

Chapter 6 Process standardization and its impact on the manufacture of amaranth products

Capítulo 6 Estandarización de procesos y su impacto en la fabricación de productos de amaranto

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Abstract

Currently, the amaranth industrialization has become in an important activity to producer families of west-center region of Puebla State to increase their economic incomes. The objective of this study was propose a strategy based on the good practices and current applicable regulations of food industries, finding out the quality in the process and products of the microenterprises dedicated to create amaranth products. The analysis was applied to six microenterprises of Tochimilco and Atzitzihuacán, Puebla, to get the general characteristics of the families and agro-industrial activities that they realize. Results show that the economic and ignorance restricts the competitive grow in the agro-industrial market, due to deficiency of bases to guarantee the hygiene and safety during the elaboration processes. This project proposes to introduce the requirements of the food industry through improvement tools and methodologies and available resources from producers.

Industrialization, Amaranth products, Methodologies

Resumen

Actualmente, la industrialización del amaranto se ha convertido en una actividad importante para las familias productoras de la región centro poniente del estado de Puebla para incrementar sus ingresos económicos. El objetivo de este estudio fue proponer una estrategia basada en las buenas prácticas y normativa vigente aplicable de las industrias de alimentos, conociendo la calidad en el proceso y productos de las microempresas dedicadas a la elaboración de productos de amaranto. El análisis se aplicó a seis microempresas de Tochimilco y Atzitzihuacán, Puebla, para obtener las características generales de las familias y actividades agroindustriales que realizan. Los resultados muestran que la economía y el desconocimiento restringen el crecimiento competitivo en el mercado agroindustrial, debido a la deficiencia de bases para garantizar la higiene y seguridad durante los procesos de elaboración. El presente proyecto propone introducir los requerimientos de la industria alimentaria a través de herramientas y metodologías de mejora y recursos disponibles de los productores.

Industrialización, Productos de amaranto, Metodologías

1. Introduction

Alejandre and Gómez (1986), comment that, in Mexico, agriculture is one of the priority and most important activities, generating a large number of jobs and responding to the basic needs of millions of people. According to the 2019 Agrifood Panorama, of the 54.9 million Mexicans who work, 5.5 million do so in agricultural activities. According to the profile of agricultural and fishing workers, 45.9% are subordinate and paid workers, 35.8% are own-account workers, 12.1% do not receive payments, and 6.2% are employers.

According to data from INEGI (2014), the Mexican territory has an area of 198 million hectares, of which 14% (27.4 million) are considered to have agricultural vocation. Of the total agricultural area, the rainfed modality covers 79.7% (21.9 million), where basic crops stand out, such as corn, sorghum, beans, and wheat. However, the latter have presented various factors that hinder agricultural production, mainly due to the increase in prices of chemical inputs, of the labor that is used during the cultivation cycle, of the degradation of the land where it is produced and of climate change. Becoming some of the reasons why growers have decided to switch their crops to more adaptable alternatives, According to data from SIAP (2019), production is concentrated mainly in the central zone of Mexico, in the states of Puebla, Tlaxcala, Morelos, the State of Mexico and Mexico City. Highlighting the participation of the State of Puebla, contributing 61% (3,396 tons) of the national production (5,548 tons).

Amaranth stands out as an important alternative for small producers that allows economic income in addition to that provided by the cultivation of corn, since it has agronomic characteristics that allow it to adapt to adverse environmental conditions, where other crops do not prosper (Islas and Islands, 2001) and capable of developing in soils of all kinds of qualities. Currently, groups of residents dedicated to the cultivation of amaranth have explored new forms of activities in search of economic growth for their families and to enhance the development of this seed through industrialization. Based on its adaptability to different environments and its nutritional properties.

The small producers of these areas have adapted their homes in terms of equipment and infrastructure for the industrialization of amaranth, which has applications similar to that of basic crops, mainly corn, finding sweets and fried foods, such as joy sweets, atoles, flours with which breads, pastas, cakes and cookies are made, as well as its consumption as cereal. Despite the efforts, most of these microenterprises have notable deficiencies in terms of the design of their facilities, equipment and utensils, hygiene and sanitation practices both in the production process and in the establishment in general.

