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The Relationship between Consumption, Socioeconomic Level and Reasons of Tomato Intake in Mexico

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Abstract

The red tomato has been associated to Mexico throughout history. This vegetable is native to the New World and was domesticated in Mesoamerica, before its arrival to Europe. It has always been of great cultural importance in Mexicans diet and of great economic value. Currently, Mexico is the first tomato exporter in the world. However, its marketing affects its price and availability and can harm consumption. Then, due to the cultural role of this vegetable, it is interesting to analyze the relationship between consumption, socioeconomic status and tomato intake reasons in the case of Zapotlan el Grande, Jalisco, Mexico. For this reason, a Food Consumption Frequency Questionnaire (FCFQ) was applied to 384 adults from 18 to 65 years old, which included classification of socioeconomic level and consumption reasons. The results showed that the tomato was ingested by more than 90% of the population, with an average frequency of 21.66 ± 10.57 times per month and 114.68 daily grams per capita. For the relationship between socioeconomic level and intake reasons, it was found that there was an impact of monthly income, occupation and gastronomy on the intake of this vegetable.

Keywords

Tomato, Consumption, Socioeconomic Level, Motives of Consumption, Zapotlan El Grande

1. Introduction

The red tomato or better known as tomato (*Solanum lycopersicum*) has been

associated to Mexico throughout history. This vegetable is native to the New World and was domesticated in Mesoamerica before its arrival in Europe [1]. Currently this vegetable, included in the basic basket of Mexico [2], plays an important nutritional role in the diet. If only proteins, lipids and sugars are taken into consideration, it may seem that it does not have a high nutritional value. However, tomato represents a relevant source of nutrients that are very important for human health, such as antioxidants that are present due to their lycopene content. The main source of this compound is considered protective against cancer and cardiovascular diseases [3] [4].

Likewise, tomato contains vitamin A (B-carotene), ascorbic acid (vitamin C) and minerals such as potassium [3] [4]. But it is also of great cultural importance. In gastronomy it is the main component of soups, sauces, and purées, as garnish or complement of ceviche and cocktails among many others [5]. It is of great economic value and is considered one of the most important vegetables, since it is consumed worldwide [3] [6]. Currently, Mexico is the tenth tomato producer in the world. Zapotlan el Grande is the second municipality in the state of Jalisco with the highest production of this plant where greenhouse production has increased significantly, which is why it is a region of interest in this aspect (**Table 1**) [6] [7] [8].

Due to the role of Mexico and Zapotlan el Grande in the production of this vegetable, its exports have quadrupled in the last 14 years. At the same time, its import has decreased (see **Table 1**) [9]. Currently the country is the first exporter in the world, selling abroad between 50% and 70% of production [10]. In Zapotlan el Grande, tomato is the horticultural crop that generates the most income for producers [11]. This situation could be related to little availability of this vegetable for the population or with alterations in its price, because, although for a long time this vegetable was considered as one of the most affordable for the entire population, regardless of their socioeconomic level [12], in recent years its price has presented wide variations. In 2016, its sale was reported between 13.83 pesos and 19.23 pesos per kilogram [2] [13]. However, at the beginning of 2017 it exceeded 28 pesos for the same amount [2].

Modifications in the cultivation and sale of food in a region can lead to changes in the diet [14]. It is well known that food consumption is influenced by many factors. From social, cultural and economic aspects [15], to traditions, physiological and psychological factors, food preferences, fashions among many other factors [16]. Specifically, an important relationship has been identified between the socioeconomic level of people and their consumption of vegetables. Generally, a healthy diet, rich in these foods, is considered expensive and even unaffordable for people with low socioeconomic status, who have been reported to tend to eat fewer vegetables than those with higher socioeconomic status [17] [18] [19].

However, some authors affirm that the socioeconomic level is not always a determining factor in the behavior of food choice and there are other factors that

Table 1. Sowing, production, exports and imports of tomato in Mexico.

