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## AÇAÍ PULP DEMAND IN THE RETAIL MARKET OF BELÉM, STATE OF PARÁ<sup>1</sup>

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**ABSTRACT** - The aim of this work was to estimate the parameters associated to the demand for açai pulp in the retail market of Belém. Multiple regression analysis was applied to identify the key variables that impact on product consumption and to estimate the price and income elasticities and cross demand. The econometric estimation method applied was the least squares to correct heteroscedastic variance problems. Results have shown that the demand for açai pulp is price and income inelastic. Fish and cassava flour were confirmed as complementary products of strong influence on the decisions of consumers. Product quality, with regard to its association to Chagas disease, also revealed a strong influence on product choice for household consumption. Finally, the socio-economic benefit of açai pulp was R\$ 762.78 million per year.

**Index terms:** Açai market, demand elasticities, food safety, Amazon.

## A DEMANDA DE POLPA DE AÇAÍ NO MERCADO VAREJISTA DA CIDADE DE BELÉM, ESTADO DO PARÁ

**RESUMO** - O objetivo deste trabalho foi estimar os parâmetros da demanda por polpa de açai do mercado varejista de Belém. Aplicou-se a análise de regressão múltipla para identificar as principais variáveis que influenciam sobre as decisões do consumo do produto e estimar as elasticidades preço, renda e cruzada da demanda. O método econométrico de estimação foi o de mínimos quadrados robustos, para corrigir problemas de variância heterocedástica. Os resultados mostram que a demanda de polpa de açai é inelástica a preço e a renda. Os produtos peixe e farinha de mandioca confirmaram-se como produtos complementares de forte influência nas decisões dos consumidores. A qualidade do produto, em função da associação do produto à doença de Chagas, revelou forte influência na escolha do produto para o consumo das famílias. Finalmente, o benefício socioeconômico da polpa de açai foi de R\$ 762,78 milhões por ano.

**Termos para indexação:** Mercado de açai, elasticidades da demanda, segurança alimentar, Amazônia.

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## INTRODUCTION

Açaí pulp, or simply açaí, is one of the main foods of the population of the state of Pará. Açaí is consumed in the fresh form in Belém and when it is combined with flour and fish, is the basis of the food diet of the Amazonian riverside and urban center populations, especially those of lower purchasing power (SANTANA et al., 2012; SANTANA et al., 2014; FREITAS et al., 2015).

Some studies have analyzed the behavior of the açaí market both at extractive and wholesale level in the State of Pará (NOGUEIRA et al., 2013). Others have analyzed the behavior of prices and the integration of the açaí fruit with the market of other tropical fruits (NOGUEIRA et al., 2013, HASKELL, DIXON, 2013, OGAH et al., 2014).

The pulp market has received little attention due to the importance of the network of horizontal and vertical connections defined in the local economy. Horizontal connections are essentially established with cassava flour and fish markets. Vertical connections are established with families who collect the fruit and sell the surplus to middlemen who negotiate with wholesalers and retailers of urban centers. In general, the destination of açaí fruits is supermarkets, ice cream factories, feeding points and agroindustries, where they are processed (SANTANA et al., 2014). The pulp, in turn, is destined to local, national and international markets. The share marketed in the national and international markets is expanding, but the precarious conditions of fruit extraction and commercialization logistic, which makes the supply increasingly inelastic, causes an impact on the equilibrium prices of the local market and, as a consequence, affects the consumption of low-income populations.

The governance of this production chain is inefficient with regard to the regulation of production, marketing, processing and distribution for consumption (NOGUEIRA et al., 2013). The pulp consumed in the local market is not submitted to pasteurization, or to any chemical transformations that modify the natural characteristics of açaí pulp. Therefore, food quality and safety conditions still cause problems, according to reports that associate cases of Chagas' disease with açaí consumption due to the precarious hygiene conditions of fruits before processing, according to Santana et al. (2014) and Yamaguchi et al. (2015).

In this context, this work amplifies the results generated by Nogueira et al. (2013) on the açaí fruit market and by Santana et al. (2014) on the segmentation of the açaí pulp retail market in Belém,

highlighting the importance of socioeconomic factors and product quality in the household consumption decision and in the definition of public policies towards the aggregation of value to the product and providing food security for the population. Thus, we question the magnitude of the effect of product quality and educational level on açaí consumption, in addition to variables price and income in the retail market of Belém.