Due to the aforementioned, the present investigation seeks to carry out a general analysis in the micro-enterprises of the municipalities of Tochimilco and Atzitzihuacán, Puebla; to propose strategies that serve as a guide towards compliance with current regulations established for food companies and the search for products that guarantee safety and quality specifications for consumer safety (Casas, A. et al; 2001).

2. Objectives

2.1. General Objectives

Formulate an improvement strategy for the standardization in the production process of amaranth through the use of good practices and current regulations applicable to food industries, to generate a higher economic income in the producing families and create a higher level of competitiveness in the agro-industrial sector. microenterprises in the municipalities of Tochimilco and Atzitzihuacán.

2.2 Specific Objectives

- Define good practices for food processing to ensure their safety and innocuousness.
- Establish the current procedures and regulations applicable to establishments and processes for the production of food based on amaranth.
- Design a consultation document, which serves as theoretical support to improve the process of elaboration of amaranth products.

3. Statement of the problema

Amaranth, belonging to the Amaranthaceae family and the *Amaranthus* genus, is a crop that places its origin in Mesoamerica, more precisely in the Southwest of the United States of America and North of Mexico (Sauer, 1967). There are indications that tribes from those areas cultivated amaranth as food and later it was transferred to the Central Table due to migrations, where it reached greater relevance in times before the conquest (Sauer, 1967). During the last years, the cultivation and consumption of amaranth have increased, thanks to its good content of digestible protein, essential amino acids, fiber, with high nutritional and nutraceutical value (Contreras, Jaimez, Soto, Castañeda and Añorve, 2011).

In addition to being a promising economic livelihood, since the nineties, the basic crops of corn, beans, wheat, sorghum, among others; they have difficulties to continue their production due to problems of economic profitability (Ayala et al., 2014). Reasons that could have influenced the producers of the west-central region of the country to make changes in their crops, seeing amaranth as an opportunity for economic improvement due to its small cultivated area and its excellent agronomic characteristics, due to the fact that it adapts to environmental conditions. where other crops fail (Islas y Islas, 2001).

During 2019, Mexico registered a cultivated surface of amaranth of 4,227 hectares (INEGI, 2019) of which approximately 5,548 tons of amaranth were produced per year, of which the State of Puebla stands out as the largest producer, contributing 61% (3,396 tons) of the total national production of amaranth, according to the information published by the Agrifood and Fisheries Information Service (SIAP, 2019). Among the municipalities of Puebla dedicated to the production of amaranth are Tochimilco and Atzitzihuacán, who registered a harvest area of 1,127 and 208 hectares, obtaining a yield of 2,107 and 333 tons per hectare, respectively, according to the data obtained in SIAP (2019).

In the search for strategies of economic activities, the residents of these municipalities have seen the opportunity to add value to the cultivation of amaranth, through the production and sale of amaranth products, which allows improving economic income and improving the quality of life. For this reason, they have created family micro-enterprises, adapting their homes as workshops for the transformation of the seed, characterized by the presence of equipment, means and basic spaces for the small-scale production of amaranth products.

Thanks to its extraordinary properties, amaranth has a wide variety of uses. The usual way of consumption is as cereal or through amaranth bars, traditionally known as alegrías. Which follows a production process, starting with the mixture of amaranth with syrups or honey to later mold the mixture into rectangles, circles or other shapes; and finally be packaged for sale (Argüelles et al., 2018)

Despite efforts to obtain quality products, these microenterprises vary in the design of their facilities and practices during the production process, situations that limit obtaining products that adhere to quality regulations and, therefore, an obstacle to become competitive companies for the agribusiness sector. Some of the conditions found are listed below:

1. Staff.

1.1. Absence of personal protection equipment (gown, face mask, nets or caps).

1.2. Lack of knowledge on the part of production personnel about good hygiene and safety practices.

2. Physical facilities.

2.1. Establishment of workshops in conditions that cause contamination of the product and proliferation of pests, proximity to toilets, poorly stored equipment, growth of herbs, workshops used for activities other than the transformation of amaranth.

2.2. Ceilings that facilitate the formation of mold and bacteria, predominating the use of sheets. The existence of cables and beams predominates, constituting risks of condensation and accumulation of dust that contaminate the products.