	Hectares planted			Tons produced			Exports in Mexico		Imports in Mexico	
Year	**Mexico**	**Jalisco**	**Zapotlan el Grande**	**Mexico**	**Jalisco**	**Zapotlan el Grande**	**Tons exported**	**Value in dollars**	**Imported tons**	**Value in dollars**
2003	70390.37	3009	250	2171159.43	102468.5	6250	849,880,465	817,140,021	16,373,373	12,276,390
2004	75605.26	3007	198	2,314,629	109929.87	6885	835,441,086	847,334,161	33,736,309	23,041,055
2005	74354.56	2673.75	210	2246246.34	117500.45	9800	846,718,776	827,608,475	13,558,247	8,904,516
2006	66509.39	2100	220	2093431.59	87533.64	9325	927,337,829	1,014,745,709	23,841,195	22,020,257
2007	66635.31	2683.54	280	2425402.77	141796.28	13499.6	1,005,959,200	1,022,138,037	48,003,984	35,608,654
2008	57248.08	2449.5	251.5	2263201.65	122420.73	11250.25	1,010,812,660	1,171,018,667	29,692,264	47,100,605
2009	53572.62	1938.85	270	2043814.55	115544.19	12,580	1,111,339,423	1,183,460,054	49,770,950	68,265,244
2010	54510.59	1861.75	315	2277791.43	140801.9	16122.6	1,494,589,345	1,601,655,233	33,042,779	71,477,241
2011	53780.18	2157.45	342	1872481.69	136539.82	14,560	1,472,382,929	2,035,820,395	23,710,614	47,420,479
2012	55888.04	2079.98	325	2838369.87	156660.03	15190.2	1,449,412,398	1,642,530,108	26,593,512	32,191,977
2013	48234.01	1601.5	310	2694358.19	134436.65	21,675	1,462,860,442	1,736,196,384	14,326,739	23,449,095
2014	52374.91	2263.2	267	2875164.08	158561.46	13216.02	1,380,614,985	1,609,001,607	14,081,698	27,498,436
2015	50595.56	2216.43	248.5	3098329.41	161804.59	16465.6	1,302,935,853	1,648,182,849	5,996,670	12,176,731
2016	51861.1	2290.65	315.5	3349154.71	158231.97	27150.63	1,578,226,594	1,899,942,691	1,336,943	831,596

Source: own elaboration with data from SIAVI (2017); monthly statistics; with data from Agri-Food and Fisheries Information Service [SIAP] (2017); statistical Yearbook of Agricultural Production.

are more important in terms of consumption of vegetables, for example, the personal relevance of the food, the interest in a nutritious and healthy diet or it has even been found that taste is an extremely important aspect in terms of its intake [17] [20] [21]. Therefore, this article aims to analyze the relationship between tomato consumption, intake reasons and socioeconomic status in the case of Zapotlan el Grande, Jalisco, Mexico.

2. Materials and Methods

The method of this study was mixed, descriptive and transversal. The participants in the study were randomly selected and the sample was calculated for a finite and known population of 58,140 people corresponding to the total adult population of the Guzman city. (98% of the total population of the municipality is concentrated there). The 95% level of confidence was used, leaving a margin of error of 5%. In the end, a statistically representative sample of 384 participants was obtained, of both sexes and between 18 and 65 years of age. The participants must have been residents of Guzman city with an age of more than one year.

2.1. Instrument and Data Collection

The data were obtained from a structured survey, consisting of a quantitative section, a qualitative section and a socio-economic classification section. The

quantitative section had the purpose of obtaining data on the frequency and quantity of tomato consumption. A validated Food Consumption Frequency Questionnaire was used for the Mexican population [22] and adapted to the study. Tomato consumption was questioned in pieces, grams or cups. Before starting with the data collection, field work was carried out where it was corroborated that the main tomato variety sold in Zapotlan el Grande is tomato or tomato saladette. Therefore, this variety was the only one that was evaluated [23].

