ISSN-E 2539-0554
Vol. XXVI No. 2 – 2nd Semester 2025
July - December - Pages 107-135

Universidad de Nariño
COLOMBIA

TENDENCIAS
Revista de la Facultad de Ciencias Económicas y Administrativas

Research Article
Responsible consumption

The responsible food sourcing and consumption in Toluca, State of Mexico

El abastecimiento y consumo responsable de alimentos en Toluca, estado de México

O fornecimento e consumo responsável de alimentos em Toluca, estado do México

Felipe Carlos Viesca González; Violeta Alvirde Castañeda; Gerardo Novo Espinosa de los Monteros; Baciliza Quintero Salazar

PhD in Administration, Instituto Tecnológicos y de Estudios Superiores de Monterrey Campus Ciudad de México. Full-time Professor at the School of Tourism and Gastronomy, Universidad Autónoma del Estado de México. ORCID: 0000-0003-0980-3507. Email: fviescag798@profesor.uaemex.mx, Toluca - México.

Master in Regional and Metropolitan Sustainable Studies, Universidad Autónoma del Estado de México. ORCID: 0000-0002-2824-4969. Email: valvirdec081@alumno.uaemex.mx, Toluca - México.

PhD in Tourism Studies, Universidad Autónoma del Estado de México. Full Time Professor at the Faculty of Tourism and Gastronomy, Universidad Autónoma del Estado de México. ORCID: 0000-0002-5136-642X. Email: gnespinosad@uaemex.mx, Toluca - México.

PhD in Biotechnology, Universidad Autónoma Metropolitana. Full Time Professor at the Faculty of Tourism and Gastronomy, Universidad Autónoma del Estado de México. ORCID: 0000-0002-3142-3714. Email: bquinteros@uaemex.mx, Toluca – México.

Received: February 4, 2025 **Accepted:** June 19, 2025
DOI: https://doi.org/10.22267/rtend.252602.277

How to cite this article: Viesca, F., Alvirde, V., Espinosa, G. & Quintero, B. (2025). Responsible food supply and consumption in Toluca, State of Mexico. Tendencias, 26(2), 107-135. https://doi.org/10.22267/rtend.252602.277

Abstract

Introduction: In the world there is a serious problem of hunger, malnutrition, food loss and waste, environmental degradation and depletion of natural resources. **Objective:** To identify food supply habits and some sustainable practices of consumers in Toluca, State of Mexico. **Methodology:** The field research method used was the survey; a questionnaire was designed as an instrument and applied in the municipality of Toluca to a convenience sample of 281 adults, in the months of September and October 2023 in markets, tianguis and supermarkets. **Results:** Family spending on food is high; food acquisition and preparation is still a female activity; food is based on vegetables, cereals, meats, eggs; most of them check the refrigerator and pantry before going shopping, and make a shopping list of food before acquiring it. **Conclusion:** some food supply habits, the profile of responsible and non-responsible consumers were known; food is healthy and responsible food consumption is practiced.

Keywords: food consumption; expenditure; commodity prices; food preparation; role of the family.
JEL: D100; I310; M140; Q210; Z130

Resumen

Introducción: En el mundo se presenta un grave problema de hambre, desnutrición, pérdida y desperdicio de alimentos, degradación del medioambiente y agotamiento de los recursos naturales. **Objetivo:** Identificar los hábitos de abastecimiento de alimentos y algunas prácticas sostenibles de los consumidores en Toluca, Estado de México. **Metodología:** El método de investigación de campo que se utilizó fue la encuesta; como instrumento se diseñó un cuestionario que se aplicó en el municipio de Toluca a una muestra por conveniencia de 281 adultos, en los meses de septiembre y octubre de 2023 en mercados, tianguis y supermercados. **Resultado:** El gasto familiar en alimentos es alto; la adquisición y preparación de alimentos sigue siendo una actividad femenina; la alimentación está basada en vegetales, cereales, carnes, huevos; la mayor parte verifica el refrigerador y la despensa antes de ir de compras, y hace una lista de compras de alimentos antes de adquirirlos. **Conclusión:** se conocieron algunos hábitos de abastecimiento de alimentos, el perfil de consumidores responsables y no responsables; la alimentación es sana y se practica un consumo responsable de alimentos.

Palabras clave: consumo alimentario; gasto; precio de productos básicos; preparación de alimentos; rol de la familia.

JEL: D100; I310; M140; Q210; Z130.

Resumo

Introdução: O mundo tem um sério problema de fome, desnutrição, perda e desperdício de alimentos, degradação ambiental e esgotamento dos recursos naturais. Objetivo: Identificar os hábitos de abastecimento de alimentos e algumas práticas sustentáveis dos consumidores em Toluca, Estado do México. Metodologia: o método de pesquisa de campo utilizado foi a pesquisa; um questionário foi elaborado como instrumento e aplicado no município de Toluca a uma amostra de conveniência de 281 adultos em setembro e outubro de 2023 em mercados, tianguis e supermercados. Resultados: os gastos das famílias com alimentação são altos; a aquisição e o preparo de alimentos ainda são atividades femininas; a alimentação é baseada em vegetais, cereais, carne e ovos; a maioria verifica a geladeira e a despensa antes de fazer compras e faz uma lista de compras de alimentos antes de comprá-los. Conclusão: são conhecidos alguns hábitos de abastecimento de alimentos, o perfil dos consumidores responsáveis e não responsáveis, a alimentação saudável e o consumo responsável de alimentos.

Palavras-chave: consumo de alimentos; gastos; preços de commodities; preparação de alimentos; papel da família.

JEL: D100; I310; M140; Q210; Z130.

Introduction

The effects of environmental degradation and the depletion of natural resources, without considering the effects of climate change, have been increasing over time, generating serious problems that put the survival of humanity at risk.

Planet Earth is inhabited by around 8,200 million people (United Nations, 2024), of which almost 700 million live in extreme poverty (World Bank Group, 2024), unable to meet their basic food needs. Paradoxically, while many people lack food, an increasingly significant part of the population suffers from overweight, obesity, diabetes and other diseases, all caused by an unbalanced diet and unhealthy lifestyles, among other factors.

In this sense, for Schanes et al. (2018), one of the most significant impacts on the planet comes from food production, an activity that requires an intensive use of natural resources such as soil, water and energy, and which, in addition, generates atmospheric pollutants due to greenhouse gas emissions that originate during cultivation. storage, transport and management of food waste.

As for food loss and waste, it is necessary, first of all, to define and differentiate both concepts. According to Basso et al. (2016), the former refers to the "decrease in the mass of edible food, specifically for human consumption, which occurs during the stages of production, post-harvest, processing, storage, transport, and distribution" (p. 26).

On the other hand, according to the Food and Agriculture Organization of the United Nations (FAO, 2014):

Food waste refers to losses arising from the decision to discard food that still has value in the final stages of chains and is primarily associated with the behavior of wholesalers and

retailers, food sales services, and consumers. (p. 3)

> Food waste is also considered to be products of adequate quality that, even in excellent condition, are discarded; this aspect is related to various factors, such as inappropriate purchasing and consumption habits, as well as inappropriate food management and handling (Basso et al., 2016).

The global cost of food waste is estimated to amount to more than one trillion dollars each year (United Nations Environment Programme [UNEP], 2024a). Hidalgo and Martín-Marroquín (2020) present a breakdown in the following terms: the economic costs for this concept are close to 1 trillion euros, the environmental costs amount to 700,000 million euros and the social costs reach 900,000 million euros.

For García (2020), the causes of food losses and waste vary according to the country's income level. In low-income countries, these losses are associated with social, cultural and technological inequalities; while in middle- and high-income countries, consumers make wrong choices due to poor purchasing planning and demands on the appearance of products.