2.3. Deteriorated walls, without plaster and without washable and waterproof paint. The joints between floors and ceilings do not facilitate the cleaning of the establishment.

2.4. Doors and windows without protections that prevent the entry of dust, rain and harmful fauna.

2.5. The bulbs and lamps established during any production process do not have the protection to avoid contamination in case of breakage.

3. Equipment.

3.1. Lack of equipment and utensils made of inert materials that do not transmit toxic substances, odors, flavors and that facilitate cleaning.

4. Raw material.

4.1. The manufacturing areas are not clean and there are materials foreign to the process.

4.2. The raw material is mixed with the already processed products.

4.3. The raw material containers are not covered or closed to avoid contamination by the environment.

5. Storage.

5.1. The raw materials stored in the establishments are not kept under specific conditions for each case.

5.2. There is storage of raw materials, ingredients, packaging material and finished products directly on the floor.

6. Pest control.

6.1. Lack of pest control systems and plans.

6.2. Entry of domestic animals is observed in the areas close to the product manufacturing processes.

7. Hygiene and sanitation.

7.1. Existence of garbage, scrap and waste in the product processing areas.

7.2. Deficiency in the cleaning and disinfection of the establishment, equipment and materials to reduce the number of microorganisms that can infect the products.

8. Labeling.

8.1. The labeling of the finished product does not have the commercial and sanitary specifications established by current regulations.

9. Ignorance of the marketing channels for amaranth products.

Situations that, according to the producers, are mainly caused by the lack of budget and government support for the improvement of technology, difficulty in accessing technical assistance to create the appropriate conditions.

Thus, the problem lies in the lack of strategies focused on improving quality, which allow control of the process in the production of amaranth products, thus offering microentrepreneurs a new source of food and income at the moment. of its commercialization, as well as to improve the quality of life of the rural and peasant population in the central west zone of the State of Puebla.

4. Rationale

Puebla is presented as the largest producer at the national level, however, the industrialization of amaranth is carried out mainly in the State of Mexico, Morelos and Tlaxcala. Although part of the grain used is obtained from their own plots, most of it is acquired through local producers or intermediaries who buy in the State of Puebla. Situation that affects economic growth in the municipalities of Atzitzihuacán and Tochimilco.

In order to generate strategies that improve economic support, the inhabitants of these two municipalities, who are dedicated to the cultivation of amaranth, have developed micro-enterprises dedicated to the production of amaranth-based products. Being among its variety mainly sweets or fried foods, such as alegrías, atoles, cookies, breads, among others. Despite the fact that this activity generates a higher income than dedicating themselves only to cultivation, there are quality problems that prevent their proper growth, which are mainly generated by the lack of knowledge of the appropriate practices to be carried out during the transformation processes. the lack of technical assistance, equipment and technology and the training of the workforce.

Through this project, the aim is to generate regulation strategies that serve as a guide to promote the use of good practices and regulations applicable to food industries in micro-enterprises in the municipalities of Tochimilco and Atzitzihuacán, to directly benefit around 50 residents of areas vulnerable members of family labor in these small industries. In addition to obtaining quality products that are integrated into the national market and make amaranth a viable option for the food industry, mainly due to its nutritional benefits.

5. Hypotheses

General Hypothesis:

The definition of good practices and current regulations in the food sector will increase the competitiveness opportunities of micro-enterprises dedicated to the production of amaranth products and generate a higher income for families belonging to the municipalities of Tochimilco and Atzitzihuacán.

Specific Hypotheses

1. The lack of knowledge about Good Practices in the micro-enterprises of the municipalities of Tochimilco and Atzitzihuacán dedicated to the elaboration of amaranth products, limits the guarantee of harmlessness and safety to consumers.
2. The application of current regulations and procedures to the food industry is conditioned by ignorance and lack of economic resources within micro-enterprises.
3. The definition of methodologies and process improvement tools are essential tools for the standardization of the production process in micro-enterprises.

6. Reference Framework

Since the point of study of this analysis will be focused on the strategies proposed for the search for quality management in the amaranth production process, it is necessary to elucidate what are the key concepts that guarantee action-oriented knowledge.