In the qualitative section, the reasons for vegetable intake were questioned, as well as the reasons why it was not ingested. On the other hand, to classify the participants according to their socioeconomic level, indicators used by other researchers were chosen [19] [24]. These corresponded to monthly income, educational level, occupation and the participant's frequent food purchase point was identified, that is, the socioeconomic strata where the data were collected, which were the Local markets of Zapotlan el Grande and two commercial places where the main supermarkets of the town are located. The educational level of the population was classified according to the National Educational Plan [25], where three educational levels are established, the basic level, the upper secondary level and the upper level. The first includes those who have completed preschool, primary or secondary. The upper middle level refers to those who have finished high school or baccalaureate and finally, the upper level corresponds to those subjects whose highest level of education is undergraduate or engineering, or where appropriate, master's or doctorate.

With respect to the occupational level, the classification of the National Occupational Classification System (SINCO) [26] was classified as high, medium and low occupational level. At the high level, officials, directors and chiefs, professionals and technicians, auxiliary workers in administrative activities and merchants were included. On the other hand, employees in sales and sales agents, workers in personal services and surveillance, workers in agricultural activities, livestock, forestry, hunting and fishing; artisanal workers, industrial machinery operators, assemblers, drivers and transport drivers and housewives, were placed at the middle level and at the low-level workers were included in elementary and support activities, students, pensioners and unemployed.

In the case of monthly income, the population was classified into two groups: the first consisted of those subjects whose monthly income was less than or equal to the minimum wage, which according to the Tax Administration Service (SAT) [27] corresponded in 2016 to 73.04 pesos per day, or 2191.20 pesos per month; and in the second, participants who had reported higher income than this were included.

The application of surveys was carried out by personnel with knowledge in health of the University Center of the South, who were trained in the application of surveys. It is worth mentioning that the application of surveys was carried out on subjects who were buying groceries in the established places or who had bags with a pantry. It is important to point out that the data of this study were raised

in parallel to additional information, regarding the consumption of regional fruits that is in the process of being published.

2.2. Statistical Analysis

The data obtained were converted to monthly frequency, considering the daily consumption as a maximum of 30 days per month. The information regarding the amount of intake was converted to grams, using as reference the weight of the established ration of tomato saladette, in the Mexican System of Equivalent Foods (SMAE) [28], which corresponded to 124 grams, that on average they are two tomatoes. A normality test was performed using the Shapiro-Wilk test. Once the normality of the data was identified, a descriptive analysis of the frequency and amount of consumption of the participants was elaborated; the average, variance, standard deviation, minimum, maximum, median and mode were calculated. To compare the frequency and quantity of tomato consumption, as well as the indicators of socioeconomic level, the student's t test was used with a Welch type correction at 95% confidence. A value of $p < 0.05$ was considered significant, because it is a study without risk to health. For socio-economic indicators and consumption reasons that included more than two variables, the Kruskal-Wallis test was used. The information was analyzed with the statistical software package STATA/SE V12.

2.3. Ethical Considerations

This investigation is considered without risk according to the Regulation of the General Health Law on Health Research [29] for which the consent of the participants was granted verbally. The data obtained was confidential and the name, address or telephone number of the participants was not requested because it is not relevant for this study and for the protection of the subject's identity.

3. Results

Concerning the characteristics of the sample, 62.5% of the total sample was women. The average age of the population was 36.7 ± 13.1 years. The minimum age reported was 18 years and the maximum age 65. 38.8% of the population was classified as basic education. 24.7% corresponded to people with higher educational level and the rest were participants with an average level of education. 86.9% of the evaluated population said that they earned a wage higher than the minimum wage established in 2016 by the SAT [27]. 50.5% of the sample was surveyed in the supermarkets and the rest in the Local markets. 29.4% were cataloged at the low occupational level. The 38.0% in the average occupational level and 32.6% corresponded to people with a high occupational level. As shown in **Table 2**, more than 90% of the population of Zapotlan el Grande, Jalisco consumes tomato. On average, this vegetable is consumed 21.7 ± 10.6 times per month. The average amount ingested each time it is consumed is 158.8 ± 136.9 grams. Relative to the per capita daily consumption of this vegetable, it was

found that the population ingests, on average, 114.7 grams of tomato every day.