Schanes et al. (2018) identify households as key actors in the generation of food losses and waste, which directly affects hunger and nutrition, poverty, income generation, and economic growth. In this regard, Basso et al. (2016) point out that throwing away food implies an inefficient use of resources such as water, soil, fertilizers, fuels, energy and money, not counting greenhouse gas emissions that contribute to global warming and climate change. All of this has a negative impact on biodiversity worldwide due to monocultures and agricultural expansion in wild areas (Juárez, 2022).

It is also estimated that, globally, food waste accounts for more than 20% of the pressure on biodiversity and entails high costs in waste management, including landfill maintenance, transportation, and the operation of waste disposal facilities (Hidalgo and Martín-Marroquín, 2020).

According to Basso et al. (2016), although some steps are being taken to reduce waste, the underlying problem lies in the imperative of economic growth based on the continuous consumption of goods and services, which demands greater resources and energy, thus

generating an unsustainable model. In this sense, García (2020) argues that food waste acquires social relevance when analyzing its ethical and moral implications in the context of the problem of hunger in the world.

At the same time, significant water waste is incurred in homes, particularly in the kitchen during culinary processes. Faced with this situation, the World Health Organization (WHO) recommends an optimal average amount of water for human domestic consumption of 100 liters per inhabitant per day, intended for activities such as drinking, cooking, and personal and household cleaning, of which 20 liters should be used to cover basic hygiene and food needs (Blanco et al., 2014). However, in Mexico, the average daily consumption of water is 380 liters per person, an amount that almost quadruples the recommended expenditure and shows the inefficient use of the resource (National Institute of Statistics, Geography and Informatics [INEGI], 2022).

Something similar happens with the energy resources used in homes, especially in cooking, such as gas and electricity, since rational use practices are implemented on a very small scale, which generates a significant waste.

Currently, food waste and loss are problems on a global scale, from which Toluca is not exempt. These situations occur throughout the entire food production process, including its preparation, consumption and, finally, waste management. However, it is in the preparation and consumption phases where the most relevant waste is generated, due to causes such as lack of planning when buying, preparing and consuming food, the waste of all edible parts, the replacement of traditional eating habits with diets based on ultra-processed products, and the lack of awareness about the amount of natural resources and human effort invested in each portion of food that arrives daily to the tables.

Likewise, the lack of knowledge of the economic and environmental cost of food production has led consumers to undervalue edible products, adopting inappropriate practices in their purchase, storage and preparation.

In the face of the global environmental crisis, there is a need to adopt more efficient food models that respond to the basic principles of sustainable development: diversity, self-sufficiency, social control (by individuals and society over the production process), local

participation, grassroots democracy and autonomy (Barkin, 1998).

The United Nations (1987), when referring to sustainable development, establishes that:

> It is in the hands of humanity to make development sustainable, that is, to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own. The concept of sustainable development implies limits, not absolute limits, but constraints imposed on the resources of the environment by the current state of technology and social organization and the capacity of the biosphere to absorb the effects of human activities - but both technology and social organization can be ordered and improved in ways that open the way to a new era of economic growth. (p.23)

Faced with this situation, on September 25, 2015, during the United Nations General Assembly, the 2030 Agenda for Sustainable Development was approved, conceived as an action plan for people, the planet and prosperity. Its fulfillment is articulated through the 17 Sustainable Development Goals (United Nations, 2018), among which is the objective related to sustainable production and consumption, the guiding axis of this research, since it seeks to guarantee sustainable patterns of consumption and production, promoting the efficient use of resources, the reduction of waste and the adoption of responsible lifestyles in harmony with the environment. for which the United Nations (2018) mentions:

> They consist of promoting the efficient use of resources and energy efficiency, sustainable infrastructures and facilitating access to basic services, green and decent jobs, and a better quality of life for all. Its implementation helps to achieve overall development plans, reduce economic, environmental and social costs, increase economic competitiveness and reduce poverty. The goal of sustainable consumption and production is to do more and better things with fewer resources, increasing the net welfare gains of economic activities by reducing resource utilization, degradation and pollution throughout the life cycle, while achieving a better quality of life... There is also a need to take a systemic approach and achieve cooperation between participants across the supply chain.

It requires the involvement of "consumers through awareness and education on sustainable consumption and lifestyles, providing them with adequate information through

standards and labels, and participating in sustainable public procurement, among others" (United Nations, 2018, p. 55).

The problem of food losses and waste is global; For this reason, researchers from all over the world are developing theories and proposing both practical and technological recommendations to reduce the economic, social and environmental effects of food waste.

Schanes et al. (2018) conducted a study in Austria to analyse sociodemographic, psychosocial and household behaviours related to food, through interviews and observation guides, in order to determine the causes of food waste. The results show that the daily routines and practices of acquiring, preparing, consuming and storing food in households are fundamental activities that contribute to waste. It is suggested to improve the infrastructure for purchasing activities, as well as to involve political actors and all stakeholders along the supply chain, to apply prevention measures in the generation of food waste in households.

In the European Union, there are public and private programmes and initiatives aimed at reducing waste. One of them is the "Food has no waste" program, designed by the Association of Manufacturers and Distributors (AECOC) in Spain, whose objective is to establish prevention and efficiency practices throughout the entire food production and distribution chain, maximizing the use of resources through models of reuse and recycling of surpluses. Similarly, mobile apps such as Too Good to Go, Zu Gut für die Tonne, and Love your Leftovers help link stores and restaurants that want to liquidate products with consumers, as well as offering tips for extending the shelf life of food through recipes with leftovers (García, 2022).

In Latin America, Casimiro and Delgado (2020) examined the causes of food waste, focusing on eating routines at home. Using surveys and a focus group, they analyzed fifteen hypotheses about consumer behavior, such as food planning, purchasing, storage, and reuse.

They concluded that the routines of buying, cooking and reusing leftovers are determinants in domestic food waste. Finally, the authors recommend carrying out a more in-depth theoretical analysis to check the correlation between food planning and waste, in addition to incorporating new storage practices that contribute to its reduction, and analysing the most wasted types of food and the reasons for discarding them.

García (2020) analyzed the habits of purchasing, storing, consuming, and wasting ground meat at home, with the purpose of identifying the causes of such waste and generating environmental awareness in this regard. To obtain the information, surveys were applied in the cities of Guadalajara and Monterrey. It was concluded that, by ignoring and not applying the optimal conditions for the acquisition, transport and conservation of perishable foods, consumers violate the cold chain, which compromises the safety of the products.

In the technological field, Sánchez et al. (2016) developed the mobile application "Fácil Hogar", aimed at housewives, with the aim of reducing food waste in households in Tlaxcala (Mexico). This tool allows you to manage the inflows and outflows of products in both cupboards and refrigerators. The results reflect considerable savings in domestic spending, which went from an average of two thousand to three thousand Mexican pesos per supply event, to between 800 and one thousand Mexican pesos after the use of the application.

Environmentally, socially, economically and culturally responsible gastronomy is one that seeks to make culinary practices and the use of resources more efficient at each stage of the food production chain. In this sense, Garza (2014) states that:

> When talking about sustainable gastronomy, we refer to the system that provides healthy food for food needs, while maintaining balance in ecosystems, so that they can provide food to future generations, with a minimum negative impact on the environment. (p. 64)

Due to the above, the need arises to make the activities of producers and consumers more sustainable, through the optimization of economic performance with minimal environmental and social deterioration. This implies fostering a sustainable supply and demand chain, through energy efficiency and the use of resources, the strengthening of infrastructure, the promotion of social equity, the generation of green jobs, the promotion of ethical consumption options and, in general, a better quality of life for the population (Velázquez et al., 2020).