6.1. Origin and history

In relation to the origin of the species of the genus *Amaranthus* there are controversies, several authors point out that amaranth has been cultivated since ancient times in various countries. Sauer (1950) compiled information on its origin in the American continent, more precisely in the southwestern United States of America and northern Mexico.

There are indications that tribes belonging to these areas cultivated amaranth for food and later migrations moved it to the Central Table where it reached its greatest relevance. According to the explorations of MC Stevenson, it was found that the Indians of Arizona and the Suñiz Indians of New Mexico used this crop for food. During colonial times, the Jova and Tarahumara Indians cultivated amaranth under the name of the word guegui.

6.2 Nutritional Value

One of the main characteristics of amaranth is its high nutritional value, both in its leaves and seeds. The proximal composition of amaranth seeds shows that the protein content ranges from 13 to 18%, the fat from 6.3 to 8.1%, the fiber from 2.2 to 5.8%, and the ash content from 2.8 to 4.4%. However, the most important thing is their high degree of protein, they have a better balance of essential amino acids than most cereals and legumes (Table 1. Approximate composition of amaranth grain and some cereals) (Barba de La Rosa, Gueguen, Paredes and Viroben, 1992; Schnetzler and Breene, 1994) in addition to being a value close to the optimum required in the human diet.

Table 1. Approximate composition of amaranth grain and some cereals

Coposition	Amaranth	Wheat	Mcorn	yesorgo	upoz
Huhage	8.0	12.5	13.8	11.0	11.7
Protein	15.8b	14.0c	10.3d	12.3e	8.5d
Rawa	6.2	2.1	4.5	3.7	2.1
Grhandle					
Fibera	4.9	2.1	23	1.9	0.9
Ashace	2.4	1.9	1.4	1.9	1.4
Calories/100 g	366	343	352	359	353

Source: Own Elaboration

Amaranth protein contains the eight essential amino acids in the essential quantities, according to the standards for adults reported by organizations such as the Food and Agriculture Organization of the United Nations (FAO, 1997), the United Nations University (UNU) and the World Health Organization (WHO).

Despite the foregoing, in Mexico amaranth does not occupy a place within the products that are considered basic and strategic (Article 70, Sustainable Rural Development Law), but it could position itself within the main grains used by the industry. food, mainly in the integration of precursor foods and health preservatives worldwide, especially because the nutritional and economic utilities are high.

6.3 Location and characteristics of the study site

6.3.1 Tochimilco

Its name comes from "tochtli", rabbit; "i", possessive that expresses yours, his; "milli", sementera heredad, and "co", in; means "in his field" or "in the rabbit field". Its geographical coordinates are parallels 18° 49'32.16" and 19° 01'42.24" north latitude and meridians 98° 42'51.12" and 98° 32'24.72" west longitude. It borders to the north with the states of Morelos and Mexico and with the municipalities of San Nicolás de los Ranchos, Tianguismanalco and Atlixco; to the east with the municipalities of Atlixco and Atzitzihuacán; to the south with the municipality of Atzitzihuacán; to the west with the municipality of Atzitzihuacán and the state of Morelos. It occupies 0.64% of the surface of the state (INEGI, 2009). The municipality has a population of 17,028 inhabitants, of which 7,910 are men and 9,112 women (INEGI, 2010). The main source of employment is the primary sector with 89.1%, followed by the secondary sector with 7.4% and, finally, the tertiary sector with 3.5% (INEGI, 2009). It presents a great edaphological diversity in its territory, identifying seven types of soil; Regosol (30%), Phaeozem (24%), Andosol (19%), Cambisol (12%), Durisol (5%), Leptosol (4%) and Fluvisol (3%).

6.3.2 Atzitzihuacan

It comes from Nahuatl and means "Place that has little water", it is formed from atl, water; tzitzi, apocope of atzitzini, duplicate of diminutive tzintli; hua, voice that denotes property or possession, and can, place. Its geographical coordinates are parallels 18° 44'16.44" and 18° 53'18.96" north latitude and meridians 98° 42'04.32" and 98° 30'08.64" west longitude.

