

# Socioeconomic profile and game theory in potential consumers of functional cheeses with bean flour

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## ABSTRACT

**Objective:** To analyze the influence of consumer preferences and socioeconomic profile on the adoption of functional bean flour cheese.

**Design/methodology/approach:** The study was conducted in Zacatecas, Mexico, where a questionnaire was applied to consumers stratified by age. Significant variables were detected using a Kruskal-Wallis test, and three socioeconomic profiles were identified using a post hoc test. In addition, correlations were assessed through Pearson's correlation coefficient. Game theory was then used to evaluate strategic choices in different scenarios: willingness to purchase a functional food, health awareness, and motives for adoption.

**Results:** Relationships were identified between socioeconomic variables and consumer preferences, including income, gender, age, educational level, cheese price, consumption expenditure, label, and consumption frequency. Overall, game theory revealed distinct purchasing patterns: "Strong Consumers", "Conscious Consumers", and "Cautious Consumers".

**Limitations on study/Implications:** The research is limited to a specific geographic region, so caution is required when results are generalized. Key implications include market segmentation, functional food design, differentiated strategies, and consumer education.

**Findings/conclusions:** The importance of considering socioeconomic variables when analyzing consumption patterns and purchasing choices for functional foods is emphasized. The methodology used can serve as a basis for future research in diverse settings or to focus on different food products.

**Keywords:** Functional foods, Bean flour, Game theory, Agronomic products.

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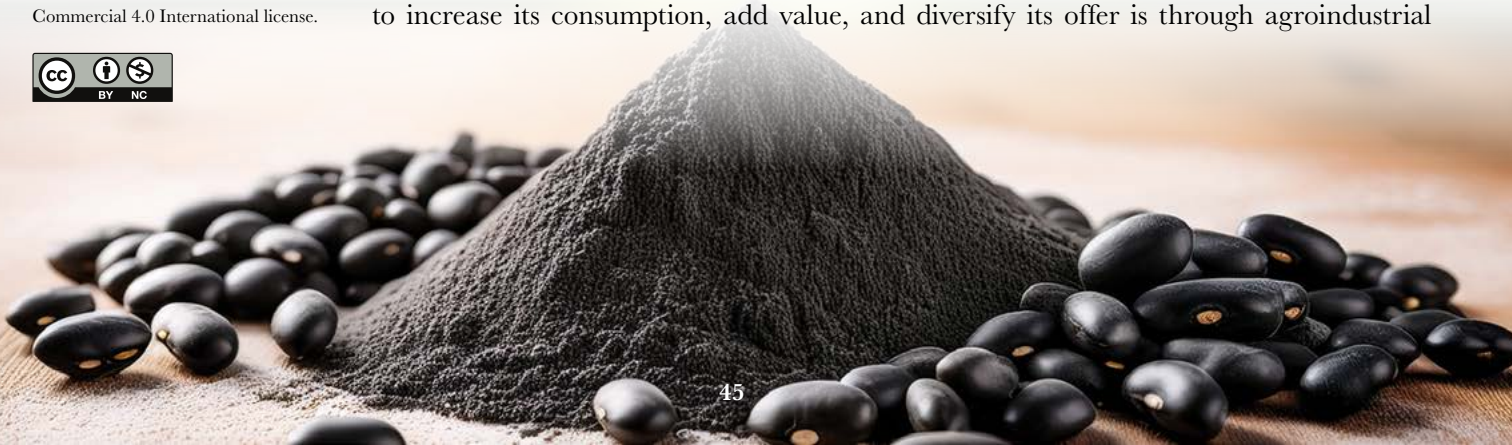
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## INTRODUCTION

Black bean (*Phaseolus vulgaris*) is an important crop in Mexico; however, its value chain has weakened (Ramírez-Jaspeado *et al.*, 2020; García-Vázquez *et al.*, 2024). One way to increase its consumption, add value, and diversify its offer is through agroindustrial



transformation (Sánchez-Toledano *et al.*, 2021; Figueroa-González *et al.*, 2023). In this context, the development of functional foods has been investigated (Granato *et al.*, 2020), and the increasing interest of consumers for healthy products has generated a growing demand (Rojas-Rivas *et al.*, 2018; Baker *et al.*, 2022).

Among the key characteristics exhibited by functional foods, there are essential nutrients, increased wellbeing, and reduced disease risk (Granato *et al.*, 2020). Some studies have shown that agricultural products such as beans meet these criteria (Rojas-Rivas *et al.*, 2020; Sánchez-Toledano *et al.*, 2021). However, the intrinsic motivations and desires of individuals play an important role in food choice (Topolska *et al.*, 2021). Consequently, understanding consumer acceptance becomes crucial to identify potential market prospects (Palmieri *et al.*, 2022).