For sustainable production and consumption to become a reality, it requires more conscious and capable consumers, as well as responsible and committed decision-makers, who are willing to apply an appropriate mix of policies aimed at waste prevention as a key strategy to reduce the environmental impact of households (Schanes et al., 2018). Along these lines,

Velázquez et al. (2020) propose a series of actions grouped into the following headings:

a) Good practices in supply: reduce consumer demand, increase efficiency in the use of resources and encourage the use of alternative raw materials.

b) Consumer habits (demand): raise consumer awareness through education on sustainable lifestyles.

c) Public policies and environmental regulations: implement measures that reduce food consumption, loss, and waste, focusing on behavior modification.

For Binz and De Conto (2019), "sustainability in gastronomy is a set of practices that allow the food system to function responsibly with the development and future of society and the environment" (p. 508). Some examples of these practices include the consumption of sustainably produced food, the promotion of environmental education, and the proper management of energy, water and waste resources throughout the food chain.

According to Certeau et al. (1999), "culinary practices are located at the most elementary level of daily life, at the most necessary and most undervalued level" (p. 159). As Meléndez and Cañez (2010) point out, these practices are made up of two components, knowledge (tangible knowledge) and practice, which encompasses the provisioning, preparation, conservation, presentation, and consumption of dishes. It is necessary to organize, decide, anticipate, adapt, modify, invent, combine, take into account the tastes and needs of each member of the family, satisfy preferences and design specific diets (Pérez, 2021).

In this regard, Pollan (2014) states that cooking is essential for human identity, biology and culture, so its decline in modern life has significant consequences, particularly in environmental terms. To address these challenges, Garza (2014) takes up six areas where it is possible to apply simple practices towards sustainable cooking: purchasing, receiving and storing raw materials, cooking itself, food service, washing dishes, and garbage management.

The problem addressed in this research can be summarized as follows: according to the FAO, in 2022 a fifth of the food available to consumers was wasted, i.e. 1,052 million tons of food were discarded worldwide, of which 60% originated in households (UNEP, 2024a).

In developing countries, more than 40% of food losses occur in the post-harvest and

processing stages. In contrast, in industrialized countries, more than 40% of these losses occur in the sales and consumption stages (Hidalgo and Martín-Marroquín, 2020). In this regard, the High Level Panel of Experts on Food Security and Nutrition (HLPE, 2014) estimates that the amount of food lost and wasted per capita annually is between 280 and 300 kilograms in Europe and North America, while in Sub-Saharan Africa, as well as in South and Southeast Asia, this figure ranges between 120 and 170 kilograms per person per year.

In particular, the Latin American region has an average of losses and waste equivalent to 34% of the total food produced. In this region, these losses are especially concentrated in the harvest (13.4%), postharvest (7.5%), and processing and packaging (5.0%) stages (HLPE, 2014).

According to UNEP (2024b), the average household food waste in Latin America and the Caribbean amounts to 95 kilograms per person per year, while in the United States and Canada it is 76 kilograms per person. In Mexico, this figure varies between 71 kg/person/year in Berriozábal - Chiapas, and 129 kg/person/year in Ensenada, Baja California. According to García (2023), approximately 30 million tons of food are lost in the country each year, of which 10 million are due to the expiration of products alone (Sánchez et al., 2016). This volume represents an economic waste of 8,000 million dollars per year, enough to feed about 12 million people or three million families each year.

In Mexico, up to 70% of urban waste corresponds to food, much of which is still in good condition. Among the most wasted products are: nopales (63.3%, equivalent to 83,784 tons), guavas (57.7%, 63,719 tons), mangoes (54.5%, 297,853 tons), and fish and sardines (54.1%, more than 127,000 tons) (San Juan, 2019).

In order to address this problem, the Mexican government has implemented various programs and created companies aimed at guaranteeing access to healthy and sustainable food. In 2025, the "Food for Well-being" program was established, whose purpose is to ensure that the Mexican population consumes healthy and nutritious food, which is offered in Wellness Stores at affordable prices (Government of Mexico, 2025a). Likewise, through the "Transformation for Well-being" program, crops are acquired from small producers directly and without intermediaries, positively impacting rural and indigenous communities, and promoting the sustainable cultivation of various products (Government of Mexico, 2025b).

On the other hand, in view of the high incidence of chronic-degenerative diseases in the population, especially in Mexican children, the General Law on Adequate and Sustainable Food (2024) was enacted, the purpose of which is, among other aspects "Promote the production, supply, fair and equitable distribution and consumption of nutritious, sufficient, quality, safe and culturally appropriate food, in order to promote the protection and exercise of the right to adequate food, avoiding food waste to any extent".

This law is already being implemented in the national education system. In one of its chapters, it contemplates the promotion of policies and actions, as well as the execution of programs aimed at reducing food loss and waste. Its implementation seeks, among other objectives, to reduce the high costs associated with the treatment of chronic-degenerative diseases. However, given the possible impact on the ultra-processed food industry, as a result of lower demand, representatives of the sector have argued that thousands of jobs could be put at risk.

In particular, in the State of Mexico, between 9% and 10% of total food is wasted at the national level, which is equivalent to approximately three million tons per year, that is, 30% of local production. In this state, the number of people with food shortages was 3.1 million in 2008, a figure that rose to 3.5 million in 2018 (San Juan, 2019). These data show the magnitude of the state's unmet food needs, which could be mitigated through better use of wasted food.

In this context, the objective of this work was to identify food supply habits and some sustainable practices among consumers in Toluca, State of Mexico, in order to analyze the economic inefficiencies associated with food waste in urban households. This information seeks to serve as a basis for proposing alternatives that optimize the use of family income for food, reduce economic losses derived from waste and contribute to the strengthening of more sustainable and efficient consumption systems.

Methodology

The area of study of this research was Toluca, one of the 125 municipalities of the State of Mexico, located in the Central Valleys of the state (INEGI, 2003). Toluca has a total area of 420.4 km², and in its urban land that represents 37% of the municipal territory, where 910,608 inhabitants reside, of which 51.8% are women and 48.2% men, making up a total of 239,734 households; 90.47% are family households and the rest are non-family (Municipal Planning Institute of Toluca [IMPLAN], 2021). The municipality is composed of the municipal seat, Toluca de Lerdo, which is also the capital of the State of Mexico, and 47 delegations; its commercial and supply infrastructure includes a Central de Abastos, seven functioning markets, 42 traditional tianguis, and 32 department or regional stores (Ayuntamiento de Toluca, 2018).

The methodological design of this research was non-experimental (Agudelo et al., 2008), with a cross-sectional and descriptive scope. A quantitative approach was used, using the survey method. The instrument was a questionnaire designed based on questions from the 2018 National Survey of Household Income and Expenditure (INEGI, 2018), which was applied to a sample of 281 adults, determined using the equation for simple random samples (Levine et al., 2019). The sample was selected for convenience, focusing on the medium-low socioeconomic stratum, in order to know their food acquisition and consumption habits. The fieldwork was carried out between September and October 2023, in markets, tianguis (markets on wheels or semi-fixed) and supermarkets in 13 delegations of the municipality of Toluca.

Data analysis was performed using Microsoft Excel and MINITAB statistical software. In the first stage, a descriptive analysis was carried out according to the nature of the variables, using percentages, box plots and pie charts. Subsequently, a new variable called "average responsible consumption" was integrated, obtained from the average of three items: (1) How often the consumer makes a shopping list, (1) How often they check their refrigerator and pantry before shopping, and (3) How often they buy food in large quantities due to promotions (for example, 2x1).