It borders to the north with the state of Morelos and the municipalities of Tochimilco and Atlixco; to the east with the municipalities of Atlixco and Huaquechula; to the south with the municipalities of Huaquechula and Tepemaxalco; to the west with the municipalities of Tepemaxalco, Acteopan, Cohuecan and the state of Morelos. It occupies 0.38% of the surface of the state (INEGI, 2009). It has a population of 11,684 inhabitants, 5,329 men and 6,355 women (INEGI, 2010). In the same way as Tochimilco, its main economic activity is the agricultural sector with 78.4%, the tertiary sector ranks second with 13% and the secondary sector third with 8.6% (INEGI, 2013). It presents a great edaphological diversity in its territory, identifying seven types of soil; Durisol (30%), Regosol (20%), Leptosol (18%), Fluvisol (10%), Cambisol (10%), Andosol (5%) and Phaeozem (4%) (INEGI, 2009).

7. Conceptual Theoretical Framework

During this chapter the theoretical-conceptual bases that will allow to base the project carried out are exposed. In this sense, concepts are addressed that allow understanding the importance of quality in the food industry, as well as methodologies and tools aimed at improving processes in general. In addition to helping the interpretation of the results obtained and the definition of the hypotheses.

7.1. Quality

From the perception of customers, companies and organizations have been created in order to provide products or services that satisfy human needs and expectations. These products are the results of a process, which is understood as a set of intertwined activities that receive certain raw materials or inputs (inputs) to be transformed into a result (outputs) or a product. A requirement of the clients is that the products or services have quality, which has different definitions. On the one hand, Juran maintains that: "Quality is that a product is suitable for its use. Thus, quality consists of the absence of deficiencies in those characteristics that satisfy the customer" (Juran, 1990).

7.2. Quality Management. Concept and Evolution

Quality Management is a new way of thinking about the management of organizations (Chorn, 1991), an approach to the management function that would adopt revolutionary ideas on traditional models, new principles on the design of the organization and culture corporate for the path to excellence. For Slater (1991), Quality Management represents customer-focused organizations that are organized by processes, function in teams, and are conducted more like a dance than a hockey game.

7.3. Inspection

The inspection emerges as a tool of great importance in the face of the rise of the manufacture of articles in series. It has various scopes: represent an information activity, also include a decision (acceptance, rejection or reprocessing) or lead to corrective actions. Its basic objective is to prevent defective products from reaching the customer. Product quality specifications are established that must be systematically verifiable, to verify conformity with the final product and separate defective products and allocate them as waste for reprocessing. According to ISO 8402 (1995), inspection is the "action of measuring, examining, testing or verifying one or more characteristics of a product or service and comparing them with the specified requirements in order to establish their conformity".

7.4. Total quality management

Dale, (1994) explains that the vision of quality has evolved towards a more global vision extending to the entire company in its conceptual growth and its objectives, reaching the level of company strategy. Quality becomes "total quality" applying to products, methods, organization, etc.

Gutiérrez, (2005) argues that, among its main objectives, it focuses on competitive advantage through the search for customer satisfaction, management leadership, internal cooperation and teamwork, good relationships with customers and suppliers, involvement and commitment of employees, training, learning and continuous improvement.

7.5. Continuous Improvement

Conti, T. (1993) comments, "Continuous Improvement is a philosophy that optimizes processes through incremental improvements and the elimination of operations that do not add value." The basis of this philosophy is that every aspect of an operation can be improved. The ultimate goal is perfection, which is never reached, but is always sought after.

7.6. The food industry

The food industry is the industrial production sector whose objective is the treatment, transformation, preparation, conservation and packaging of products intended for human consumption. This type of industry belongs to the group known as agro-industries or agro-processing industries, (Alma V. et al; 2016)

7.7. Quality in the agri-food industry

Jorge, (2016) comments that, in the food industry, the most important quality factor is the safety and reliability of the products offered. The hygienic-sanitary quality is an essential element, which is evaluated through the measurement of biotic components (pathogens such as bacteria, parasites, viruses, prions, toxins, allergens) and abiotic components (drug residues, pesticides, pesticides, contaminants, etc.) that are presented as a risk to the health of the consuming population.

