

Analysis of the Effectiveness of the OSHA Food Standard in the United States Tortilla Industry

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The Occupational Safety and Health Administration (OSHA) is a division of the U.S. Department of Labor. Its mission is to minimize health and safety hazards to workers in manufacturing industries. The focus was on its application in the food industry. Specifically in the manufacture of corn and wheat flour tortillas. These products have a high consumption in the North American country. The purpose of this study was to examine the mechanisms of the tortilla industry to adapt each activity to safety standards. In addition, to evaluate a measurable impact on the accidents that occurred and how they were corrected. The results show that OSHA standards enabled the design and management of industrial safety for the tortilla industry. This study identified three safety measures: personal protective equipment (PPE), chemical handling (SDS), and lockout/tagout (LOTO). Descriptive analyses were conducted to examine the impacts of the revised standard on tortilla worker safety. The findings indicate that nearly 24% of all injuries occur in this type of industry. It can be concluded that increasing workplace safety and compliance with legislation is currently a high priority in the food industry, although food safety is also of great importance. Both aspects can now go hand in hand thanks to the wide variety of safety solutions identified with low risk of contamination.

1. Introduction

The Occupational Safety and Health Administration (OSHA) protects the health and safety of workers by establishing and enforcing standards for working conditions in American companies (Thomas et al., 2022). OSHA defines an occupational injury or illness if an event or exposure in the work environment caused or contributed to the condition, or significantly aggravated a preexisting condition (OSHA, 2023a). In 2023, OSHA published a seven-year report (2015 to 2021) of workplace injuries in the United States. Among the highlights of this report, OSHA has a registry for reporting accidents and injuries, classifying them as follows: injuries, skin disorders, respiratory conditions, poisonings, hearing loss and all other diseases. In the United States, there are various industrial centers in the food sector (Judd and Serap, 2023). One of the most popular is the corn and wheat flour tortilla industry, due to the great influence of migrants coming mainly from Central America. In this type of factories, proper safety management is imperative, due to the large volume of production and the use of big machines to produce tortillas. The literature reports that inefficient safety control can significantly increase the rate of occupational injuries and illnesses (Thomas et al., 2022). At the same time, analyzing and applying safety measures such as personal protective equipment (PPE), control of chemical products and blocking handling machines, is registered in the world as an advantageous tool to prevent disastrous accidents (OSHA, 2024b).

For plant personal, protective equipment used during their activities, usually called "PPE", is a group of items and accessories that are managed to reduce exposure to hazards that produce severe illnesses and injuries within the workplace. These accidents can result from contact with chemical materials, radiological, physical, electrical, mechanical or other occupational hazards (OSHA, 2024a). Personal protective equipment is the last barrier of defense and does not replace engineering or administrative controls (National Institute for Occupational Safety and Health, 2022). Personal protective equipment may include items such as hard hats,

safety glasses, ear muffs or plugs, insulating gloves, steel-toed safety shoes, full body suits, respirators or coveralls, and reflective vests (OSHA, 2024b).

In factories where food processes, the use of chemical inputs is very common; they are used as ingredients, for laboratory analysis, and for cleaning equipment and surfaces (Swee et al., 2017). The North American Hazard Communication Standard, revised in 2012, requires the manufacturer, distributor, or importer to provide safety data sheets (SDS), for each hazardous chemical, to communicate information about these hazards to intermediaries users. The SDS includes information such as the properties of each chemical substance, the physical, health risks, environmental health, protective measures, and safety precautions for handling, storing, and transporting the chemical (OSHA, 2022). The SDS should be grouped into 16 components. The first 8 sections should have general data, chemical input information, classification, hazards, structure, safe handling practices, and emergency control provisions. Units 9 through 11 and 16 should show other technical and scientific data, such as stability, reactivity information, chemical and physical properties, exposure control information, toxicological information and date of preparation or last use data. The SDS must also contain Sections 12 through 15, to be consistent with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) (OSHA, 2022).

In addition, due to the high rate of accidents due to improper handling of powered machinery, the OSHA standard has regulated actions to control hazardous energy through lockout/tagout of equipment (LOTO), Addressing the mandatory handling and instructions for disabling equipment or machinery, thus preventing the escape of compromised energy while personnel perform maintenance work and cleaning tasks (OSHA, 2024a). The standard refers to alternatives to reduce the risks of thermal, electrical, pneumatic, mechanical, chemical, hydraulic, and other energy sources. Strict compliance with lockout/tagout procedures prevents an estimated 50,000 injuries and 120 deaths each year. Employees injured on the job due to hazardous energy exposure miss an average of 24 working days for recovery (Texas Department of Insurance, 2021). This preventive action requires prior training for workers to guarantee the use of LOTO. To identify, understand and comply with standards adaptable to the management of hazardous energy control. The training should involve at least three aspects: components of the energy control procedure relevant to the employee's duties or assignment, the employer's energy control program, and the various conditions of the OSHA Standards concerning lockout/tagout (OSHA, 2024c).