With this variable, the participants were classified into responsible and non-responsible consumers, and a profile was built for each group; likewise, Spearman's correlation coefficient

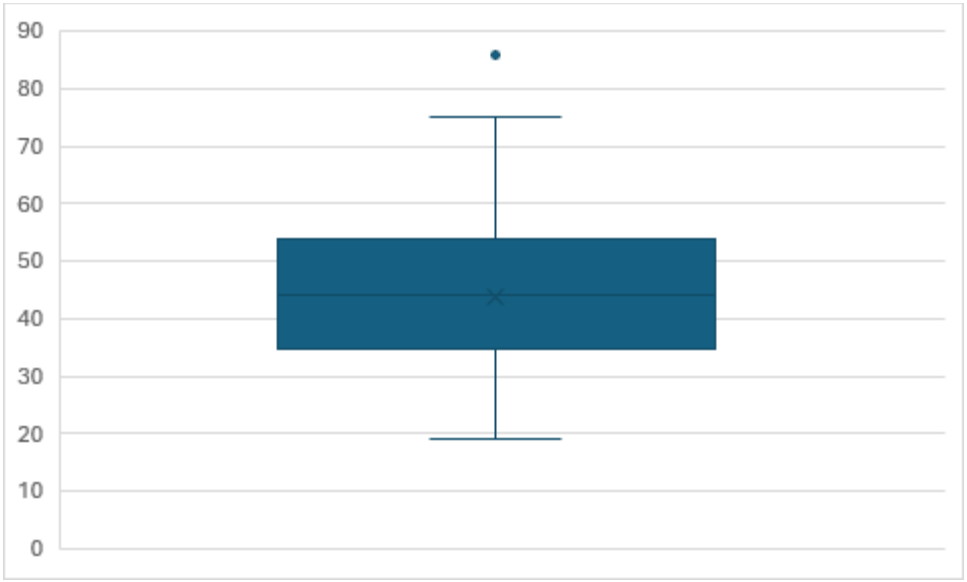
was calculated between the variables income and percentage of income allocated to the purchase of food, since both were measured on an ordinal scale. Finally, two multiple regression models were adjusted to identify the variables that explain: a) the average responsible consumption, and b) the percentage of income allocated to food.

Results

Of the 281 adults interviewed, 35% were approached in markets, 34% in flea markets and 31% in supermarkets; in different places in the municipality of Toluca. 70% corresponded to the female sex and 30% to the male sex. The mean age was 43.94 years, with a standard deviation of 13.25 years and a coefficient of variation of 30.15%; the minimum was 19 years and the maximum was 86 years (an outlier). The distribution is slightly asymmetrical to the right, as shown in the box plot in Figure 1.

Figure 1

Age Box Diagram



Source: Authors.

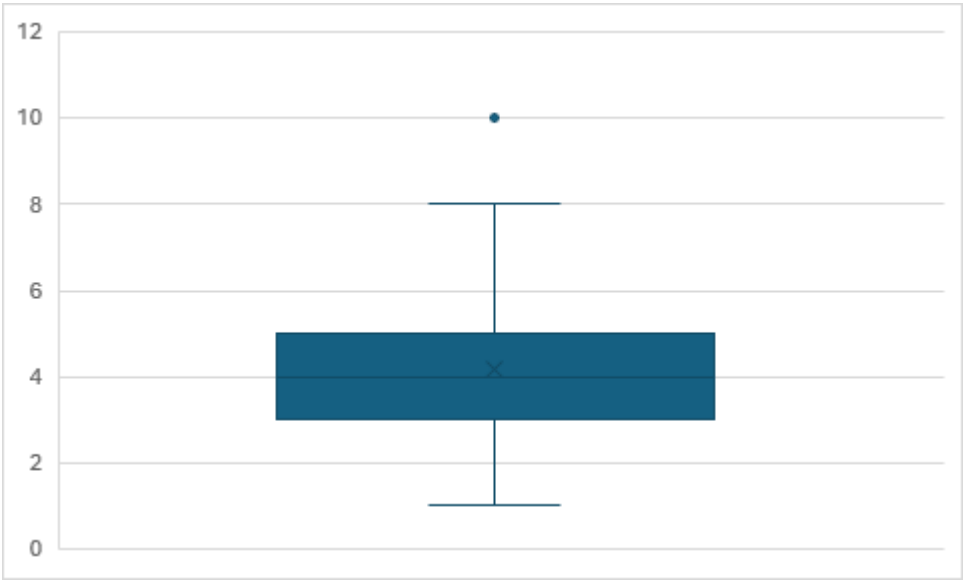
The households of the interviewees are inhabited by at least one person and a maximum of 10 (outlier), with an average of 4.17, which may correspond to the case of a family made up of parents and two children, with a standard deviation of 1.68 and a coefficient of variation of 40.28%. The box plot for this variable appears in Figure 2, with a very slight

asymmetry on the right.

The vast majority of households, 98%, are family-owned, that is, those in which at least one member is related to the head of the household, and the rest are not; this figure contrasts with 87% at the national level in 2020 (INEGI, 2025). As for the type of them, Figure 3 shows that the majority, 76%, are nuclear, that is, they are made up of the parents (or one of the two) and children who live with them; 22% are composites, which are those formed by a nuclear or extended household (nuclear household together with other relatives) and at least one other person unrelated to the head of the household; the rest are single-person.

Figure 2

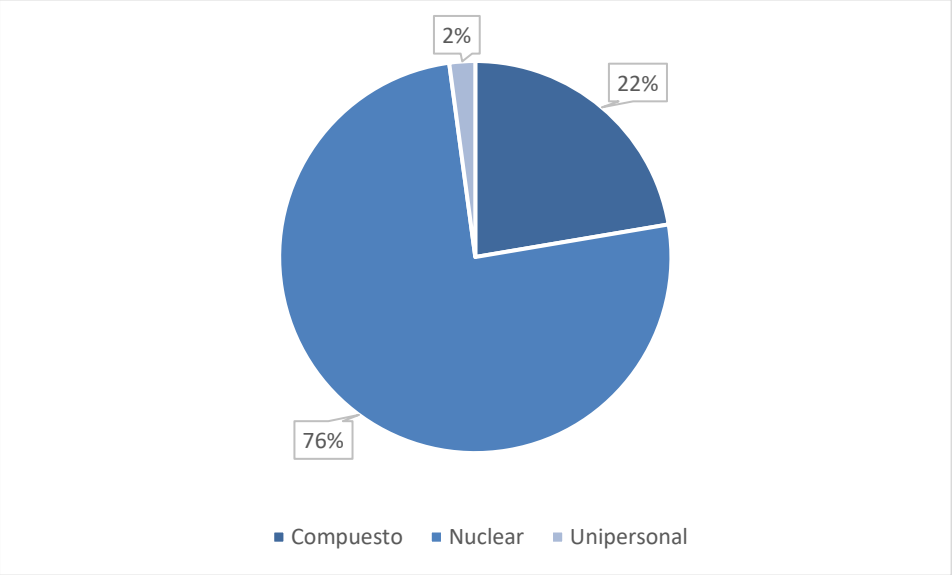
Box Plot of the Number of Persons per Household



Source: Authors.