To answer this question, the aim of the study was to specify the demand for açaí pulp and to estimate the parameters associated to the following explanatory variables: product quality, educational level, açaí price, income, price of complementary products, and to determine the total monetary value of the socioeconomic benefit of açaí pulp for the families of Belém.

The study was structured in three sections, in addition to the introduction. The first describes the methodology used to obtain data, the econometric specification of the demand equation and the socioeconomic benefit of açaí pulp for the population. The second contains the analysis and discussion of results of the açaí demand model and the total value of the benefit generated by açaí consumption. In the third one, the conclusions of the work are presented.

## MATERIAL AND METHODS

### Study area and data

The study area is the Belém açaí pulp retail market, as it is the main consumer center of the state of Pará, Brazil and the World, whose dynamics of factors influencing the açaí pulp consumption decisions is still little studied, which compromises the effectiveness of the governance of this productive chain for the economy of the state of Pará.

The monthly açaí pulp consumption data were obtained from the application of a questionnaire with qualitative and quantitative questions in a sample of consumers in 150 açaí sales concentration sites, including greengrocers and supermarkets, as defined in Santana et al. (2014). In all market segments, the buying and selling conditions of most consumers and sellers are strongly defined by the proximity economy operating in these sales outlets.

The population corresponds to the number of families of Belém, estimated at 348 thousand. Thus, a probabilistic sample, determined according to Santana et al. (2014) and Santana et al. (2014a) was used:

$$n = \frac{p \cdot q \cdot z^2 \cdot N}{[(N-1) \cdot e^2 + p \cdot q \cdot z^2]} \quad (e01)$$

where:

$N$  is the size of the population living in Belém in 2010 and was estimated at 348 thousand families;  $p$  is the proportion in which the characteristic to be researched is present in the universe of the 348 thousand families with the possibility of being interviewed, equal to 50% favorable and 50% unfavorable to açai consumption, that is, the largest possible variance is estimated to ensure reliability;  $q = (1-p)$  and  $p.q = 0.25$ , with  $n.p \geq 5.0$  and  $n.q \geq 5.0$ ;  $z$  represents the normal curve score for the 95% confidence level, equal to 1.96, acceptable in social researches (SANTANA et al., 2014);  $e$  is the estimation sampling error of 10.0%, which is the maximum value of tolerance in relation to the results of the survey; and  $n$  is the sample size or the number of people interviewed, 362 consumers, representing a sampling error of 5.15%, after eliminating 23 respondents due to the presence of outliers and / or lack of information on some of the economic variables price, quantity and income.

### The demand for açai pulp

The consumer theory proposes that the demand for a product necessarily has a negative correlation between quantity demanded and price and a positive correlation between quantity and consumer's income (NOGUEIRA et al., 2013, WEERAHEWA et al. 2013, COSTA, SANTANA, 2015). Therefore, the amounts demanded tend to vary in a direction contrary to the market price of açai, keeping constant the effects of the other explanatory variables on the demand. Thus, when the price of the product increases, the consumer, with fixed income, cannot buy the same amount of that product he used to buy, then the consumer processes an adjustment to smaller amounts, and vice versa. On the other hand, variations in the *per capita* income tend to produce changes in demand in the same direction, keeping constant the effect of the other variables. Therefore, a product classified as a normal good, as income increases, the family tends to acquire more of the product, but at a ratio less than proportional to the increase in income.

In addition to variables price and income, others may be included in the demand equation, depending on the reality of the local market. The following variables were added to the demand equation: educational level of the interviewed consumer, product quality, *per capita* income, price of fish and two types of cassava flour as complementary products of açai and a dummy variable to identify the difference in consumption of families with income equal to or greater than R\$

2.000,00 / month. Other variables, such as price of jerked meat, shrimp and water meal were also tested, but did not show statistical significance.

Variables educational level and product quality tend to produce changes in demand in the same direction. An increase in consumer's schooling (measured by the number of years of formal study) and improvement in product quality in relation to food safety conditions (fruit hygiene, packaging, pulp storage and brand) and suitability of consumption habits also tend to increase the demand for açai pulp. Cassava flour and fish are considered the main complementary products of açai (SANTANA et al., 2014; NOGUEIRA et al., 2013).