7.8. Regulations

ISO 9000, (2015) The regulation is a set of rules by which a certain matter or activity is governed; In our country, these standards are mandatory, these being understood as the Official Mexican Standards. According to the Ministry of Health, (2015) the Official Mexican Standards (NOM) are technical regulations of mandatory compliance issued by the competent agencies, whose purpose is to establish the characteristics that processes or services must meet when these may constitute a risk for the safety of people or harm human health; as well as those related to terminology and those that refer to its compliance and application.

8. Materials and methods

As is known, the methodology of a research project can have 4 types of studies. According to this project, the descriptive study will be used, seeking to specify and describe the research, experiences and points of view collected by the theory and experts on the subject.

8.1. Scope and Limitations

8.1.1. Scopes

This project covered microenterprises dedicated to the production of amaranth products in the municipalities of Tochimilco and Atzitzihuacán in the State of Puebla. A strategy was developed that allows microentrepreneurs to integrate into the agroindustrial sector, seeking to increase their competitiveness, as well as offer a higher economic income to the producer families of the aforementioned municipalities.

8.1.2. Limitations

- Due to the current SARS II-COVID 19 virus pandemic, only 6 of the existing micro-enterprises in the aforementioned municipalities were visited.
- Resistance to change by microentrepreneurs.
- Lack of commitment and organization within companies to properly structure their organization.

- Insufficient data on the handling and care during the industrialization of amaranth in companies of the same branch.

9. Determination of the universe and obtaining the simple

According to the data presented in the reference framework, the population under study comprised 20 micro-enterprises from the municipalities of Tochimilco and Atzitzihuacán, dedicated to the production of amaranth-based products. Which are characterized by having various levels of progress, but most are in the process of formation and consolidation.

For the purposes of this study, the sample was determined through convenience sampling, since due to the current SARS II-COVID 19 virus pandemic, visits to companies remained very limited.

10. Research techniques and data collection plan

Since it was sought to obtain a broader and deeper perspective of the phenomenon under investigation, a mixed research method was chosen. By generating a conjunction of qualitative and quantitative approaches, a data representation is obtained through texts; as well as the use of numerical variables, graphs, formulas and analytical models.

10.1. Questionnaire

Based on the data collected in the previous point, a structured questionnaire was carried out aimed at microentrepreneurs in the municipalities of Tochimilco and Atzitzihuacán, where general data on families, productive activities, knowledge about aspects of food quality, production process were collected. and products offered. In addition, the dialogue with the owners allowed us to understand the perception they have about their companies, the limitations and the opportunities for improvement according to their experience.

10.2. Pareto Chart

As part of the quantitative analysis, Table 2 shows the data obtained in the verification sheet of Good Manufacturing Practices and applicable regulations in micro-enterprises that produce amaranth products, in order to apply more complete systems related to safety management and quality in food production (Table 2. Comparative analysis of the percentages of compliance and non-compliance according to the verification sheet application applied to each of the companies).

Table 2 Comparative analysis of the percentages of compliance and non-compliance according to the verification sheet application applied to each of the companies

Areato study													
Personal		Instaalations		Equipation		Process		Storage		Control of plagas		Lclean and desinfection	
Compliant	Fails	Compliant	Fails	Compliant	Fails	Compliant	Fails	Compliant	Fails	compliant	Fails	compliant	Fails
4	5	6	13	6	5	2	8	2	2	0	4	1	1
3	6	5	14	4	7	2	8	2	2	0	4	1	1
5	4	6	13	3	8	2	8	1	3	0	4	1	1
5	4	10	9	7	4	3	7	2	2	0	4	1	1
4	5	6	13	5	6	2	8	1	3	0	4	1	1
6	3	9	10	7	4	2	8	1	3	2	2	1	1
27	27	42	72	32	3.4	13	47	9	15	2	22	6	6
50%	50%	37%	63%	48%	52%	22%	78%	38%	63%	8%	92%	50%	50%

Source: Own Elaboration

For its analysis, the values of compliance (yellow boxes) and non-compliance (red boxes) were determined in each of the areas, to continue with the sum of total values of the micro-enterprises under study.

11. Results

The results obtained during the analysis of the current situation are presented through the techniques and tools proposed in the methodology, carried out on the micro-enterprises of the municipalities of Atzitzihuacán and Tochmilco. The results collected in the verification sheet show the data that will serve as the basis for the elaboration of the Pareto Analysis; quantitatively showing the areas to be treated to reduce 80% of the problems found (Table 3. Values of the current situation in companies for the Pareto Analysis).