Figure 3

Household Type Percentage Pie Chart

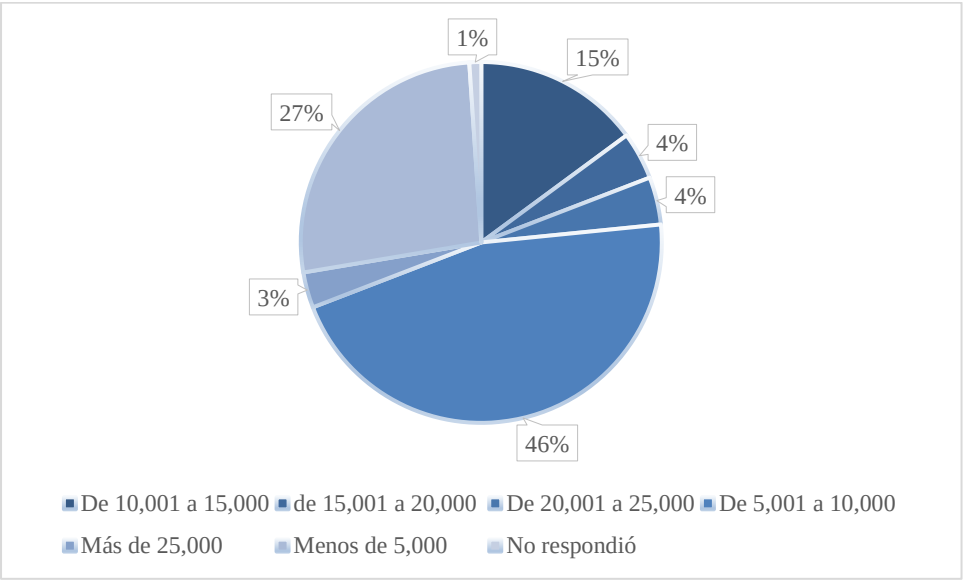


Source: Authors.

Regarding income, it is noteworthy that 72% declared that they had income in Mexican pesos of a maximum of $10,000 pesos per month in their household; 15%, from $10,001 to $15,000 (Figure 4). The national average was $22,437 and the average in the State of Mexico was $19,078 (INEGI, 2023a).

Figure 4

P*ie Chart of Percentage of Monthly Household Income (Pesos)*

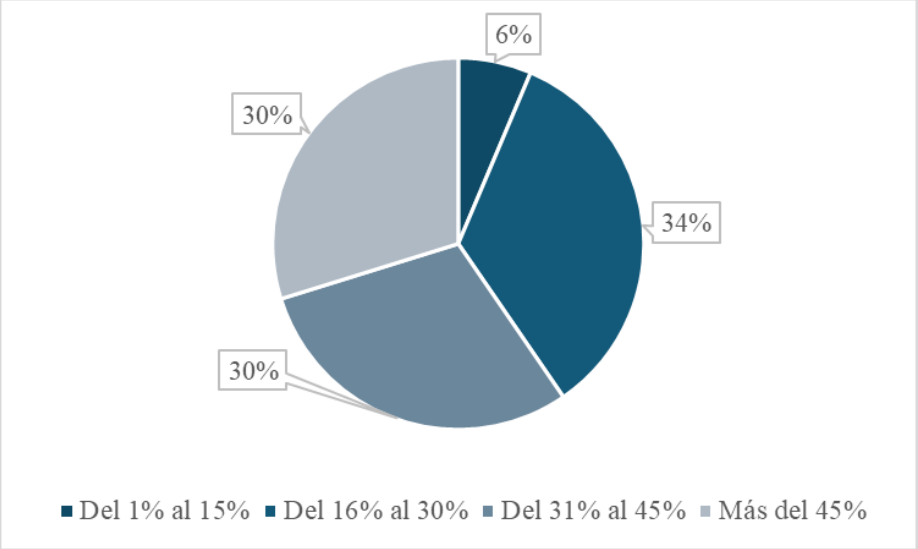


Source: Authors.

According to Figure 5, 34% of those interviewed said they spent between 16% and 30% of their income on food; 30% between 31% and 45%; and 30% more than 45%. At the national level, 38% of monthly expenditure is allocated to food and beverages, a figure that rises to 51% among households with the lowest incomes; at the State of Mexico level, this figure is 43.3% (INEGI, 2023a).

Figure 5

Pie Chart of Percentage of Income Spent on Food (Pesos)



Source: Authors.

When the interviewees were asked to order the foods they had bought in the last seven days on a scale of importance from 1 to 10, where 1 was for those who bought the most and 10 for those who bought the least, the greatest relevance corresponded in the first place to fruits and vegetables. followed, in descending order, by tortillas and flours, meats and organ meats, eggs, legumes and seeds, dairy products, fish and seafood, oils and fats, sweeteners and soft drinks, and, finally, coffee, tea and condiments. This result shows how the diet of this population group is integrated, in which the first products listed acquire greater importance; in the case of corn, it should be remembered that traditionally the Toluca Valley has been an important producer of the grain, to date a fundamental pillar in the diet of its inhabitants.

To complement the above information, it should be mentioned that, according to INEGI (2023b), at the national level, the average monthly expenditure on food and beverages consumed at home is $3,814 Mexican pesos, an amount that is mainly used for the acquisition

of: meat ($859), cereals ($646), various foods (rice cereal, oatmeal, banana, apple, mixed for baby, baby porridge, fresh mushrooms, custards, jellies, puddings powder, among others, $591), vegetables, legumes, legumes and seeds ($407), milk and its derivatives ($342), alcoholic and non-alcoholic beverages ($318), fruits ($193), eggs ($147), among others.

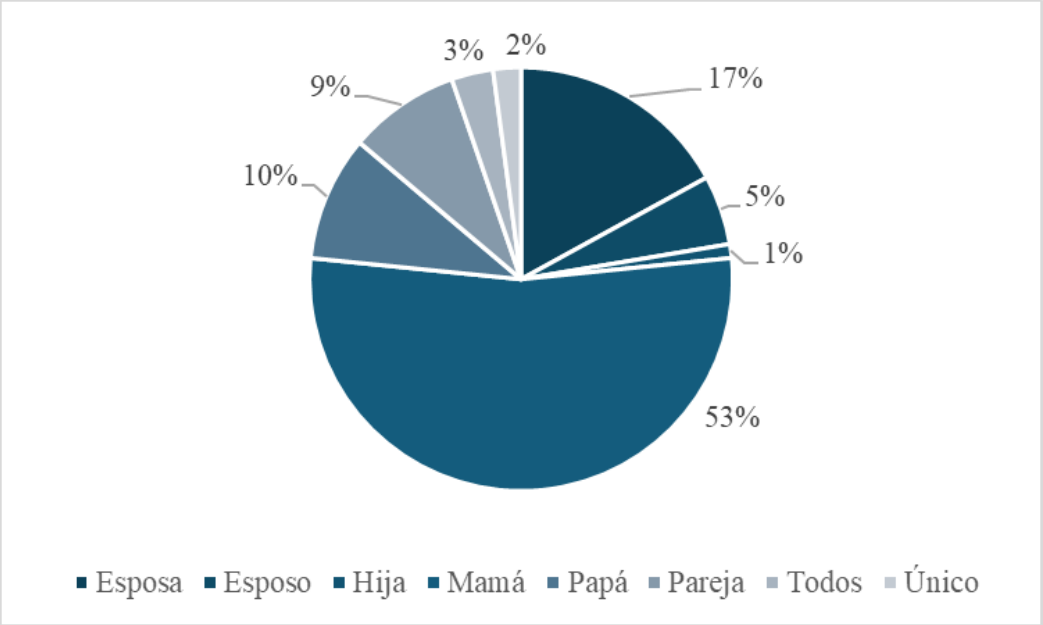
Here it is worth making some considerations about the impact that inflation and volatility have on the availability and consumption of some of the most consumed foods in Toluca. According to León and Díaz (2020), food inflation impacts different types of items, such as food poverty, malnutrition, the abandonment of agricultural producers, wages in the primary sector, and the depletion of natural resources, among others. Each food group has a particular inflationary behavior; for example, fruits, vegetables, and grains and cereals are the three groups that present the greatest volatility and cyclical behaviors; wheat and foods of animal origin have more stable behaviors. Díaz et al. (2019) report that fruits and vegetables and foods of animal origin presented the greatest decreases in demand due to price increases.

Attanasio et al. (2013), with information from 2003 to 2011, conducted research in order to test the effects of food price volatility and found that increases in the prices of these products strongly and negatively impacted the well-being of rural households. Thus, it is shown that it is necessary to keep basic foods such as fruits, vegetables and cereals under control, to ensure their availability to the population and to ensure their well-being.