Finally, dummy variable DV assumes value equal to 1 for consumers with incomes higher than R\$ 2.000,00 / month and zero value for other consumers. If the coefficient associated with such a variable is positive and different from zero, it indicates that the demand of such consumers is higher than the average consumption of other consumers with lower income. This evidences the influence of income distribution on açai consumption and suggests a public policy not to restrict the right of access to this food by families with income less than R\$ 2.000,00. This family income value represents an inflection in the household consumption curve for the market basket products, according to data from the Family Budget Survey (FBS) for Brazil. From this income level, elasticity tends to decrease for low added value products. Therefore, it is expected that there will be a difference in the levels of açai consumption among these categories of consumers due to the income effect.

The demand for açai pulp is defined assuming a situation of equilibrium with a fixed supply in the very short term, understood as the harvest of one year. The research was carried out in the months of September to November, considered the peak harvest of açai, and this amount offered represents the maximum availability of the product for this horizon of very short term. Thus, the market is regulated by demand, since the product is perishable, and the production units do not freeze the product due to the preferences of consumers, and because they do not have the structure to expand the supply in an instantaneous form.

The demand was specified as follows: (e02)

$$Q_{açai_i} = a + b_1 Pa_{açai_i} + b_2 Income_i + b_3 Education_i + b_4 Quality_i + b_5 PTCF_i + b_6 PTM_i + b_7 PFish_i + b_8 DV_i + u_i$$

In that the dependent variable, *Qaçaí*, is the per capita quantity of açaí pulp consumed (liter of açaí / month) by family *i*, in the retail market of Belém.

The explanatory variables are: *Paçaí* is the average price of açaí paid by family *i*, in (R\$ / L); *Income* is income of family *i*, in R\$ / month; *Educacion* corresponds to the education level of respondent *i*, given in schooling years; *Quality* is the importance given to the quality of açaí by respondent *i* (refer to the hygiene and safety conditions used in the fruit processing). This variable assumes value 1 for quality importance attribute as influencing the purchase decision and zero for no influence; *PTCF<sub>i</sub>* is the price of traditional cassava flour consumed by family *i*, in R\$ / kg; *PTM<sub>i</sub>* is the price of tapioca meal consumed by family *i*, in R\$ / kg; *PFish<sub>i</sub>* is the price of fish consumed by family *i*, in R\$ / kg; *DV<sub>i</sub>* is the dummy variable that assumes value 1 for families that earn at least R\$ 2.000,00 / month and zero for the other consumers of the açaí pulp retail market in Belém.

$b_j$  are the coefficients to be estimated and represent the individual influence of each variable on açaí consumption and  $u_i$  is the random error term with mean zero and constant variance.

The elasticity coefficients should be estimated from the ratio between the percentage variation in quantities demanded and the percentage variation in açaí prices, household income and prices of other quantitative variables included in the equation (WEATHERSPOON et al., 2013; COSTA SANTANA et al., 2015).

In order to estimate the total socioeconomic benefit value of the açaí pulp for the consumers of Belém relative to the year 2010, the average value of each explanatory variable was substituted in the demand equation; the result was added to the intercept to generate a new demand equation only as a function of price:  $Qaçaí_i = A - b_1 Paçaí_i$ . Thus, parameter A incorporates the influence of all demand-shifting variables. The area bounded by quantity and price axes, and below the demand line, represents the monetary value of this benefit.

## RESULTS AND DISCUSSION

The sample had confidence level of 5% and sample error of 5.15%. The mean family size was 4.0 people, and the consumption frequency was 2.5 times per month. Açaí pulp consumers in the retail market of Belém in general are differentiated by the quantity purchased, family income and educational level. The

average annual consumption per family was 38.01 liters and deviation of 13.66 liters. In relation to variable average real per capita family income, the value of R\$ 1.612,68 per month was obtained, with deviation of R\$ 677.86 / month. The average price of açaí was R\$ 5.74 per liter, with deviation of R\$ 1.93. The average prices of tapioca and traditional meals and fish were respectively R\$ 5.17 / kg, 4.79 / kg and R\$ 5.19 / kg. As for the educational level, 79.33% had up to high school and only 20.67% have higher education and / or graduate studies.