Table 2 Values of the current situation in companies for the Pareto Analysis

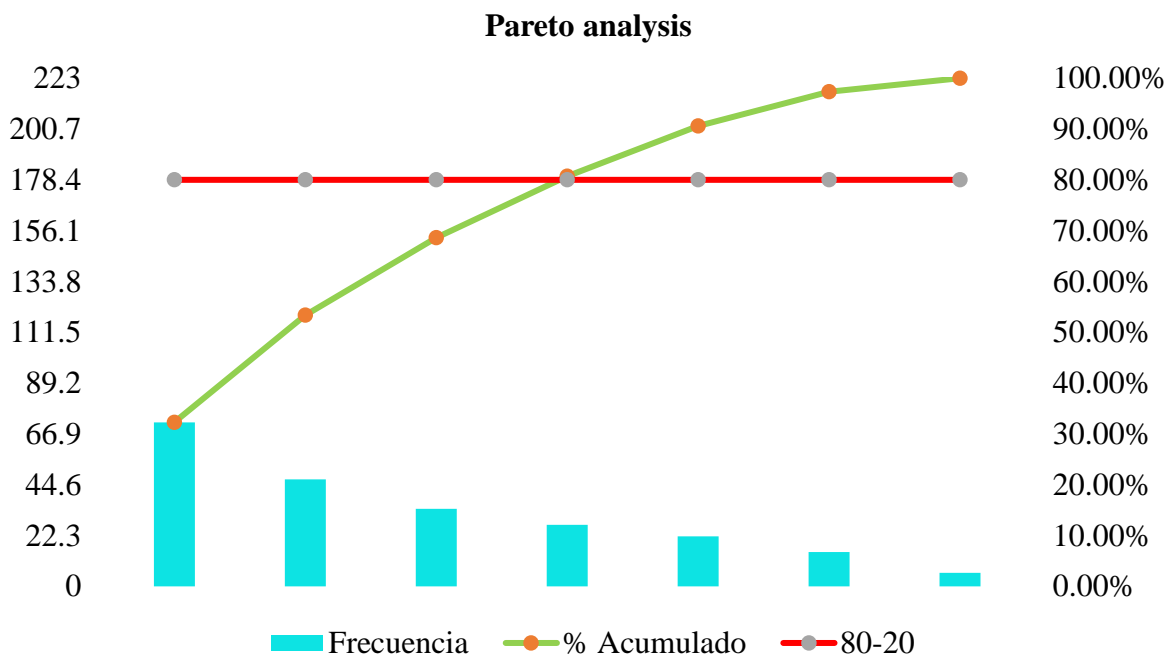
Areato study	Frequency	%	Accumulated	% Accumulated	80-20
Insfellings	72	32.29%	72	32.29%	80%
Process	47	21.08%	119	53.36%	80%
Equipment	3. 4	15.25%	153	68.61%	80%
Personal	27	12.11%	180	80.72%	80%
Cpest control	22	9.87%	202	90.58%	80%
To thestorage	15	6.73%	217	97.31%	80%
Cleaning and disinfection	6	2.69%	223	100.00%	80%
Total	223	100.00%			

Source: Own Elaboration

11.1 Pareto Analysis

For the Pareto analysis, the values of non-compliance by area of study in the micro-enterprises under study were taken as a basis (Figure 1. Pareto analysis of the micro-enterprises under study).

Figure 1 Pareto analysis of the micro-enterprises under study



Source: Own Elaboration

As a result of the analysis of the data through the Pareto analysis (Table 4. Pareto analysis of the microenterprise), it was obtained that the Facilities, Process and Equipment areas are the cause of 80% of the problems found. Therefore, the improvement strategy was aimed at solving them and this will help reduce the quality problems found in the remaining areas.

