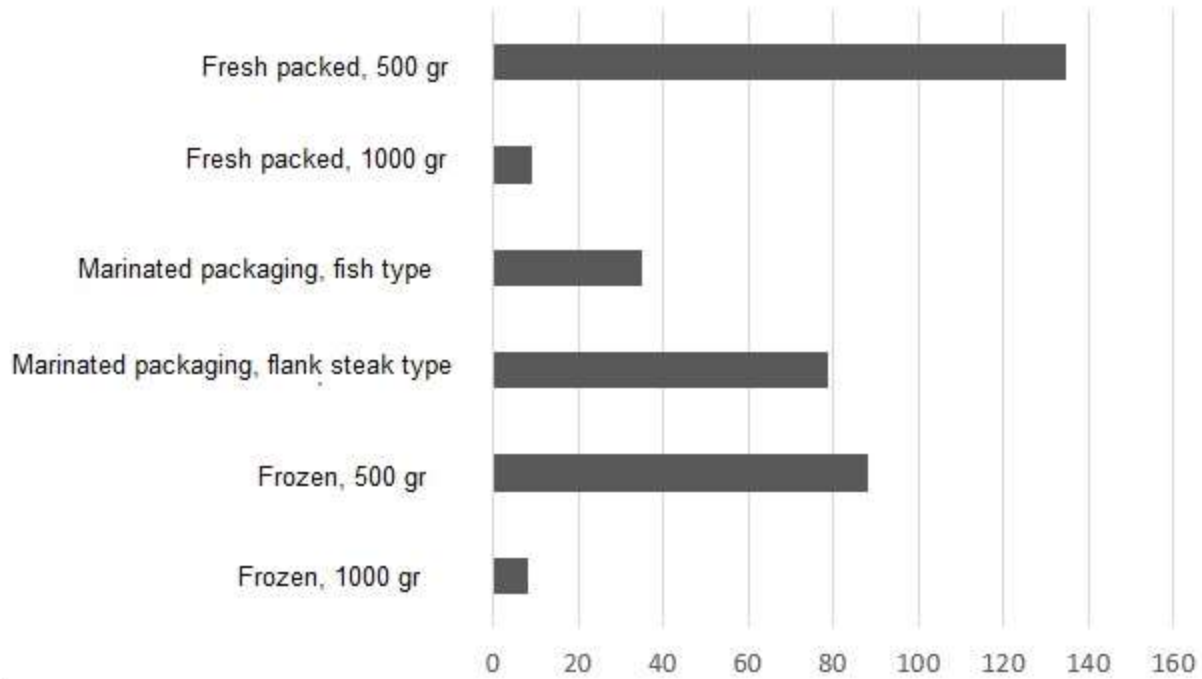


Figure 6. Presentation and packaging preference for frog meat

The results obtained allow us to see the areas of opportunity that exist for the introduction of this product to the domestic market of the country, it also shows the weaknesses that at this moment present the marketing channels of this product and the growing interest of the population for consumption of alternative animal protein sources, despite being considered a type of gourmet product.

The results found in this study indicate the possibility for producers to organize themselves to have slaughter and packaging establishments with quality and safety certification, which would allow them to have more competitive value-added products in the market, despite what was reported by [Islas et al. \(2017\)](#), in the studied central highlands that included Jalisco, Aguascalientes and Zacatecas, there are only three farms that have slaughter rooms and in no case do they have the appropriate sanitary characteristics and specifications, this opens the possibility of management for producers have this type of slaughter and packaging areas to be able to explore the marketing channels in a safe way from the sanitary point of view.

On the other hand, it shows the difficulty that exists for the introduction of the product to the market when it is a product that is little known and little consumed among the population of the three population segments under study, it is important to carry out dissemination campaigns that increase the consumption of this product. In this regard, primary aquaculture products share similar problems since, as described by [Gonzalez et al. \(2016\)](#), the main agents participating in the tilapia commercialization process are: producers, collectors, restaurants and final consumers. The traditional marketing channel

that the product follows from its exit from the farm to its arrival at the final consumer is: producer → final consumer, which is developed by 75% of the agents participating in the process. For their part, 20% of the agents practice two aspects of this traditional channel, represented by: 1) producer → collector → final consumer and 2) producer → collector → restaurant → final consumer, while the remaining 5% develop the channel: producer → restaurant → final consumer; it should be noted that the collector acts as a retailer, in the case of the bullfrog, the marketing channels are not well defined in these terms, the producer → collector → final consumer scheme prevailing, for this purpose this study shows that there is a potential in the marketing systems that bullfrog meat could have in the Mexican market.

CONCLUSION

The usefulness and power of social networks for conducting market research and marketing of aquaculture products is shown, taking into account that there is misinformation in the population about the characteristics and benefits of bullfrog meat, so it is important to carry out dissemination campaigns focused on increasing the consumption of frog in Mexico, as a high-quality protein alternative. The present study can contribute to the producers strengthening their marketing channels for frog meat and its by-products, likewise the cultivation of the bullfrog in arid zones is today an option as an aquaculture activity due to its low water consumption. For this reason, it is important to carry out more market studies of these products that allow their diffusion among the population and open a window of possibilities for commercialization.

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