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Acceptance of Dishes based on Mechanically Separated Meat of Tambaqui (*Colossoma macropomum*) in a Public School, Brazil

Kato HCA[1], da Silva Maciel E[2*], Quaresma FRP[3] and de Freitas AA[4]

[1]MSc in Food Science and Technologies (UFP), Researcher, Brazilian Agricultural Research Corporation (Embrapa), Brazil

[2]Post doctor in Science (USP), Professor at the Federal University of Tocantins, Brazil

[3]PhD Professor at the Professor at the Federal University of Tocantins (UFT), Brazil

[4]Brazilian Agricultural Research Corporation (Embrapa), Brazil

*Corresponding author: Erika da Silva Maciel, Pos doctor in Science (USP), Professor at the Federal University of Tocantins (UFT), Brazil, Tel: 55-6381095453; E-mail: erikasmaciel@gmail.com

Abstract

In Brazil, due to economic and social factors, public policies are needed to grant access to quality nutrition in school. This provision should respect the local food culture; however, in the North, the region with the highest production of inland fisheries, fish consumption among students is still very low. The aim of the present study is to characterize Tambaqui (*Colossoma macropomum*) MSM, suggest planned school dishes based on this MSM and assesses their acceptability among students at the elementary and high school levels in northern Brazil. The study was carried out over one month and was a quantitative (hedonic scale and leftover/intake index) and qualitative research about preference. The participants were 120 elementary- and high-school students chosen randomly after they were authorized by their parents or legal guardians. Fish-based dishes were inserted in the diet of schoolchildren and their acceptability was evaluated. The children were also inquired about their fish consumption routines. The statistical analyses used were frequency tables and chi-squared independence test associated with Fisher's exact test. Two dishes were well accepted by the students; however, the results showed that fish acceptance among younger students are higher than among adolescents. So, policies that promote fish intake and a healthy lifestyle must be stimulated since the early grades.

Keywords: Nutrition Programs and Policies; School Health Services

Introduction

Diet and physical activity are considered changeable factors that, in the long term, greatly impact the prevention and treatment of non-communicable chronic diseases (NCCD), particularly high blood pressure and diabetes [1].

However, the access to a healthy diet does not depend only on individual choices, but means investing in integrated public policies such as educational activities,

Acceptance of Dishes based on Mechanically Separated Meat of Tambaqui (*Colossoma macropomum*) in a Public School, Brazil

Food Sci Nutr Technol

providing healthy school meals, and incentivizing the production, distribution, and commercialization of healthy foods [2].

In Brazil, due to economic and social factors that restrict access to quality diets, public policies are required as safe and effective tools to fight off nutrition-based physiological disorders [3]. In this context, the *Programa Nacional de Alimentação Escolar* (National School Diet Program – PNAE) is the largest diet program in effect in the country, targeting public-school students to offer at least 20% of their daily nutritional requirements while contributing to the formation of good dietary habits among children and adolescents [4].

Providing healthy foods during school years is crucial since, in this phase, dietary habits are formed and consolidated, thus lowering the odds of inappropriate practices in adulthood that may favor the development of NCCDs [5].

Therefore, including fish in the school diet is considered a key matter [6] because this food is considered an excellent source of proteins with high biological value. Moreover, fish is an important source of calcium, vitamins D and B12, and high-availability iron [7]. The World Health Organization (WHO) suggests that a diet that includes fish in children's diet may directly influence nutritional and health parameters in adulthood [8].

One of PNAE's foundations is valuing the local dietary culture. In northern Brazil, several modalities of obtaining fish commonly coexist – from subsistence fishing aiming to provide fishermen's families to large-scale industrial fishing, an important regional economic activity [9]. This stresses the need for including fish in food meals, however, a study of 21 menus suggested to schools in the North region showed that in only one was fish provided, which evidences a deficiency in its offer and purchase [10].

The reasons for the little use of fish meat in the school community are mainly associated with the lack of habit of preparing and consuming it, complex logistics, high price, and the presence of spines [11-14].

While evaluating school meals in Spain, concluded that fish is among the most often rejected foods by students and that a way of increasing acceptance would be to offer a wider variety of dishes using products with no spines [15].