In Table 3, an analysis is presented between tomato consumption and the socioeconomic level of the population. It was found that the frequency of consumption of subjects with a monthly income lower than the minimum wage is significantly lower (p = 0.0002*) than those who earn a higher salary. Likewise, it was identified that people with low occupational level consume less frequently and in a smaller amount tomato than those with a higher occupational level. The differences found in both cases were statistically significant (p = 0.0000*). It was found that people who buy the product in the Local markets eat it more often than those who buy it in supermarkets (p = 0.0308*). The rest of the evaluated indicators did not show significant differences, so, in these cases, tomato consumption occurs regardless of the socioeconomic level of the subject.

Regarding the reasons why the tomato is ingested, Table 4 shows that about half of the people evaluated consume it because they use it in the meals they prepare. Followed by that, more than 28% people said to ingest it because they like the taste, texture or organoleptic characteristics. 8.6% said eating it by habit

Table 2. Consumption of tomatoes in Zapotlan el Grande.

Variable			
Is it consumed			
Yes	n - %	359	93.49
Not	n - %	25	6.51
Monthly consumption frequency			
Average	d/m	21.66	
Standard deviation	d/m	10.57	
Variance	d/m	111.74	
Minimum	d/m	0	
Maximum	d/m	30	
Mode	d/m	30	
Median	d/m	30	
Amount of consumption			
Average[1]	g	158.84	
Daily per capita	g	114.68	
Standard deviation	g	136.88	
Variance	g	18710.62	
Minimum	g	0	
Maximum	g	744	
Mode	g	62	
Median	g	124	

d/m = days a month, [1]Each time it is swallowed, g = grams.

Table 3. Relationship between tomato consumption and the socioeconomic level of the population.

Variable	n		p value
Sex[1]			
Monthly consumption frequency[2]			0.4719[ns]
Female	240	21.4	
Male	144	22.2	
Consumed grams[2]			0.9404[ns]
Female	240	158.4	
Male	144	159.5	
Educational level[3]			
Monthly consumption frequency[2]			0.2332[ns]
Basic level	149	22.6	
Upper middle level	137	20.7	
Upper level	94	21.2	
Consumed grams[2]			0.0919[ns]
Basic level	149	171.4	
Upper middle level	137	150.7	
Upper level	94	147.4	
Monthly income[1]			
Monthly consumption frequency[2]			0.0002*
≤Minimum salary	49	15.7	
>Minimum salary	335	22.5	
Consumed grams[2]			0.5066[ns]
≤Minimum salary	49	146.1	
>Minimum salary	335	160.6	
Occupational level[3]			
Monthly consumption frequency[2]			0.0000*
Low	113	20.7	
Medium	146	22.2	
High	125	21.8	
Consumed grams[2]			0.0000*
Low	113	150.5	
Medium	146	172	
High	125	151	
Socioeconomic stratum[1]			
Monthly consumption frequency[2]			0.0308*
Local markets	190	22.8	
Supermarkets	194	20.5	
Consumed grams[2]			0.5941[ns]
Local markets	190	162.5	
Supermarkets	194	155.2	

[1]Student t test with Welch type correction between consumption, according to socioeconomic level indicators of two variables, [2]Average, *p < 0.05 considered as significant, ns = difference not statistically significant. [3]Kruskall-Wallis test between indicators of socioeconomic status of more than two variables.

Table 4. Reasons for tomato consumption or non-consumption.

Variable			p value[2]
Reason for consumption	n	%	
Liking	103	28.7	
Give them away	2	0.56	
Used for cooking	161	44.9	
Nutritional properties	29	8.1	
Availability	5	1.4	
Because is cheap	20	5.6	
Habit	31	8.6	
Does not know	8	2.2	
	n = 359		
Reason for non-consumption	n	%	
Does not like	16	64	
It does not get used to	3	12	
Does not know	6	24	
	n = 25		
Monthly consumption frequency according to intake[1]			0.0010*
Liking	22		
Give them away	27		
Used for cooking	24.7		
Nutritional properties	25.7		
Availability	22.4		
Because is cheap	18.7		
Habit	22.5		
Does not know	12.4		
Amount of consumption according to reason intake[1]			0.4265[ns]
Liking	170.8		
Give them away	279		
Used for cooking	174.2		
Nutritional properties	143.2		
Availability	322.4		
Because is cheap	150.3		
Habit	150		
Does not know	170.5		