The relevant explanatory variables included in the açaí demand equation explained 87.86% of açaí pulp consumption variations (Table 1). The F statistics was significant at 1%, showing that the equation is valid to represent the demand for açaí in the retail market of Belém. The error term presented a heteroscedasticity problem and was corrected by the White method, using the EViews software<sup>7</sup>. The Durbin-Watson statistics showed that there is no first-order serial autocorrelation problem, as expected for cross-section data samples (COSTA; SANTANA et al., 2015). The inflationary variance test allowed rejecting the hypothesis of the presence of multicollinearity among independent variables. Therefore, the demand equation was correctly specified, and the results are valid.

According to results of Table 1, it was observed that the autonomous consumption, expressed by the value associated with the constant term, was positive and presented value equal to 9.46 L / family / month. This would be the maximum per capita açaí consumption of interviewed families, without the influence of explanatory variables. When considering the income distribution, it was found that the autonomous consumption of families with monthly income from R\$ 2.000,00 was 21.20 L / family / month.

From this knowledge, it is estimated that for each variation of R\$ 1,00 in the açaí price, the amount demanded decreases by -1.79 L per family. The income coefficient showed a positive correlation with açaí consumption, indicating that, for unitary increases in household income, demand increases, keeping the effects of the other explanatory variables constant.

The price-elasticity coefficient of demand for açaí equal to -0.8114 indicates that demand is price inelastic since, in response to price increases of 10%, the interviewed families tend to reduce the amount consumed by 8.11%, *ceteris paribus*. That is, the variation in the quantity demanded of açaí, on average, was less than proportional to price changes. This result is expected because the product



is perishable and has low added value, since the pulp is consumed shortly after the fruit is pulped (SANTANA et al., 2014).

The demand for açaí pulp is more price elastic than the demand for extractive fruits, whose price elasticity was -0.209 and for the Pará fruit aggregate of -0.6799, for the period from 1995 to 2005 (SANTANA et al., 2011; SANTANA et al., 2012). Considering the temporal evolution, the estimated price elasticity of açaí pulp is increasing: in 2008 it was estimated at -0.191 by Santana et al. (2012) and reached -0.8114 in 2010, mainly due to improved quality in processing, packaging, pulp storage and marketing.

With the income-elasticity coefficient equal to 0.8655, the açaí pulp is classified as a normal good. Therefore, in response to increases of 10% in household *per capita* income, demand tends to increase by 8.65%, keeping constant the effects of the other variables. Therefore, açaí consumed in Belém can be classified as an essential product, since it increased less than proportional in response to increases in income.

In relation to other products, açaí is more income elastic than milk, which presented elasticity equal to 0.439 in the Belém market (SANTANA et al., 2010). The income elasticity of the Pará fruit aggregate was 0.7201 (SANTANA et al., 2011). When considering the evolution in time, the income elasticity of açaí pulp presented a strong increase in relation to 2008, estimated at 0.167 by Santana et al. (2012). The local demand for açaí pulp is becoming more elastic due to improvements in quality and the restriction of fruit supply to the local market, given the increase in commercialization for the States of Amapá and Maranhão and mainly to the industrial processing, whose product destination is to supply the national and / or international markets. These factors make prices higher and the low purchasing power and the attempt to maintain the same consumption level make adjustment in consumption more sensitive to income changes.

With respect to cross-relations with the consumption of other products, it is known that açaí is generally mixed with cassava flour (several types, in the case of Pará) and / or with fish. The cross-elasticity of demand for açaí in relation to traditional and tapioca flours (-0.4542 and -0.6783) indicates that such products are complementary and, in response to 10% price changes, consumption tends to fall, respectively, by 4.74% and 5.74% for traditional and tapioca flour. In relation to fish, the cross-elasticity was -0.806, indicating that açaí consumption tends to fall by 8.06% in response to a 10% increase in the

fish price, *ceteris paribus*. Therefore, the magnitude of coefficients shows that these products cause strong impacts on the adjustment of açaí consumption of families in the state of Pará.

Tapioca flour is considered the classic blend of açaí pulp, but the relatively higher price than traditional flour has a stronger impact on consumption, especially for lower purchasing power families, whose average *per capita* consumption is lower due to the higher price. Fish, in addition to its relatively higher price compared to flours, and due to that fact that it is the most easily accessible protein product for consumers, may make a difference in flavor and make the combination of food (açaí, flour and fish) preferential, since is the food of greater weight in the consumer demand for açaí in the state of Pará (NOGUEIRA et al., 2013; SANTANA et al., 2014; FREITAS et al., 2015).