Previous research has highlighted the importance of the socioeconomic profile when it comes to the adoption of functional foods (Topolska *et al.*, 2021; Baker *et al.*, 2022; Mohammad, 2022). This serves as the driving force behind the present study, which has the objective of researching the influence of socioeconomic factors.

The use of game theory as an analytical framework is the innovative aspect of this work. This approach allows predictions and recommendations to be made in product promotion (Zhao *et al.*, 2018). It allows analyzing different factors that influence consumer behavior (Mousapour *et al.*, 2022), and it is a valuable tool to expand knowledge on different topics when evaluating strategic options (Choi *et al.*, 2020).

The study proposes an integrated view of consumer interaction with functional foods by bringing together key concepts from agriculture, nutrition, and game theory. Therefore, the main objective was to analyze the influence of consumer preferences and socioeconomic profile on the adoption of functional cheese made from bean flour. The hypothesis is that socioeconomic variables such as income, age, and spending patterns significantly influence the decision to adopt functional foods, specifically functional cheese made from bean flour.

## **MATERIALS AND METHODS**

### **Characterization of the study sample**

The study was conducted in the city of Zacatecas, Mexico, located at an altitude of 2,169 meters above sea level on the geographic coordinates 22° 56' 57" latitude North and 102° 42' 08" longitude West (Instituto Nacional de Estadística y Geografía [INEGI], 2023). A structured questionnaire was used to investigate consumer habits, socioeconomic characteristics, and strategic decisions regarding the willingness to purchase new functional products, consumer health awareness, and the reasons for adopting new functional foods in their diet.

The survey was applied to a sample of 100 consumers, stratified by age and with a confidence level of 90%. The sample size was validated using convenience sampling and finite population sampling. This strategy has been validated in similar studies (Sánchez-Toledano *et al.*, 2021). Subsequently, a discriminant survey was used to select participants, whose key question was whether they consumed cheese in their households. Respondents were presented with the functional cheese enriched with bean flour microcapsules, and they were given the opportunity to taste it before answering the questionnaire.

### Methodological process

Significant variables related to consumption habits were identified using the Kruskal-Wallis test. This was done at 95% confidence level and significance level of  $p \leq 0.05$ . Three socioeconomic profiles were identified and characterized using this procedure and a post hoc test. To validate them, Pearson's correlation coefficient was applied, which revealed relationships between the variables and their bilateral significance.

Consecutively, game theory was used to create payoff matrices and to evaluate the strategic choices of these three profiles using Nash equilibrium.

The consumers were divided into three profiles: A, B, and C. Each profile was assigned a decreasing value (60, 40, and 20) depending on its importance within the sample. The assignment of values was adjusted considering the frequency of income distribution of each profile.

The responses obtained and the associated assumptions for the different scenarios were evaluated with the same values and parameters (60, 40, 20). These values, when combined with the frequency of response, reflected the relative importance of the options in each scenario and socioeconomic profile.

The establishment of matrices was based on the following assumptions:

Scenario 1. Willingness to purchase a new functional food.

- Strong consumers (60 points). They demonstrate a strong level of commitment, and they purchase even without trying the food. They are often the first to purchase within their social circle.
- Conscious consumers (40 points). They show a balanced approach, are open to trying new foods, but tend to be more cautious when it comes to early adoption.
- Cautious consumers (20 points). Cautious, they tend to delay their choice until the majority has already adopted them.

Scenario 2. Consumer health awareness.

- High awareness (60 points). Consumers who are highly committed to their health, consistently engage in self-reflection, and prioritize their well-being.
- Balanced awareness (40 points). This group shows neutral awareness. They are alert to changes and have a general awareness of their well-being.
- Moderate awareness (20 points). They exhibit less care, with daily awareness, but without deep reflection.

Scenario 3. Reasons for adopting a new functional food.

- Ecological and solidarity reasons (60 points). They seek to ensure that the functional food has "ecological" and "solidarity" principles.
- Natural and wellness reasons (40 points). Foods are intended to be "natural", "plant-based", "medicinal", and offer "energy and well-being".
- Practical reasons and lifestyle (20 points). Their adoption depends on "nomadism", "saving time" and "easy management".

The procedures were carried out in Excel spreadsheets and in the SPSS statistical package.

## RESULTS AND DISCUSSION

According to the grouping category, “Economic income”, Table 1 shows the fundamental variables in consumption habits.

Then, a post hoc test was performed to determine the minimum significant difference, and three distinct groups were formed (Table 2).