[1]Average, [2]Kruskal-Wallis test between consumption reasons, *$p < 0.05$ considered as significant, ns = difference not statistically significant.

and 29 people expressed that they eat this vegetable due to its nutritional properties, among which were mentioned vitamins, fiber, antioxidants, among other properties of the product (8.1%). A lower percentage said they chose that vegetable and consumed it because it is cheap and affordable for them (5.6%). In as much to the people who said not to eat this vegetable, it was identified that 64% of these subjects, it does not do it because it does not like the flavor or characteristics of the tomato. 12% and 24% of people who do not consume tomato do not eat it, respectively, because they are not used to consume it and because they do not know why they do not consume it. The average intake frequencies of the population, according to each consumption reason, presented statistically significant differences ($p = 0.0010^{*}$), while the consumption quantities were similar regardless of the reason why they were eaten ($p = 0.4265^{ns}$).

4. Discussion

Tomato has been identified as a basic product in the Mexican diet for more than five centuries [30]. However, despite the importance that this red vegetable showed for the population of Zapotlan el Grande, being consumed by more than 90% of the population with a frequency of more than 21 times a month and a daily consumption per capita of 114.68 grams, that is, about two pieces, according to the SMAE [28], its exportation in Mexico and Zapotlan el Grande continues to increase [9]. While for the moment the remaining amounts are sufficient to provide adequate availability to carry out such consumption, it is important to note that the average consumption of the most basic vegetable does not occur at a maximum frequency of 30 days. For the above, one could think of a possible decrease in their intake, considering that the literature points to it as a product as consumed as corn tortilla [12].

However, although the commercialization of this vegetable can be considered relevant for the Mexican economy, it is important to emphasize that its importance in the population's diet could be considered greater since, as it was proved with our results, this is a daily consumption vegetable, because the statistical mode obtained was 30 days a month. In this sense, although the Mexican economy may benefit from the international commercialization of this vegetable, this study suggests that this commercialization has begun to generate alterations in its price, a situation that has led to a reduction in consumption by the population with a low socioeconomic level. The sale price is a determining factor for food consumption [31]. In addition, people with a lower socioeconomic status tend to eat fewer vegetables than those with a higher socioeconomic status. In this case, it may be that current prices are increasingly out of reach of the population with low socioeconomic status [17] [18] [19] [24].

According to Chapman *et al.* [32], the cost of vegetables is a known barrier for consumption and in this study, it was identified that only about 6% of the population chooses to consume this vegetable, above others, because it is cheap. Likewise, price is a central factor that leads consumers to replace traditional re-

tail food stores with supermarkets [33]. This research found the opposite, because people who buy their vegetables, including tomatoes, in the local markets, consume more often the vegetable compared to those who buy it in the main supermarkets of the city ($p = 0.0308^*$). In Zapotlan el Grande, the regional markets are known to be cheaper than the commercial chains, in fact, some of the respondents who said buying tomatoes in Local markets, said they do so because it is cheaper.

However, the lack of income is one of the most important causes that prevent the population from obtaining an adequate diet rich in vegetables [12] [17] [24]. In this study, it was found that people with monthly incomes above the minimum wage established by the SAT [27] in 2016 reported eating tomato more frequently than those who said they earned less than the minimum wage ($p = 0.0002^*$), according to what was expressed by Martínez and Villezca [12]. Regarding the occupational level, this is an aspect that is positively related to the intake of vegetables, that is, the greater the occupational hierarchy, the greater the consumption of vegetables [2] [4]. This research agrees with the study of Galobardes *et al.*, since it was identified that people with low occupational level consume less frequently and in a smaller amount tomato, than those with a higher occupational level. The differences found in both cases were statistically significant ($p = 0.0000^*$). Despite having found a relationship with these aspects, sex and educational level did not prove to be important variables with respect to tomato consumption, although the existence of differences in food consumption between men and women has been affirmed [34] or, on the other hand, a relationship has been found between educational level and food consumption [35].