Hence, an alternative appropriate to the school reality is the use of mechanically separated meat (MSM), an industrial by-product of fish filleting that is one of the safest ways of offering fish meat to students while maintaining the important nutritional values [16]. Therefore, the present study aims to suggest Tambaqui (*Colossoma macropomum*) MSM-based dishes and assess its acceptance among a group of elementary- and high-school students in a public school in the city of Palmas, TO, Brazil, as a way of promoting the inclusion of fish in the diet of schools belonging to the public education system.

Materials and Methods

Obtaining Tambaqui MSM

Two groups were divided with 48 individuals each: Tambaqui 0.7-1.0 kg (T1) and 1.0-1.3 kg (T2). The fishes were stored in cool boxes between layers of ice flakes. Each group was rinsed with cold water, decapitated, gutted, opened longitudinally into halves and washed again. After being washed, each set of three fishes were weighted, randomly chosen within the group. Each set was subjects to deboning process. The muscle was extracted using a deboner machine (Brusinox, SC, Brazil) equipped with a drum (5 mm holes). The minced fish obtained of each set was weighted to calculate process yield and used to determinate the proximate composition. Moisture, protein, fat and ash contents were determined according to the method of AOAC [17].

Developing MSM Dishes

Dishes with tambaqui MSM were developed taking into account the current menus of the state schools and the cooks' observations and suggestions by making small adaptations on the ingredients of the dishes already offered to the students so that the nutritional requirements of the school diet program were met. Thus, tambaqui MSM was experimentally included in the school meals. The dishes were previously prepared and tested in a laboratory.

MSM in 5 kg frozen blocks was chosen to prepare the dishes. The school cooks received training to prepare the dishes and check for possible modifications in order to avoid greatly changing their routines.

The school menu was structured by including the following dishes: nutritive tambaqui rice, cold macaroni salad, and tambaqui pie. These menus were prepared by the project's team along with the school cooks.

Acceptance Test

The dishes were offered weekly over a month to the elementary- and high-school students of a state school in the city of Palmas, TO, Brazil. The students were randomly selected from among those who received parental consent to participate in this research, which is the limiting factor for the total number in groups.

The mean caloric (energy) and protein intakes recommended by PNAE were used to calculate the nutritional adequacy. These guidelines mandate a minimum of 350 Kcal and 9 g proteins in school meals [18].

All dishes were broken down into their ingredients and, from their composition and per capita intake (amount in grams), their nutritional values were evaluated following the indirect composition of the *Tabela Brasileira de Composição de Alimentos* (Brazilian Food Composition Table) [19].

The dishes were served and the acceptance test was carried out using a hedonic scale and leftover/intake method: The hedonic scale used verbal file ranging from 1 to 5, where ratings from 1 to 3 are considered as "dish not accepted" and 4 and 5, "dish accepted."

The leftover/intake assessment considered the net weight of the tray with the finished dish, from which the leftover weight was subtracted. The latter was the weights of the food remaining on the tray and after the meal and of the leftovers on the plates, which were collected into plastic bags and weighed individually. The result was the total intake, which was compared as a percentage of the total produced [20].

Data Analysis

For the MSM yield, statistical analysis was performed with the PSPP 0.8.4 software (FSF Inc., Boston, MA, USA) using a one-way ANOVA. A value of $p < 0.05$ was considered statistically significant and adjusted according to Shapiro-Wilk.

For PNAE, a dish is considered accepted when its acceptance is equal to or above 85% in the hedonic scale or over 90% in the leftover/intake ratio. Data were tabbed and the statistical analyses were carried out in Microsoft Excel (Microsoft Excel 2010 SP2 MSO; Microsoft Corp., Redmond, WA, USA). Numerical data results are presented as percentages. Besides the acceptance tests, the students answered a questionnaire on their fish consumption habits. This evaluation considered only the valid answers and excluded the answers such as "I don't know," "I don't consume it," or empty forms. Data were tabbed in PSPP 0.8.4 (Free Software Foundation Inc., Boston, MA, USA), where the descriptive frequency tables were created. The variables acceptance, sex, schooling, and frequency of intake were compared using descriptive statistics through the non-parametric chi-squared test for independent samples (p<0.05) associated with Fisher's exact test.