In 53% of households, the mother is the one who buys food, followed by 17% of wives (in households made up only of couples). As shown in Figure 6, women, in their multiple roles, continue to play a fundamental role in this activity.

Figure 6

Pie Chart of Who Buys Food Percentage

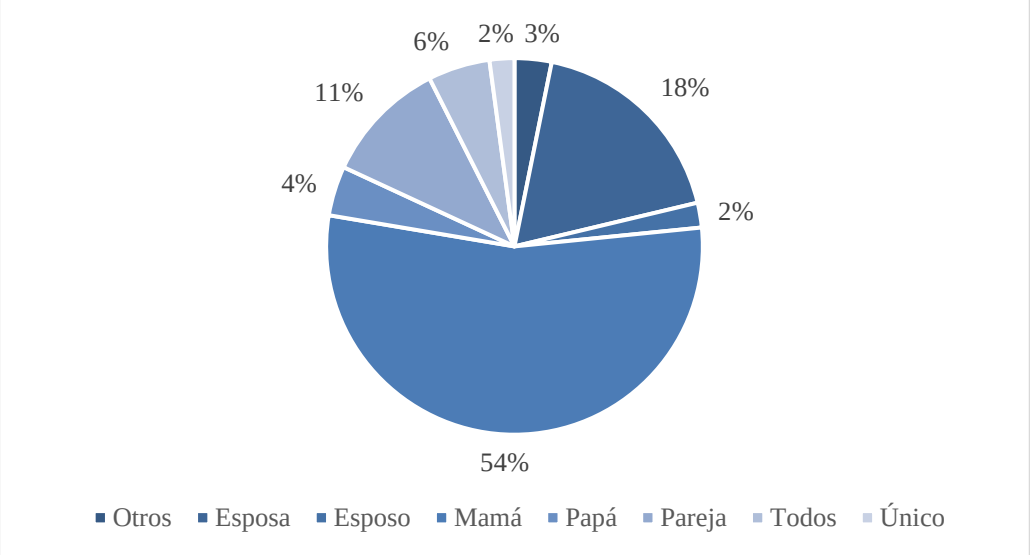


Source: Authors.

A similar conclusion can be derived from Figure 7, which shows the summary of the answers to the question of who prepares the food; 54% answered that the mother and 18% the wife. Although it can be seen that this activity, traditionally female, is also carried out by men in a significant percentage (around 20%), assuming their various roles.

Figure 7

Cake Diagram of Who Prepares Food Percentage



Source: Authors.

On how often the refrigerator and pantry are checked before shopping, 62% said always, 14% half the time and 14% never. This is a result that can partially indicate the execution of responsible food consumption.

When asked about how often they make a grocery list before buying them, among the most important results, it was found that 49% answered always, 21% that about half of the time, and 19% that they never. That is, a significant percentage of the interviewees do not carry out this basic practice to prevent food waste. Regarding the frequency with which they buy large quantities of food because they are on promotion, among other figures, the most relevant indicate that 22% answered always, 28% said they did it half the time, and 27% that they never; In this way, it is evident that, to a large extent, this possibility of creating savings in the purchase of food prevails in many consumers, although food waste may eventually be generated.

The previous paragraphs show the results of some actions carried out by consumers who make up the sample studied, such as planning food purchases; according to Hidalgo and Martín-Marroquín (2020), consumers play a decisive role in this process, since these types of decisions, among others, have a strong impact on domestic food waste.

For the municipality of Toluca, no precise figures have been found on the volume of waste and its economic value, only that in the Central de Abastos (the most important place for the commercialization of food in the capital of Mexico) various charitable institutions and entire families in the area, weekly rescue 50 tons of fruits and vegetables that are in good condition. but that no longer meet the quality demanded by the clientele that attends that place (San Juan, 2019). Food waste and losses have serious economic and social consequences, such as increases in their prices in the markets, with the consumer absorbing the costs of these losses and waste, since it is included in the final price of the product; thus, any level of losses directly affects consumers (Caixeto, as cited in Aguilar, 2019). In this way, the demand for food decreases and, therefore, also the income of producers and sellers.

The profile of responsible consumers and responsible non-consumers is presented in Table 1. Most of the respondents are classified in the group of responsible consumers, which is characterized, compared to the non-responsible consumers, by having a higher average age, being made up mostly of women, having lower incomes, allocating a higher percentage of their

income to the purchase of food, and because more people buy their food in markets in the neighborhood and not in supermarkets.

Table 1

Profile of responsible and non – responsible consumers

Variable	Non – responsable consumers	Responsible consumers
Conformation	30%	70%
Average age	41.4 years	44.7 years
Sex	Female 51% Male 49%	Female 79% Male 21%
Income	Maximum de $10,000, el 61%	Maximum de $10,000, el 78%
Percentage of income spent on food purchases.	54% of the sample, at least 31% of their income.	62% of the sample, at least 31% of their income.
Food Shopping Place	Markets in the neighborhood, 27% Tianguis, 24% Supermarkets, 34%	Markets in the neighborhood, 45% Tianguis, 25% Supermarkets, 24%

Source: Authors.

Engel's Law (Shaiadul and Rabiul, 2024) states that: "when household incomes increase, the proportion of food expenditures in total household income decreases, although the real amount of food expenditures increases" (p. 5). To verify its applicability to the collected dataset, the variables income and percentage of income dedicated to food purchases were graphed, and Spearman's correlation coefficient was calculated; the graph showed a great dispersion and the correlation was very low, which is why it is considered that there is no evidence to support compliance with Engel's Law. Perhaps this may be due, at least partially, to the fact that the measurement scale of both variables was ordinal and not as reported in various publications such as Shaiadul and Rabiul (2024).

The regression analysis carried out, considering as a dependent variable the percentage of income dedicated to the purchase of food and as independent variables age, number of people living in the household, income and sex, yielded a very low coefficient of determination and P values greater than 0.05 for each of the independent variables. therefore, it is stated that none of these contributed to explain the dependent variable. A regression model was also adjusted with the average dependent variable of responsible consumption and the independent variables: age, number of people living in the household, percentage of income dedicated to food purchases, and sex; the results were similar, a very low R squared and no independent variable was significant at 0.05 significance level. It is likely that the results of these analyses are due to the great natural variability of socioeconomic variables, such as those included in this research, as shown above.

Finally, when asked about the number of days they ate their meals at home, in terms of breakfast, 81% answered that they always and 4% two days a week; Regarding food, 74% always eat at home, 9% five days a week, 4% two and 4% three days. 71% always dine at home, while 13% said they always eat out of home. In line with these data, INEGI (2023b) reports that the average monthly expenditure per household on food and beverages consumed outside the home is $822 Mexican pesos.

In general, it can be perceived that, as Cristancho (2023) points out in his research carried out in Bogotá, people intend to improve the way they consume their food and the management they make of the waste produced at home, in order to contribute to the care of nature.

Conclusions

In the population group studied, it was observed that family expenditure on food is high, a situation that occurs when household incomes are low and the acquisition and preparation of food continues to be predominantly a female activity; This corresponds to a very strong tradition in some societies in which these activities have historically corresponded to women.

The diet is based on fruits, vegetables, corn, wheat, meat and eggs. According to all the answers of the interviewees in this area, it can be considered that their diet is healthy, by privileging, depending on their income, the consumption of vegetables. The diet of this segment of Tolucans continues to preserve to a large extent its traditional character.