2. Methodology

2.1 OSHA data collection

OSHA conducts serious injury investigations through inspectors who visit companies that report accidents. The goal is to help control hazards and prevent future injuries. Official OSHA data was collected from the website (<https://www.osha.gov/severeinjury>). This study analyzed the report downloaded as of December 5, 2023. The information collected and structured only limits the data of the "federal OSHA jurisdiction" for companies in the United States of America. Currently, 34 states are included in this group, which considers only private sector personnel. The processed data covers information from the general list of all industrial sectors in this jurisdiction, the annual average of reports of severe injuries, the number of hospitalizations and amputations, the body parts injured by accidents at work, the origin of the injury, the nature of the injury, list of machinery accidents, injuries due to toxic substances, the date of the injury event, the address of the employer, the state, latitude and longitude, the 4 digits of the Classification System of Diseases and Injuries Occupational Classification System (OIICS), 6-digit industry codes from the North American Industry Classification System (NAICS), codes that characterize the injury event/exposure that precipitated the injury, the origin of the injury, the nature of the injury and the affected body part.

2.2 The industrial case-study: wheat and corn tortillas factory in California

Tortillas factories located in the California area, United States, have been growing in recent years. They work mainly with corn and wheat flour that they unload from trucks to the companies' silos. The transformation process is through kneading, baking and packaging the final product. This process may seem simple, but when working with large volumes, large equipment, high temperatures, and many workers are used in various areas.

In this study, a first in-depth analysis of the same data has made it possible to highlight more specific aspects from the point of view of security control. The work of preventive safety actions was observed in one of the plants located in Panorama city in the state of California. The structure of the plant for processing, reception/shipping warehouse and quality control laboratories was analyzed. The entire process to obtain tortillas is supervised; they are distributed in 2 lines of corn flour that use 1 formula and 4 lines of wheat flour that use 4 different formulas.



Figure 1: Typical production flowchart of corn tortillas in California



Figure 2: Typical production flowchart of flour tortilla in California

The identification of the critical mechanisms was carried out based on the data contained in the Plant Safety Report. For this process, the mixer, kneader, rounder, press, cooler, oven and packaging machine were identified as critical points in the production area. In the warehouse area where shipping and receiving is carried out, loading and unloading equipment are the main risk mechanisms. In the quality assurance department, the critical components are the humidity, acidity and pH measuring equipment, and the use of chemical products for these activities. There are a total of 5 departments in the tortilla plant, production, quality assurance, sanitation, maintenance and logistics. Each of these has a manager in charge of controlling and planning the safety of the personnel on duty. A typical tortilla factory organizational matrix structure is shown in Figure 3. The quality assurance department reports directly to the regional Quality Department, managed outside the plant.

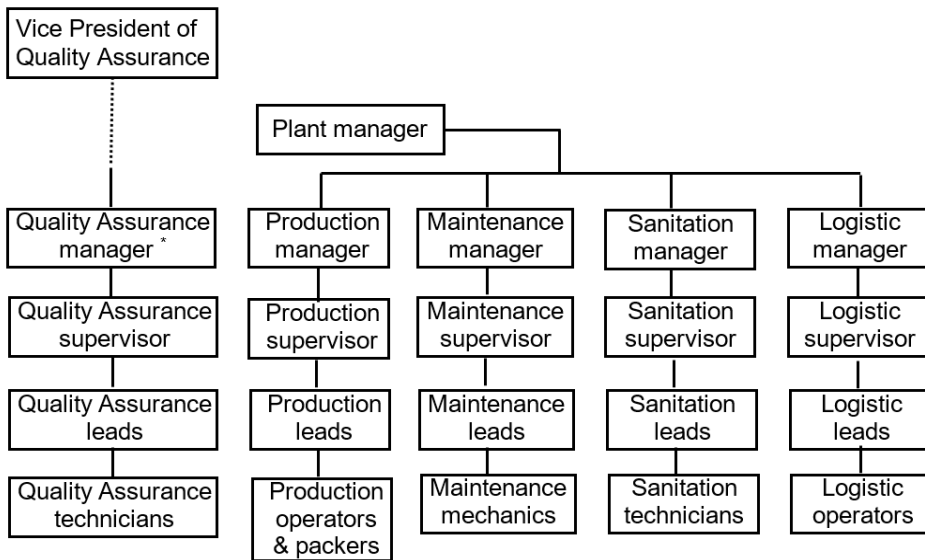


Figure 3: Typical tortilla factory organization and matrix structure in California

Each position is assembled to give the organizational result of reliable and safe production. Regularly, decisions about personnel management are made by each department manager. However, there is also a safety committee, made up of all plant managers. This committee makes safety risk decisions that affect the entire plant. They are responsible for the general security, operation of the facility and other aspects that could put the safety of personnel at risk.