The Human Research Ethics Committee of the Lutheran University of Brazil (Protocol CAAE 07564412.0.0000.5516) approved the study protocol and all participants' parents or legal guardians provided written informed consent for child assent.

Results

The deboning process of tambaqui clean carcass in different weight classes produced variable yields and a similar composition, as shown in Table 1. The yields and composition established in this work aimed to found the purchasing process of food institutional market in Tocantins, Brazil.

Group	Yield (Mean±SE)	Moisture (Mean±SE)	Protein (Mean±SE)	Fat (Mean±SE)	Ashes (Mean±SE)
Tambaqui (0.7-1.0 kg)	46.31±1.13	70.1 ± 1.2	25.6 ± 0.9	5.3 ± 1.8	2.3 ± 0.4
Tambaqui (1,0-1.3 kg)	48.25±0.38	69.0 ± 1.3	24.3 ± 0.8	6.1 ± 1.5	2.4 ± 0.5

Table 1: Yields and proximate composition in different classes of weight of Tambaqui clean carcass.

Among the results, it is worth pointing out that all dishes met the PNAE requirements regarding the macronutrient recommendation per portion offered to the students (Table 2). As for the acceptance test (Table 3), the results show that the macaroni salad was rejected by part of the students in both the elementary and high schools. The nutritive rice received the best acceptance indices, perhaps because it is a hot dish and because rice is easily accepted in the regional diet.

Dish	Kcal	Carbohydrates	Proteins	Lipids
Macaroni salad	444.42	70.86	16.62	8.5
Nutritive rice	358.01	53.68	14.53	7.15
Tambaqui pie	356.92	44.82	16.74	9.34

Table 2: Nutritional evaluation of the dishes through ingredient breakdown.

Source: Research data.

	Elementary school	High school	Both
Dish	Hedonic scale (%)	Hedonic scale (%)	Leftover/intake (%)
Macaroni salad	83.4	57.5	79
Nutritive rice	86	37.5	84
Tambaqui pie	100	93.8	99

Table 3: Acceptance of the Tambaqui MSM-based dishes by elementary- and high-school students.

Source: Research data.

The pie was highly accepted according to both methodologies employed and is a dish whose inclusion could be recommended for the state's school menus. The fish consumption questionnaire from 36 high-school and 37 elementary-school students (Table 4) showed that 62.5% and 70.6%, respectively, do not consume fish at home or do so less than once a month. Among the most consumed fish in the household, peacock bass and round species (tambaqui, Cubera snapper, pacu) stand out at both school levels. The elementary-school students prefer roasted dishes (42.4%), while the high-school students prefer fried fish (61.3%).

		Elementary school (%)	High school (%)
Sex	Male	54.3	40
	Female	45.7	60
Fish consumption Fish consumption frequency	Never	26.5	21.9
	Once a month	44.1	40.6
	Twice of three times a month	5.9	12.5
	Once a week	5.9	9.4
	Twice a week or more	17.6	15.6
Most consumed species	Round fish species	21	31.9
	Peacock bass	26.3	40.9
	Pirarucu	10.5	4.5
	Piau/Piaba	15.8	13.6
	Sardine	15.8	4.5
	Others	10.5[a]	4.5[a]
Most consumed dish type	Fried	36.4	61.3
	Roasted	42.4	19.3
	Sauced	21.2	19.3

Table 4: Fish consumption habits reported by elementary- and high-school students as percentage of valid answers.

[a]Other species mentioned were: Tetra, pirana, spotted sorubim, and gilthead bream
Source: Research data.

In order to identify the possible relations among the study's qualitative variables (Table 5), it can be seen that acceptance is a variable that significantly depends on the students' school level, but is not influenced by sex or fish intake at home.

Factors	Acceptance			
	Accepts		Rejects	
Sex	n	%	n	%
Male	27	47.4	6	37.5
Female	30	52.6	10	62.5
χ^2 (value and p)	v=1.23		p=0.483	
School level				
Elementary school	36	63.2	5	31.2
High school	21	36.8	11	68.7
χ^2 (value and p)	v=3.99		p=0.023*	
Consumption frequency				
Never	12	22.6	4	25.0
Once a month	23	43.4	9	56.2
Twice to four times a month	9	17.0	1	6.2
Over four times a month	9	17.0	2	12.5
χ^2 (value and p)	v=0.40		p=0.660	

Table 5: Chi-squared (χ^2) values between dish acceptance, sex, schooling, and consumption frequency at home according to the independence test.