These products have a coincident seasonal period, a characteristic that must be taken into account in the design of policy actions to regulate the production and marketing of these products, so that governance contemplates the three productive chains on the behalf of extractive products, of processing units and açaí pulp consumers. Currently, the institutional arrangement focused on açaí has low efficacy in the governance of these chains, given that the unidirectional relationship prevails in the price formation of these products and in determining the amount to be marketed in the local market.

The educational level of consumers positively influences the consumption decision of fresh açaí, also indicating that higher educational level can contribute to increase the consumption of better quality açaí, in part by knowledge of the nutritional properties of the product and food safety of the population.

The relationship between açaí consumption and educational level showed that, when the consumer changes from one educational level to another, the amount of açaí consumed increases by 1.30 liters per family per month, leading to a monthly increase of 452.4 thousand liters. This result is consistent with the consumer's theory, which tends to associate the increase of knowledge with the demand for product quality, especially with regard to food safety and nutritional content. Thus, the demand for products that meet these quality requirements tends to increase.

In fact, product quality had a strong influence on açaí consumption, given that, for those who take this item as a reference for food safety, product consumption may reach 4.6596 liters *per capita* above the average consumption of families that do

not take into account this aspect (Table 1). That is, considering the amount of families that take into account açai quality (110,568 families \* 4.5696 L per family), the increase would be 515.2 thousand liters per month.

In Belém, the history of quality açai consumption shows this increase, since, in the 1980s, only açai sold in greengrocers was consumed, then, this consumption was replaced by açai provided by supermarket segments, in which the product presents a higher quality standard, according to Santana et al. (2014). Açai pulp suppliers are currently improving the product quality as a result of the consumers' demands and the action of the surveillance agencies (SANTANA et al., 2014; FREITAS et al., 2015).

Finally, the açai pulp benefit value for consumers of Belém was determined from the following demand equation:  $Q_{açai} = 25.579 - 1.791 Pa_{açai}$ . The monetary value given by the area defined by this equation was equal to R\$ 182,66 per family per month. This is the socioeconomic benefit that the monthly consumption of 12.67 L of açai pulp generates for each family. The expenditure on the acquisition of this amount of product represents only 51.5% of the benefit or satisfaction obtained by the family. Multiplying this result by 12 months and by 348 thousand families, there is a total monetary value of R\$ 762,78 million per year, which represents the total benefit generated by this segment for Belém in the year of 2010.

**TABLE 1** - Results of the demand model of fresh açai for the retail market of Belém.

Variable	Coefficient	Standard deviation	Statistics t	Elasticity
Constant	9.4632 **	1.7326	6.4618	-
Price	-1.7910 **	0.1852	-9.6706	-0.8114
Income	0.0068 **	0.0007	9.7143	0.8655
Educational level	1.3015 **	0.4447	2.9266	-
Product quality	4.6596 **	1.0080	4.6226	-
Traditional flour	-1.2008 *	0.5358	-2.2411	-0.4542
Tapioca flour	-1.6615 *	0.7303	-2.2751	-0.6783
Fish	-1.9686 **	0.6032	-3.2636	-0.8057
DV	12.5528 **	1.8938	6.6284	-
R-squared	0.88197	Average of the dependent variable		12.6707
Adjusted R-squared	0.87861	White statistics: Wh		145.677
Regression S.E.	4.76462	Prob. (Wh test)		0.0000
F Statistics	262.286	Durbin-Watson: d		1.6837
Prob. (F Statistics)	0.00000	Inflationary variance factor: FVI		1.250

(\*\*) Significant at 1%; (\*) Significant at 5%. FVI = 1.250 and FVI<sub>max</sub> = 1.540.

Source: Research data.

CONCLUSIONS

The demand for açai pulp is price inelastic and belongs to the category of essential goods with respect to income. Therefore, changes in prices tend to cause large impacts on consumer's budget to the point of compromising the consumption level.

Traditional and tapioca flours, together with fish, were evidenced as strong complements of açai consumption by the families of Belém. Fish is the product that causes greater influence on demand, followed by tapioca and traditional flour.

Product quality causes a large differential in the açai consumption by families, indicating a direct impact of increased demand of 4.66 L / family / month, if food quality and safety standards improve.

The educational level positively influences the açai consumption, and can increase consumption by 1.3 L per family per schooling year above the average schooling level.

Finally, it is concluded that the retail market of açai pulp of Belém generates an annual socioeconomic benefit of R\$ 762,78 million for consumer families.

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