Group A (<\$5,000) shows a predominantly female population, young, and with a tendency towards lower educational levels compared to the other groups. The price of one cheese is shown to be a defining factor in its consumption. Likewise, moderate weekly consumption and low spending were observed, although they do pay attention to the product label, reflecting a willingness to invest moderately in this food.

In general, young consumers tend to analyze the information before purchasing a product. They also tend to evaluate several alternatives, with price being one of the aspects that they prioritize most (Santoso and Prastiwi, 2023).

In the case of Group B (\$5,001 to 15,000), it is predominantly made up by men. Most are young adults with a university education. A negative relationship is observed with the price of cheese, suggesting that they don't pay much attention to this aspect. Despite this,

**Table 1.** Kruskal-Wallis test statistics and key variables in consumption habits.

Significant variables	Kruskal-Wallis H	Degrees of freedom	Asymptotic significance
Gender	6.01	2	0.05
Age	18.48	2	0.00
Level of education	19.78	2	0.00
Price of a cheese	6.73	2	0.03
Consumption spending	17.28	2	0.00
Label	6.48	2	0.04
Weekly consumption	12.78	2	0.00

**Table 2.** Consumption habits in relation to economic income through *post hoc*.

Income	Gender <sup>a</sup>	Age <sup>b</sup>	Level of education <sup>c</sup>	Price of one cheese <sup>d</sup>	Consumption <sup>e</sup>	Label <sup>f</sup>	Weekly consumption <sup>g</sup>
Group A. <\$5,000	0.55	-3.65	-1.94	0.57	-2.02	0.55	-1.34
Group B. \$5,001 a 15,000	-0.08	-2.61	-0.13	-0.01	-0.53	-1.00	-1.23
Group C. >\$15,001	-0.47	6.92	2.07	-0.56	2.56	0.65	2.58

<sup>a</sup> Categorical variable. 1=Male; 2=Female.

<sup>b</sup> Categorical variable. 1=15 a 19; 2=20 a 24; 3=25 a 29; 4=30 a 34; 5=35 a 39; 6=40 a 44; 7=45 a 49; 8=50 a 54; 9=55 a 59; 10=>60.

<sup>c</sup> Categorical variable. 1=Primary school; 2=Secondary school; 3=High School; 4=University; 5=Graduate studies.

<sup>d</sup> Dichotomous variable. 1. Yes, and 0. No.

<sup>e</sup> Categorical variable. 1=Less than 50; 2=51 to 100; 3=101 to 150; 4=151 to 200; 5=201 to 250; 6=251 to 300; 7=301 to 350; 8=more than 351.

<sup>f</sup> Categorical variable. 1=Always; 2=Sometimes; 3=No, never; 4=Not aware.

<sup>g</sup> Categorical variable. 1=200 gr; 2=300 gr; 3=400 gr; 4=1 kg; 6=Más de 1 kg.

their consumption spending is only slightly higher than that of Group A, and their weekly consumption is similar.

Group C (>\$15,001) presents notable differences, since although it predominantly made up by men, it includes older individuals with postgraduate education. They pay less attention to the price of one cheese but do pay more attention to the product label. In contrast to the first two groups, their consumption spending is higher, as is their weekly consumption.

Some studies such as Topolska *et al.* (2021) and Szakos *et al.* (2022) have shown that older adults tend to be the most committed to consuming this type of food. Furthermore, the relevance of the information on the label is notable for these consumers (Baker *et al.*, 2022).

Under these assumptions, the study indicates that there is a correlation between income and age, educational level, price of one cheese (negative correlation), consumption spending, and weekly consumption (Table 3). It is revealed that as age increases, income also increases. Similarly, there is a correlation with the variable “Educational level”, so it can be inferred that higher educational levels are linked to higher spending on cheese consumption, as well as an increase in weekly consumption frequency.

In contrast, the price shows a negative correlation, indicating that when income is high, people are more willing to purchase it regardless of this factor. The information is relevant in supporting and substantiating the data presented in the groups, while highlighting the influence of the variables on consumption habits. Accordingly, the existing literature shows that the acceptance of functional foods is conditioned by different socioeconomic variables such as income, gender, age, educational level, and price, among others (Mohammad, 2022; Palmieri *et al.*, 2022; García-Vázquez *et al.*, 2024).

Table 4 shows the payoff matrix obtained for scenario 1. Analyzing the Nash equilibrium, there is indication that Profile A has a willingness to purchase a new functional food like a conscious consumer (40/40); this profile tends to be more reluctant to adopt a functional food early. Profile B, on the other hand, tends to have the characteristics of a cautious consumer type (60/60). Meanwhile, strong consumers are found in Profile C (20/20), which may suggest that they are willing to pay more for this experience.