*$p < 0.05$

Discussion

Lee endorsed as an effective way to promote nutrition and health in the school setting, coordinating actions that integrate school activities; a sequential and planned nutrition curriculum; aspects of the school environment such as improvements in nutrition-related school policies and physical improvements to food-related areas; and engagement with families and broader school community [21]. Given the low fish intake observed in the results, the school diet represents a good policy to include and promote fish consumption, which must be allied to planned nutritional education and health promotion through physical activity.

Dishes that were not accepted by the high-school students were well accepted in elementary school, which shows that acceptance significantly depends on the school level. This behavior can be justified by the age difference, which is an important and determining component in the consumption attitude towards fish [22].

Fish acceptance is higher among children below eight years old and the preference for this type of protein decreases as they enter puberty, along with a greater preference for unhealthy foods. Hence, including fish as early as the first school grades is a relevant strategy [23].

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Younger students tend to consume foods such as fish and vegetables more often, possibly due to the greater influence of the parental and teacher authority compared to older students [24,25]. However, mothers strongly resist offering fish to children mainly for fear of accidents with spine ingestion [26].

In case of older students, this influence loses strength and their nutritional habits are influenced by their peers' dietary patterns and habits [27]. When analyzing 11-year-old children in England Ross identified that their food choice was not determined by the health attributes of food but rather that values of preference, play, socialization and convenience, besides peer influence at school, lead to children adopting a negative attitude towards seafood and, finally, to refuse consuming it [28].

In Brazil, Rivera and Souza point out that the diet of adolescents, irrespective of whether they study in public or private schools, has a low intake of milk and dairy, fruits, vegetables, whole grains, and fish, and a high intake of lipid-rich foods [29].

Nonetheless, the present research identified that dish acceptance was not linked to the frequency of fish consumption at home, which was low for both school levels. This result matches Rivera and Souza [29], who, when assessing the dietary habit of students in a rural community, identified that fish was not consumed by 70% of the subjects. One of the factors mentioned for the low consumption was the lack of habit. Borges *et al.* also point out that, in Brazil, fish acceptance is restricted since it is not adopted as a dietary habit [30]. Loureiro highlights that effective voluntary healthy food adoption by students must be preceded by a set of strategies at their individual and environmental levels [31]. For younger students, the author recommends the exposition to foods in a positive social context, while adolescents must be the target of behavior-changing strategies, such as self-assessment, clarification of expectations, and knowledge on healthy eating for them to be able to make competent choices. It is important these strategies to promote consumption keep being stimulated and carried out at the school level since the World Health Organization identified that schools are the ideal setting for promoting better health and nutrition [32]. The child to benefit by the inclusion of fish into the school diet may also play an important role as a multiplying agent by incentivizing fish consumption in the family [33]. These efforts must be expended since, as reported by Trondsen *et al.*, fish consumption in childhood and the belief that the diet can be healthy is strongly related to the high fish consumption in adulthood [34].

Conclusions

Despite the low fish intake by the subjects in the present study, it was found that including tambaqui MSM-based dishes in school menus is well accepted in the public school system in the North region of Brazil. The acceptance among children in the early school levels is higher than among adolescents, which reflects the need for the early inclusion of this food in the students' routine, besides differentiated nutritional education programs for this level. A shortcoming of this study was the number of subjects in the sample and the number of dishes tested due to MSM storage and transportation to the school and the number of portions offered, since a larger number of portions would raise research costs. As a future perspective, it is important to consider acceptance tests in an elementary school community with a larger sample, while employing a study design that includes other dishes. The economic viability of including the dishes in the school diet must also be taken into account. Furthermore, a concurrent nutritional education effort towards students and their parents or guardians must be undertaken aiming to stimulate the consumption habit and demystify the prejudices against this type of protein.

Collaborations

Kato HCA and Maciel ES contributed toward the conception and design, data collection, data analysis, interpretation of data, and writing of the manuscript. Quaresma FRP and Freitas AA contributed to the interpretation of data, and critical revision of the manuscript.

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