v. 5, n. 9, 2025

International Journal of Human Sciences Research

Acceptance date: 26/06/2025

IDENTIFICATION OF CRITICAL CONTROL REQUIREMENTS IN MEAT PRODUCTS USING THE T-FINE TECHNIQUE ACCORDING TO HACCP.

Laura Leonor Mira Segura
TecNM. Tecnologico de Estudios Superiores del Oriente del Estado de Mexico
México
https://orcid.org/0000-0002-8130-2689

Alejandra Rafael
TecNM. Tecnológico de Estudios Superiores del Oriente del Estado de México
Vázquez
https://orcid.org/0009-0003-8511-8576

Alfredo Trejo Martínez
Tecnológico de Estudios Superiores del Oriente del Estado de Mexico
Mexico
https://orcid.org/0000-000-6555-2285TecNM

Miguel Ángel Martínez Cruz
ESIME-Zacatenco. IPN Mexico
https://orcid.org/0000-0002-4431-9262

Humberto Dorantes Benavidez
TecNM. Tecnológico de Estudios Superiores del Oriente del Estado de México
México
https://orcid.org/0000-0003-1490-1873

Abstract: A significant concern of meat producers is to guarantee the safety of the food they offer. The critical control point analysis system (HACCP) contributes significantly to food safety management, since it helps to identify phytosanitary risks in order to implement actions that keep a watchful eye on possible effects on consumers. This research contributes to the case study organization to identify by categorization the critical control points and the effects or risks by applying the William T. Fine technique, which is a technique widely used in the workplace to identify occupational hazards and is taken as a basis to demonstrate its wide use, in addition to the identification of these risks is intended to provide information to help the organization to shape strategies that will help to create the foundation for decision making on the implementation of HACCP or ISO 22000:2015 ensuring the execution of good food practices.
Keywords: phytosanitary risks, meat, William T-Fine technique, HACCP.

INTRODUCTION

The handling of meat and its management for phytosanitary control becomes important when good practices are lacking and risks or diseases appear transmitted by incorrect food handling, distribution, storage and poor identification contribute to the lack of correct traceability that would allow reliable information on hazard analysis and food safety. In addition, if we consider that in the eastern region of the State of Mexico there are slaughterhouses called *"rastros"* which carry out meat handling activities with few hygienic measures, the implementation of the HACCP system takes on great relevance.

According to the estimation of the World Health Organization (WHO, 2019) Foodborne Diseases (FBD) are caused by various factors such as bacteria, viruses, parasites, toxins and chemicals; so that FBD, affect almost 1 in 10 people per year. Among the foodborne diseases (FBD's) are distinguished some such as: salmonellosis, cholera, Echerichiacoli infections, among others, which are spread or transmitted through food. It is considered that the diseases can be directly related to production methods, preparation, practices and handling habits of people in contact with food supplies.

Food safety systems raise food quality, since good manufacturing practices and proper food handling are integrated into the production process, which guarantee food safety and in turn protect consumer health.

This research proposes a Hazard Analysis and Critical Control Point (HACCP) system based on ISO 22000:2018 in a self-service store in order to guarantee the safety of meat products so that they do not represent any danger to consumers. It is also intended to provide these centers with a reference in the identification of critical control points by means of the William T. Fine technique, to take advantage of the information by carrying out a classification so that they can prioritize the risks and formulate strategies that will have an impact on the better handling of meat products to guarantee food safety. The type of research was pre-experimental; the study sample consisted of 16 people working in the prepared foods line of a self--service store in the eastern zone of the State of Mexico. In the meat area, there is an important problem that puts at risk the in the meat area there is an important problem that puts the consumers themselves at risk, since very commonly the workers do not have the knowledge of the hygienic handling of food and perform bad practices in the work area, as well as cross-contamination, which causes an increase in losses within the department and therefore economic losses for the company. The hypothesis formulated gives rise to the idea that with this design for the detection of phytosanitary risks using William T. Fine's technique, strategies can be proposed to guarantee the safety of meat products offered to clients.

METHODOLOGY

According to ISO 22000:2018 "Food Safety Management Systems - Requirements for any organization in the food chain," the food chain is defined as the sequence of stages and operations involved in the production, processing, distribution, storage and handling of a food and its ingredients, from primary production to consumption. In other words, it includes from the procurement of raw materials for the production of a food, until the food reaches the consumer. The first refers to the collection of information on meat products, such as: type of meat, type of processing, quantity, refrigeration time, machines with which they are processed, among other things. In the second stage, the data obtained in the first stage will be classified and the William T. Fine technique will be applied to them, which implies the determination of limits for dealing with risks as best suits business management. In classifying the meat products handled there, meat is understood to be the edible muscular part of slaughter animals slaughtered and slaughtered under hygienic conditions. It includes the portions of fat, bone, cartilage, skin, tendons, aponeurosis, nerves and lymphatic and blood vessels that normally accompany the muscular tissue and are not separated from it in the handling, preparation and transformation processes. Meat constitutes an important source of iron for human nutrition. Approximately 25% of the iron in meat is absorbed, but it is also noteworthy that the ingestion of meat favors the absorption of the iron present in other foods. It is an established fact that the presence of this iron in meat is an important source of iron for human nutrition.