3. Results and discussion

3.1 Analysis of experiences in the OSHA database

According to the information obtained from the OSHA database in the United States, the manufacturing industrial sector is the one that has had the most accident reports between 2015 and 2021. Transportation and storage activities also have important figures because it is the third sector with the most work incidents. These two activities are a significant part of the tortilla industry. In short, it represents a great challenge in safety and

prevention of occupational risks for this entire business, both in the production and logistics parts. The report of the 5 sectors with the highest risks is shown in table 1. The first five sectors mentioned represent 75% of the activities with the highest number of reports of occupational injuries and illnesses in the US. Accidents can range from minor injuries that are treated within the company, to serious injuries that require hospitalization and can have serious consequences. such as amputations and eye loss. In a previous work (Gomes et al., 2023), dedicated to the analysis of trends and data series of serious injuries from OSHA. It showed that the manufacturing and construction industry sectors in the USA reported the highest number of injuries. Although these sectors make up approximately 13% of the workforce, around 50% of these serious accidents were reported only in these two sectors.

Table 1: Average annual number of employer-reported accidents in the United States, 2015 to 2021

	2015	2016	2017	2018	2019	2020	2021
Manufacturing	3,430	3,371	3,433	3,614	3,483	2,836	2,948
Construction	1,714	1,868	1,862	1,969	1,956	1,729	1,528
Transport and Warehousing	821	894	901	949	965	808	816
Retail Trade	673	756	720	824	887	716	678
Wholesale Trade	516	549	573	616	654	517	529
Waste Management	557	502	587	649	630	514	457
Health Care	440	479	478	539	545	409	407
Mining, Quarrying	330	239	377	403	367	149	162
Food Services	202	216	236	209	203	171	159

According to Figure 4, an exponential trend was made for the years 2022 to 2030, based on the data reported by OSHA (2015-2021) for the manufacturing industry. It is observed that the number of accidents that will be reported will gradually decrease. This is due to the regulations implemented and the preventive and corrective actions implemented by these industries to mitigate occupational risks.

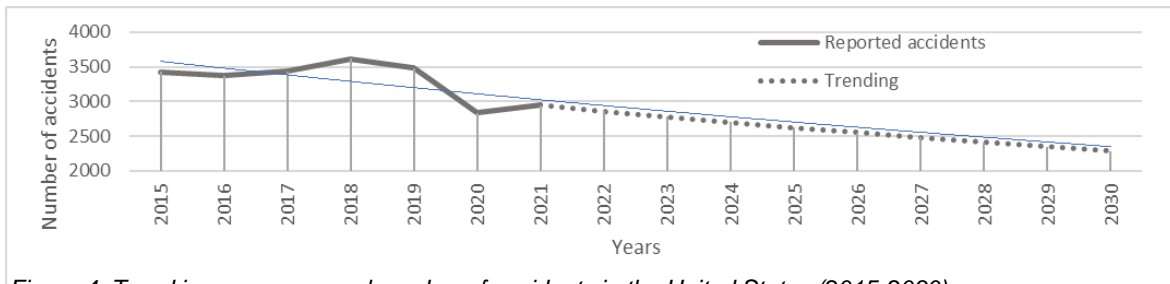


Figure 4: Trend in average annual number of accidents in the United States (2015-2030)

Table 2 shows the main parts of the body that suffer injuries in work accidents. The upper extremities are the most affected in the manufacturing of products. While in transportation and storage it turns out that the lower extremities had more accidents reported. This confirms that special attention is required from both the personnel who handle the food and those who load and unload the final product. The two most common injury events related to serious work injuries were collisions with objects and equipment, falls, trips, and slips. In comparison, the largest proportion of fatal work-related injuries were due to transportation events and falls, slips and trips. In this sense, transportation incidents are often not considered in reporting requirements, depending on the location of the injury event, as discussed by Gomes et al. (2023).

Table 2: Injured body parts in the United States industrial sector, 2015 to 2021

	Upper extremities	Lower extremities	Trunk	Multiple body parts	Head	Body systems	Other body parts	Neck, including throat
Manufacturing	60.57%	14.56%	8.36%	6.01%	4.56%	2.82%	2.79%	0.34%
Transportation and Warehousing	25.25%	30.74%	15.34%	7.72%	8.64%	6.99%	4.55%	0.76%

3.2 Mechanisms for adapting OSHA standards in the tortilla factory in California

3.2.1 Personal protective equipment (PPE)

American tortilla manufacturing companies in the state of California have adapted personal protective equipment according to the area of operation and the functions of each worker to increase safety and prevent accidents at work, as shown in the following table.