However, regarding the reasons for consumption of tomato, the literature on the influence of preferences and sensory characteristics that food exerts on food intake reveals that those act as main predictors in conditions of free access [36]. Agreeing with Benarroch *et al.* [36] and with Brug *et al.* [21] in this study it was found, as the second reason for ingestion, the taste for tomato. However, it is important to note that the use of this vegetable for the preparation of dishes was the main reason why it is consumed. This finding allowed to identify the cultural and gastronomic importance of this vegetable in the diet of the population of Zapotlan el Grande. Tomatoes can be consumed raw, cooked, stewed, as a sauce or in combination with other foods. They can be used as an ingredient in the kitchen or processed commercially whole or as a paste, juice, powder, and so on [30]. The above justifies the reason for the main reason for ingesting this vegetable.

On the other hand, a little more than 8% of the population (29 people) said consume tomato due to its nutritional properties, whether vitamins, minerals, fiber, antioxidants, among others. This agrees with authors who say that the interest to eat nutritionally healthy or to take care of the health by means of the foods that are consumed, is a factor that influences to a great extent in the election of foods, specifically those that are considered healthy or with medicinal

properties, such as vegetables [17] [20].

A high level of education has been linked to greater nutritional education and, therefore, to a greater interest in healthy eating and greater consumption of vegetables [20] [37]. However, per se, this is not a rule, since it should be remembered that the consumption of vegetables is influenced by many more factors. In fact, in this research it was identified that people with a basic educational level were the ones who ingest tomato most frequently in comparison with the population with a higher academic level. In this sense, it is important to mention once again that tomato is basic for families and is included in the country's basic food basket of 2016 [2] [12]. In addition, because no significant differences were found between the three identified educational groups, it can be affirmed that the consumption of tomato is not influenced by the educative level of the consumer and that its intake responds more to a nutritional and cultural need than to an educational aspect.

On the other hand, one of the main problems facing tomato production in our country is the excessive use of agrochemicals because pests and diseases are one of the main problems that have an impact on tomato cultivation [38]. The use of these chemicals has been described as harmful to health [39]. Therefore, the preference of this vegetable due to its nutritional properties, should be evaluated in contrast to its safety.

Finally, it is important to note that continuing to consume tomatoes is essential for the diet of population of Zapotlan El Grande and for all Mexicans in general, because being the main source of lycopene in the diet, some authors have suggested that its consumption can help prevent or delay chronic diseases [3] [4]. Besides representing an important part of the cultural identity of the country and Zapotlan el Grande, where its typical dishes include it and it is even the protagonist, as the case of the "*chile de uña*", a traditional sauce that is accompanied with toast and an infinity of stews and sauces that make up the culinary base of the municipality [5]. However, to continue selling abroad at the current rate, the prices and availability of this product are questioned, as well as currently consuming products produced in Zapotlan el Grande, which are planted under greenhouse and for export, such as berries [40], the tomato may not be too far from becoming a luxury in the diet.

5. Conclusion

The tomato is an essential vegetable in the diet of the population of Zapotlan el Grande, who consume about two pieces daily, on average. The impact of the monthly income and the occupation on the intake of this vegetable was checked. In order to continue exporting the majority of its regional production, the access of the population with low socioeconomic status to this vegetable base is questioned. The regional points of sale, in Zapotlan el Grande, as Local markets, proved to favor the consumption of this product, being the prices offered a possible explanation to this finding. The preferences of consumption due to its

use in the kitchen and its taste, proved to be the main reasons for ingesting this vegetable, highlighting its gastronomic and identity role for the population. The availability of tomatoes at prices that guarantee the population's access to it is important due to its importance in the diet and nutrition of the population of Zapotlan el Grande and throughout Mexico. The variations in the price of tomatoes generate uncertainty about whether their consumption can become a luxury, such as other products produced under greenhouse conditions in Zapotlan el Grande, such as berries. The government should focus its efforts on guaranteeing food security through local production and give preference to quality products for internal consumption.

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Conflict of Interests

The authors declare that have no conflict of interests.

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