Table 3. Pareto analysis of the microenterprise

	Installations	Process	Equipment	Staff	Pest control	Storage	Cleaning and disinfection
Frequency	72	47	3.4	27	22	15	6
% Accumulated	32.29%	53.36%	68.61%	80.72%	90.58%	97.31%	100%
80-20	80%	80%	80%	80%	80%	80%	80%

Source: Own Elaboration

12 Hypothesis testing

Based on the results described, it was sought to test the hypotheses defined at the beginning. Based on the general hypothesis that states the importance of the definition of good practices and regulations of the food sector for the economic and competitive growth of micro-enterprises, it is concluded that its specification will allow attacking the main problems found and specified in the tools to identify points of improvement. Considering the specific hypotheses, it is concluded:

1. It was verified that all the microenterprises visited present failures, considering as the standard that should be fulfilled according to what is established in the Good Manufacturing Practices, which establish the minimum requirements to reduce the risks of intoxication and ensure safe food.
2. According to the investigation, it was confirmed that ignorance and mainly the economic factor condition the application of current procedures and regulations. Given that the companies studied are dedicated to food production, the regulations require care in the design of their facilities, the use of equipment and utensils that are easy to clean and disinfect, correct storage of materials, among others. Situations that require an economic investment that many times is not among the possibilities of microentrepreneurs.
3. It was found that the problems found belong to the objectives sought by the continuous improvement methodologies and tools. Although your application will not be evaluated, these tools are the first step in standardizing processes.

In summary, the analysis showed that the areas found in the Pareto diagram fit the root causes Environment and Method found in the Ishikawa Diagram. Therefore, the improvement strategy was aimed at solving them.

13. Conclusions

During the last years, the cultivation of amaranth has caused an increase of interest at a national and international level, mainly due to its nutritional elements. Although this seed was of great food importance during pre-Hispanic times, the arrival of the Spanish made it a forgotten crop.

INEGI, (2016) indicates that the State of Puebla stands out as the largest producer of amaranth, mainly the municipalities of Tochimilco and Atzitzihuacán. Places where small producers have found a viable option to increase the income of their families. Not only carrying out cultivation activities of this seed, but also industrializing it.

Although this project has managed to contribute to the generation of income, they still have a long way to go. Reaching national and international markets entails the fulfillment of a number of requirements, especially due to the demand for hygiene and safety in companies in this area. To achieve this, an economic contribution is mainly required, but there are other activities that can be carried out as part of the search for quality.

Based on the elements analyzed in the results, it is concluded that there are a large number of deficiencies in the companies under study. Mainly because the producers do not comply with the requirements, regulations and minimum legal aspects established to reduce the risks of intoxication and thus ensure safe food for the consumer. As mentioned, their conditions are limited primarily due to the lack of economic resources and the lack of knowledge of the elements to be met.

Initially, industrial development can be achieved through the awareness of those involved about the demands involved in the preparation and sale of food, and the potential risks of not complying with adequate quality. Likewise, establishing the greatest effort to attack the main causes found, will be able to improve the conditions of the micro-enterprises found at the beginning and give way to position themselves in a competitive market.

14 Recommendations

14.1 Method

There is a relationship between the microenterprises under study. Regarding the method, the strategies are based on the training of its employees, application of 5'S and application of an ANDON system. Initially, it is necessary to make the members of the micro-enterprises aware of the benefits of adhering to the regulations that guarantee the quality of their products. Through the presentation of success stories, their scope, the demands that the food industry asks of companies to guarantee human safety and health, and faults for non-compliance with what is established (Krajewski, Ritzman and Malhotra, 2008).

Regarding training, current regulations indicate that the amaranth used as raw material must be inspected sensorially and, if necessary, establish laboratory tests. In the first case, the staff can be trained to sensorily verify that the amaranth grains meet the minimum requirements established in NMX-FF-116-SCFI-2010 and NMX-FF-114-SCFI-2009.

Integrate as part of the training the 5'S philosophy applicable to Method and Environment, through examples of its implementation and the benefits obtained by following its sequence correctly. Said training can be carried out through the use of technology with pre-recorded material or with the help of experts in the field of Good Manufacturing Practices.

Regarding the production processes, it is recommended to prepare a process manual available to employees, which establishes the order and development of operations to obtain standardized products. For the warehouse areas, the ANDON System must be applied when marking the specific spaces for raw materials and finished products and the use of signs based on the NOM-026-STPS-2008 standard, as well as the type of furniture that will be used for their storage. protection and its specific characteristics.

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17. Referencias

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