In general, in the group of people interviewed, responsible food consumption is carried out, as it is assessed as a frequent practice in the terms of the questions posed. Responsible food consumption contributes to sustainable development in a variety of ways, such as adopting a healthy and nutritious diet that minimizes impacts on nature and biodiversity; reducing the use of fossil fuels with the environmental and economic benefits that this entails; making efficient use of natural resources such as water; trying to use as many locally produced ingredients in the kitchen as possible; reducing food losses and waste, thus optimizing the economic resources allocated to food and reducing the environmental impacts of the garbage generated, which can be achieved by planning food purchases, taking advantage of all parts of the ingredients acquired and consuming all the food prepared, serving dishes with reasonable quantities; in addition to properly managing waste and chemical products, to avoid contaminating the atmosphere, soil and water. In this way, through the optimization of resources of all kinds, it affects the reduction of hunger, good nutrition, food security, income generation and economic growth, as well as the decrease in greenhouse gas emissions, global warming, climate change and impacts on biodiversity.

This research is important because, through the fieldwork carried out, it contributes to the direct knowledge of the current state of both some food supply habits and several sustainable practices of consumers in Toluca, of which no previous information was found. The results of this work may be useful for the design of promotional campaigns on these habits and practices,

knowing that the population studied, in some way, is sensitive to the problem of sustainability in food consumption, including its economic component that significantly affects it.

Among other strategies or actions that can be developed to solve the problem addressed in this research, are circular business models, especially in the food sector, with which it is expected to reduce water and energy consumption, replace plastics with recyclable or recycled packaging, reduce waste and design food to circulate. García (2022) points out that the objective of the food curriculum design model is to optimally define food products so that they last in the chain for as long as possible; and identifies five keys in this design: a) using sustainable raw materials, b) seeking a longer shelf life, c) designing ecological containers and packaging, d) introducing biomaterials in packaging or replacing them with recycled or secondary materials, and, e) designing for recycling or second life.

In future research, it is possible to deepen the concepts analyzed here, in addition to extending them to other population segments, compare the differences that arise and focus the efforts that entail the solution of the difficulties of supply, preparation and consumption of food.

Ethical considerations

The present study did not require the endorsement of an Ethics or Bioethics Committee since it did not use any living resource, agent, biological sample or personal data that represent any risk to life, the environment or human rights.

Conflict of interest

All authors made significant contributions to the document and declare that there is no conflict of interest related to this article.

Declaration of authors' contribution

Felipe Carlos Viesca González: Conceptualization, methodology, validation, formal analysis, research, resources, data curation, writing - original draft, writing: revision and editing, supervision, project management, acquisition of funds.

Violeta Alvirde Castañeda: Conceptualization, methodology, formal analysis, research, data curation, writing - original draft, writing: proofreading and editing.

Gerardo Novo Espinosa de los Monteros: Conceptualization, methodology, resources, writing - original draft, writing: proofreading and editing, supervision, project management, fund acquisition.

Baciliza Quintero Salazar: Conceptualization, methodology, validation, resources, writing - original draft, writing: review and editing, supervision, acquisition of funds.

Source of financing

Article from the project "Analysis of sustainability in family food preparation and consumption in the city of Toluca, State of Mexico" financed by the Universidad Autónoma del Estado de México, identified with code 6774/2022CIB.

References

(1) Agudelo, G., Aigneren, M. y Ruiz, J. (2008). Diseños de investigación experimental y no experimental. La Sociología en sus Escenarios, (18), 1–46. https://revistas.udea.edu.co/index.php/ceo/article/view/6545

(2) Aguilar, G. (2019). Responsabilidad social corporativa en las pérdidas y desperdicios de alimentos en México. Cuadernos PROLAM/USP, 17(33), 168–199. https://doi.org/10.11606/issn.1676-6288.prolam.2018.133625

(3) Attanasio, O., Di Maro, V., Lechene, V. & Phillips, D. (2013). Welfare consequences of food prices increases: evidence from rural Mexico. Journal of Development Economics, 104, 136-151. https://doi.org/10.1016/j.jdeveco.2013.03.009

(4) Ayuntamiento de Toluca. (2018). Plan municipal de desarrollo urbano de Toluca. H. Ayuntamiento de Toluca. https://sedui.edomex.gob.mx/sites/sedui.edomex.gob.mx/files/files/planes_municipales/Toluca/Docs/DOCUMENTO.pdf

(5) Barkin, D. (1998). Riqueza, pobreza y desarrollo sustentable. Centro de Ecología y Desarrollo.

(6) Basso, N., Brkic, M., Moreno, C., Pouiller, P. y Romero, A. (2016). Valoremos los alimentos, evitemos pérdidas y desperdicios. Diaeta, 34(155), 25-32. https://www.scielo.org.ar/scielo.php?pid=S1852-73372016000200004&script=sci_arttext

(7) Binz, P. y De Conto, S. (2019). Gestión de la gastronomía sustentable. Prácticas del sector de alimentos y bebidas en hospedajes. Estudios y perspectivas en turismo, 28(2), 507-525 https://www.redalyc.org/articulo.oa?id=180760431014

(8) Blanco, S., Henry A., Lara de Williams, M., Velezmoro, A. C. y Aguilar V. (2014). Consumo de agua en actividades domésticas. Caso de estudio: Estudiantes de la asignatura saneamiento ambiental de la UCV. Revista de la Facultad de Ingeniería Universidad Central de Venezuela, 29(1), 51-56. https://ve.scielo.org/scielo.php?script=sci_arttext&pid=S0798-40652014000100007

(9) Casimiro, R. y Delgado, G. (2020). Rutinas alimenticias en el hogar y el desperdicio de alimentos [Tesis de maestría, Universidad de Lima]. Repositorio de la Universidad de Lima. https://hdl.handle.net/20.500.12724/12799

(10) Certeau, M., Giard, L. y Mayol, P. (1999). La invención de lo cotidiano 2. Habitar, cocinar (A. Pescador., Trad., 1ª. ed.). Trabajo original publicado en 1994. Universidad Iberoamericana.

(11) Cristancho, G. (2023). Actitud e intención hacia el consumo responsable en los hogares de Bogotá. Tendencias, 24(1), 130–154. https://doi.org/10.22267/rtend.222302.218

(12) Díaz, E., Ivanic, A. y Durazo, E. (2019). A study of food retailing: how does consumer price sensitivity vary across food categories and retailer types in Mexico? Contaduría y Administración, 65(1), 1-21. https://doi.org/10.22201/fca.24488410e.2020.2182

(13) Food and Agriculture Organization of the United Nations [FAO]. (2014). Pérdidas y desperdicio de alimentos en América Latina y El Caribe. FAO. https://openknowledge.fao.org/server/api/core/bitstreams/6b37c91c-d542-4403-b24e-36b091ed0236/content

(14) García, D. (2020). Patrones de consumo y desperdicio de carne de res en hogares urbanos de México [Tesis de maestría, Universidad Autónoma de Chapingo]. Departamento de Zootecnia. https://repositorio.chapingo.edu.mx/items/71891100-34b5-40a6-8ee3-6398c4355651

(15) García, G. (2022). 5 claves para un diseño circular de alimentos. https://thefoodtech.com/seguridad-alimentaria/5-claves-para-un-diseno-circular-de-

alimentos/#:~:text=El%20prop%C3%B3sito%20del%20modelo%20de%20dise%C3%B1o%20circular,el%20aprovechamiento%20de%20todos%20los%20recursos%20naturales.