**Table 3.** Pearson’s correlation between key variables of consumption habits.

Income <sup>1</sup>	Gender <sup>2</sup>	Age <sup>3</sup>	Educational level <sup>4</sup>	Price of one cheese <sup>5</sup>	Consumption spending <sup>6</sup>	Label <sup>7</sup>	Weekly consumption <sup>8</sup>
1	-0.242	0.392**	0.455**	-0.261**	0.372**	0.008	0.329**
-0.242*	1	0.192	-0.175	-0.182	0.007	-0.162	0.00
0.392**	0.192	1	-0.34	-0.308**	0.452**	-0.151	0.379**
0.455**	-0.175	-0.034	1	0.046	0.194	0.081	0.197*
-0.261**	-0.182	-0.308**	0.46	1	-0.329**	0.227*	-0.170
0.372**	0.007	0.452**	0.194	0.329**	1	-0.003	0.368**
0.008	-0.162	-0.151	0.081	0.227*	-0.003	1	0.188
0.329**	0.000	0.379**	0.197*	-0.170	0.368**	0.188	1

\*Asterisks (\*) and double asterisks (\*\*) indicate statistical significance levels; (\*p≤0.05, \*\*p≤0.01).

**Table 4.** Socioeconomic profiles and willingness to purchase a new functional food.

	<b>Strong consumers (20)</b>	<b>Conscious consumers (40)</b>	<b>Cautious consumers (60)</b>
Profile A (40)	40/20	40/40	40/60
Profile B (60)	60/20	60/40	60/60
Profile C (20)	20/20	20/40	20/60

In an action plan, it is suggested to focus on attracting cautious consumers and to consider heterogeneity in marketing (Guinea *et al.*, 2020; Tian *et al.*, 2022). In turn, knowledge of individual preferences becomes relevant (Alongi and Anese, 2021).

Table 5 reflects how different socioeconomic profiles interact with levels of health awareness.

Values are intertwined in the decision-making process of consumers regarding health and food. Along these lines, Profile A is oriented toward balanced awareness, Profile B is characterized by moderate awareness, and Profile C is distinguished by high awareness; this distinctive feature suggests that these consumers continually reflect on their health status, which leads them to seek out functional foods that allow obtaining benefits.

In this framework, functional foods have gained significant attention (Obayomi *et al.*, 2024; Vignesh *et al.*, 2024). Specifically, it has been shown that bean flour has nutritional quality and health benefits (Figueroa-González *et al.*, 2023; García-Vázquez *et al.*, 2024).

The profiles and reasons for adopting a new functional food show differences (Table 6). When making decisions between food options, Profile A seeks ecological and solidarity attributes. Profile B consumers prioritize reasons related to naturalness and well-being. Meanwhile, Profile C shows interest in practical and lifestyle-related reasons; specifically, consumers belonging to this profile value pragmatic aspects in their choice of foods for adoption.

The study by Vorage *et al.* (2020) points out that the reasons for adoption reveal differences according to socioeconomic variables and motivations. Elements such as hedonism, well-being, and natural incentives become relevant.

**Table 5.** Socioeconomic profiles and consumer health awareness.

	<b>High awareness (20)</b>	<b>Balanced awareness (40)</b>	<b>Moderate awareness (60)</b>
Profile A (40)	40/20	40/40	40/60
Profile B (60)	60/20	60/40	60/60
Profile C (20)	20/20	20/40	20/60

**Table 6.** Socioeconomic profiles and reasons for the adoption of a new functional food.

	<b>Ecological and solidarity reasons (40)</b>	<b>Natural and well-being reasons (60)</b>	<b>Practical and lifestyle reasons (20)</b>
Profile A (40)	40/40	40/60	40/20
Profile B (60)	60/40	60/60	60/20
Profile C (20)	20/40	20/60	20/20

In these scenarios, game theory proved to be an efficient and applicable method for modeling consumer behavior (Choi *et al.*, 2020). Differences in preferences were observed based on socioeconomic profile.

New trends in the market are opening new possibilities for functional foods (Palmieri *et al.*, 2022; Sgroi *et al.*, 2024; Süfer, 2025). Therefore, identifying the reasons for consumption and the willingness to purchase agricultural products becomes necessary.

## CONCLUSIONS

The research offers valuable insights into how consumer profiles and preferences influence the introduction of new agricultural products in the functional food industry. It also emphasizes the importance of considering socioeconomic factors when analyzing consumption patterns and purchasing choices for these types of foods. The methodology employed can serve as a basis for future studies in diverse settings or focusing on different food products. Furthermore, the findings can be compared with similar studies to identify commonalities and disparities that may have broader implications.

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