Table 3: Protective equipment and sources of personnel risk in the tortilla factory in California

PPE	Area	Source of risk	Risk
Hard hats	Processing, warehousing	mixer, press, oven	blows with machines
Ear plugs	Processing, packing, warehousing	mixer, press, oven packing machines	hearing damage
Steel toe shoes	Processing, packing, warehousing	mixer, press, oven packing machines	blows with machines or heavy packages
Safety goggles	Processing, packing, lab area	mixer, press, oven packing machine blender, pH-meter, thermobalance	eye damage from small objects
Reflective vest	warehousing	forklift machines	collisions with loading equipment

Quality control personnel, managers and supervisors in the production, maintenance, sanitation and logistics areas monitor the correct use of personal protective equipment in the tortilla processing plant. Personnel who do not use personal protective equipment receive work orders and subsequently reinforcement training on the importance of using personal protective equipment, and the risks of not using it. These work orders are documented, and the corrective actions taken for compliance are monitored. The deadline to resolve observations or non-compliance regarding the use of personal protective equipment to guarantee health and safety at work is 7 days; these must be accompanied by corrective and preventive actions. For the period from October 2022 to September 2023, the standards cited by OSHA, for tortilla processing establishments, sanctioned the amounts reflected below, regarding the use of personal protective equipment.

Table 4: Fines for non-compliance with OSHA standards regarding the use of PPE in tortilla factories

Standard	Citations	Inspections	Penalty	Description
19100333	5	2	\$12,600	Selection and use of work practices.

3.2.2. Safety Data Sheets (SDS)

Tortilla processing factories have safety data sheets (SDS) for all chemical inputs used. These documents are placed in a public place and accessible to all plant personnel. These documents are stored for 30 years. There are tortilla processing factories, which carry out a monthly inspection by trained internal personnel on compliance with the OSHA standard regarding SDS. Knowledge of the SDS is assessed and monitored by trained staff. For the period from October 2022 to September 2023, the standards cited by OSHA, for tortilla processing establishments, sanctioned the amounts reflected below, regarding the safety management of highly hazardous chemical product processes.

Table 5: Fines for non-compliance with OSHA standards regarding the management of chemicals in tortilla factories

Standard	Citations	Inspections	Penalty	Description
19100119	6	1	\$41,500	Process safety management of highly hazardous chemicals.

3.2.3. Hazardous Energy Control LOTO (Lockout/Tagout)

Personnel requiring the use of Lockout/Tagout receive training prior to using the equipment. This training includes a visit to the plant and the specific locations to place the Lockout/Tagout of each equipment or machinery. Failure to comply with the procedure to carry out a lockout/tagout is punishable by dismissal within the processing plants, due to the high risk it generates. For the period from October 2022 to September 2023, the standards cited by OSHA, for tortilla processing establishments, sanctioned the amounts reflected below, regarding non-compliance with lockout/tagout.

Table 6: Fines for noncompliance with OSHA regulations regarding LOTO in tortilla factories

Standard	Citations	Inspections	Penalty	Description
19100147	78	34	\$964,954	Hazardous energy control (lockout/tagout).

Research on workplace incidents indicates that they are caused by uncontrolled events, derived from unsafe acts and conditions (Al-Bayati et al., 2021). Operating equipment without acquiring the necessary knowledge and skills, using equipment without locking it, or using chemical inputs without training represent unsafe acts; while working without the use of proper protective equipment or the use of defective protective equipment represents unsafe workplace conditions. Furthermore, Pitblado et al. (2015) mentions that the direct causes of work incidents consist of human factors and work factors. Human factors include lack of knowledge or skills and stress or inadequate motivation. Job factors include incompetent leadership, inadequate supervision, inadequate training and maintenance (Joorna et al., 2015).

4. Conclusions

In this study, we leverage publicly available OSHA data on workplace injury reporting in the United States to develop an analysis of the manufacturing sector and the tortilla industry in California. OSHA data shows that the manufacturing industry accounts for the largest percentage of workplace injuries in the United States. Therefore, this study confirmed the need for the sector to strengthen process safety management and comply with the safety procedures established by OSHA. The internal safety programs of tortilla companies help reduce occupational risks, and a system of control and verification of occupational safety standards in all work areas is considered necessary, taking work experiences as a precedent to establish corrective actions and preventive. Although there is interest from companies in workplace accidents in the manufacturing industry, there is still a lack of methodologies that account for the economic losses associated with such critical events. In conclusion, the combined preventive control of safety through adequate use of protective equipment, handling of chemical products and use of padlocks to lock equipment; It must be taken into account to significantly reduce and avoid occupational injuries, accidents and illnesses. In this way, research can serve as support for professionals in the manufacturing sector when making work decisions in order to contribute to personal health and safety.

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