(16) García, M. (2023). El impacto de la pérdida y desperdicio de alimentos. https://www.ipade.mx/newsmedia/factor-humano/el-impacto-de-la-perdida-y-desperdicio-de-alimentos/

(17) Garza, M. (2014). Gastronomía Sustentable. Hospitalidad ESDAI, (25), 55–83. https://scripta.up.edu.mx/entities/publication/955e70a1-b852-43c1-98f5-7c0a3e91e96c

(18) General Law on Adequate and Sustainable Food. (2024). Diario Oficial de la Federación. https://www.dof.gob.mx/nota_detalle.php?codigo=5723626&fecha=17/04/2024#gsc.tab=0

(19) Government of Mexico. (2025a). Gobierno de México crea Alimentación para el Bienestar para garantizar que las y los mexicanos coman sano y nutritivo. https://www.gob.mx/agricultura/prensa/gobierno-de-mexico-crea-alimentacion-para-el-bienestar-para-garantizar-que-las-y-los-mexicanos-coman-sano-y-nutritivo)

(20) Government of Mexico. (2025b). Alimentación para el Bienestar: un paso hacia la justicia social y alimentaria. https://www.gob.mx/alimentacionparaelbienestar/articulos/alimentacion-para-el-bienestar-un-paso-hacia-la-justicia-social-y-alimentaria

(21) Hidalgo, D. y Martín-Marroquín, J. (2020). El desperdicio de alimentos, un problema global. IndustriAmbiente: gestión medioambiental y energética, (29), 28-33. https://www.industriambiente.com/media/uploads/noticias/documentos/AT_Desperdicios_alimentarios.pdf

(22) High Level Panel of Experts on Food Security and Nutrition [HLPE]. (2014). Food losses and waste in the context of sustainable food systems. High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security. https://openknowledge.fao.org/server/api/core/bitstreams/b1949fae-23d4-473c-8b87-8c4359b74d6c/content

(23) INEGI. (2003). IX Perfil sociodemográfico del área metropolitana de Toluca: XII Censo General de Población y Vivienda 2000. INEGI. https://www.inegi.org.mx/contenidos/productos/prod_serv/contenidos/espanol/bvinegi/productos/historicos/2104/702825497095/702825497095_2.pdf#[0,{%22name%22:%22Fit%22}]

(24) INEGI. (2018). Encuesta Nacional de Ingresos y Gastos de los Hogares 2018. Cuestionario de Hogares y Vivienda. INEGI.

https://www.inegi.org.mx/contenidos/programas/enigh/nc/2018/doc/c_enigh18_hogares_ns.pdf

(25) INEGI. (2022). Encuesta Nacional de Ingresos y Gastos de los Hogares 2022 (ENIGH). INEGI. https://www.inegi.org.mx/contenidos/programas/enigh/nc/2022/doc/enigh2022_ns_presentacion_resultados_mex.pdf

(26) INEGI. (2023a). Encuesta Nacional de Ingresos y Gastos de los Hogares 2022 (ENIGH). https://www.inegi.org.mx/contenidos/programas/enigh/nc/2022/doc/enigh2022_ns_presentacion_resultados.pdf

(27) INEGI. (2023b). Encuesta Nacional de Ingresos y Gastos de los Hogares. Estacional (ENIGH E) 2022. INEGI. https://www.inegi.org.mx/contenidos/saladeprensa/boletines/2023/ENIGH-E/ENIGH-E2022.pdf

(28) INEGI. (2025). Hogares. https://cuentame.inegi.org.mx/poblacion/hogares.aspx?tema=P

(29) Juárez. M. (2022). El desperdicio alimentario provoca el 10% de las emisiones de CO2. El Economista. https://www.eleconomista.es/kiosco/alimentacion/?fecha=2022-07-19

(30) León, T. y Díaz, A. (2020). Impacto de la inflación de los precios de los alimentos en el bienestar de los hogares en situación de pobreza en México. Estudios sociales. Revista de alimentación contemporánea y desarrollo regional, 30(56), e201914. https://doi.org/10.24836/es.v30i56.1914

(31) Levine, D., Szabat, K. y Stephan, D. (2019). Business statistics: a first course. (8a. ed.). Pearson.

(32) Meléndez, J. y Cañez, G. (2010). La cocina tradicional regional como elemento de identidad y desarrollo local. El caso de San Pedro El Saucito, Sonora, México. Estudios Sociales, 184-204. https://www.scielo.org.mx/pdf/estsoc/v17nspe/v17nspea8.pdf

(33) Municipal Planning Institute of Toluca [IMPLAN]. (2021). Información sociodemográfica del municipio de Toluca de acuerdo a ITER de localidades del Censo de Población y Vivienda 2020, INEGI. https://www2.toluca.gob.mx/wp-content/uploads/2021/08/tol-pdf-umplan-Informacion-sociodemografica-Toluca-2020-IMPLAN.pdf

(34) Pérez, C. (2021). Tres cocinas: Una idea de arquitectura más allá de la gastronomía [Tesis de maestría, Universidad Politécnica de Madrid]. Archivo digital UMP. https://oa.upm.es/67702/

(35) Pollan, M. (2014). Cocinar: Una historia natural de la transformación. Penguin Random House.

(36) San Juan, S. (2019). Edomex desperdicia hasta 10 por ciento de alimentos del total nacional https://oem.com.mx/elsoldetoluca/local/edomex-desperdicia-hasta-10-por-ciento-de-alimentos-del-total-nacional-14440287

(37) Sánchez, A., Angelino, J., Temoltzin, D. y Águila, A. (2016). Programación e implementación del software de aplicación "Fácil Hogar" para aminorar el índice de desperdicio de alimentos en los hogares de Tlaxcala. Research in Computing Science, (126), 97-107. https://www.rcs.cic.ipn.mx/2016_126/Programacion%20e%20implementacion%20del%20software%20de%20aplicacion%20_Facil%20Hogar_%20para%20aminorar.pdf

(38) Schanes, K., Dobernig, K. y Gözet, B. (2018). Food waste matters - a systematic review of household food waste practices and their policy implications. Journal of Cleaner Production, 182, 978-991. https://doi.org/10.1016/j.jclepro.2018.02.030

(39) Shaiadul, A. H. y Rabiul, M. (2024). Comprobación de la ley de Engel en el patrón de consumo de los habitantes de Tangail Sadar Upazila en Bangladesh. Revista Semestre Económico, 13(1), 4 – 10. https//:doi.org/10.26867/se.2024.v13i1.159

(40) United Nations Environment Programme [UNEP] (2024). Food waste index report 2024. https://www.unep.org/resources/publication/food-waste-index-report-2024

(41) United Nations Environment Programme [UNEP]. (2024). Informe del PNUMA sobre el índice de desperdicio de alimentos 2024.

(42) United Nations. (1987). Informe de la Comisión Mundial sobre el Medio Ambiente y el Desarrollo. Nota del Secretario General. https://www.ecominga.uqam.ca/PDF/BIBLIOGRAPHIE/GUIDE_LECTURE_1/CMMAD-Informe-Comision-Brundtland-sobre-Medio-Ambiente-Desarrollo.pdf

(43) United Nations. (2018). La agenda 2030 y los objetivos de desarrollo sostenible: una oportunidad para América Latina y el Caribe. Naciones Unidas. https://repositorio.cepal.org/server/api/core/bitstreams/cb30a4de-7d87-4e79-8e7a-ad5279038718/content

(44) United Nations. (2024). La población mundial llegará a un máximo de 10.300 millones en este siglo. https://news.un.org/es/story/2024/07/1531126

(45) Velázquez, J. A., Cruz, C. E., Ramírez, G. J. y Vargas, M. E. (2020). Consumo sustentable en turismo: una aproximación a su estado del conocimiento. AD-minister, (37), 57-84. https://doi.org/10.17230/ad-minister.37.3

(46) World Bank Group. (2024). Poner fin a la pobreza en la mitad del mundo podría llevar más de un siglo. https://www.bancomundial.org/es/news/press-release/2024/10/15/ending-poverty-for-half-the-world-could-take-more-than-a-century#:~:text=Casi%20700%20millones%20de%20personas,de%20pobreza%20extrema%20en%202030.