The meat is an element in the diet that preserves one of the most widespread nutritional deficiencies in developed countries (Higgs, 2000).

Fundamentally, meat is constituted by the muscular part of slaughter animals. Later after the slaughter of the animals, the muscular portion (made up mostly of muscle fibers, collagen and fat) undergoes a series of changes that lead to the transformation of the muscle into meat. These changes have a sequence in time, beginning first with the period called rigor mortis, which is characterized by a sustained muscular contraction. This phase begins, depending on the animal species, between 6 and 24 hours after the slaughter of the animals and has a duration, also variable, depending on the species. In general terms, quality can be defined as the extent to which a product or service satisfies the expectations of the user or consumer over time. In the case of meat, it is at the very least complicated to define the concept of "meat quality", since it is a very heterogeneous product and there is an important subjective component in the criteria that determine its quality (color, texture, juiciness). Added to this difficulty is the fact that when it comes to evaluating the color, texture, juiciness, flavor and aroma of the meat, there are no objective (instrumental) methods easily applied on the market that allow these attributes to be measured (Allen, 1970). From another point of view, the term "meat quality" can be interpreted in terms of hygienic aspects during production, nutritional value or organoleptic or technological characteristics (Mohino, 1993). After having pointed out that the concept of meat quality is difficult to interpret, this section details the criteria that determine its organoleptic value. These are the following: chemical composition, pH, color, texture, juiciness and flavor. In general, the average values for the gross composition of edible meat or so-called fresh meat can approximate 62% moisture, 20% fat, 17% protein and 1% ash for fattier meats or 70% moisture, 9% fat, 20% protein and 1% ash in the case of leaner meats (Schweigert, 1994).) The color of meat depends on the pigment content (mainly myoglobin), the chemical state of this molecule, the physical state of muscle proteins and the proportion of fat infiltration (Forrest, 1979). The water retention capacity (WRC) was described by (Hamm, 1960), as the capacity of meat to retain its constituent water during the application of external forces or treatment. This property affects qualitative aspects in the meat, such as the retention of vitamins, minerals or salts, and quantitative aspects such as the volume of water retention. Muscles that lose water easily are drier, show weight losses during refrigeration, storage, transport and marketing, as well as substantial changes in their composition. According to FAO (FAO, 2011), "food security exists when all people at all times have physical and economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life". It is a method of identifying significant hazards in food production and applying control measures to eliminate, prevent or reduce them to an acceptable level.

HACCP as a safety concept was developed in the 1960's in response to a request from the National Aeronautics and Space Administration (NASA), as it was developed as a preventive system to increase confidence that the food provided to astronauts would not cause any type of illness. Since its inception, the HACCP concept has been evolving steadily, and today it is accepted worldwide by industry and various government authorities as the system to follow for food safety. Not forgetting that this system needs a well-founded base of operational prerequisites to be implemented (NSF International, 2011). The HACCP system is scientifically based, systematic and guarantees food safety. According to FAO (FAO, 2011), a properly implemented HACCP system stimulates greater commitment from food handlers and motivates operators. The system consists of 7 principles:

- Hazard analysis.
- Determination of critical control points.
- Establish critical limits for each critical control point.
- Monitoring of critical control points.
- Design of corrective actions.
- Establish a verification or verification system.
- Design a documentation and registration system.

Table 1 describes the meat products according to the case study, in addition to the processes to which they are subjected and the activities.

Products	Processes	Area	Activities
-Chicken -Fish -Pork -Beef	1. Thawing 2. Cut 3. Weighing 4. Packaging 5. Labeling	Meats	-Raw Material Reception -MP Inspection -Thawing of incoming frozen products -Production Processes -Finished Product

Table 1. Classification of meat products according to HACCP

Source: Own elaboration.

In order to perform the risk analysis, two variables were taken into account:

- Frequency of occurrence of the event.
- Impact of the event on the self-service store's operations.

William T. Fine's method was presented in 1971, as a method of mathematical risk assessment. T. Fine proposes, on the one hand, the use of the exposure or frequency with which the risk situation occurs, the initiating events that trigger the accident sequence, and on the other hand, the probability that once the risk situation has occurred, the accident will occur, i.e., the sequence of events until the final accident (Romero, 2023). To calculate the degree of danger of the risk, it is done with the product of three factors: the consequences that could arise, the exposure to the risk and the probability of its occurrence, according to the following formula.

$$GP= (C)\ (E)\ (P)$$

Where:
GP= Degree of hazard
C = Severity of consequences
E = Risk exposure
P= Probability of occurrence

RESULTS AND DISCUSSION

The results obtained by the analysis carried out for the present research, focuses on the observation of the operation of the process according to Figure No.1 executed by the operators during the period 2023-2024. To determine the determining factors according to the William T. Fine method, Table 2 was designed:

In addition, the risk was determined according to Table 3:

The activities that were identified with frequent operation and that have an impact on the safety of the product are:

A. Direct hand contact with food ready for consumption.

B. Packaging material stored on contaminated surfaces.

C. Packaging material stored with personnel items in the warehouse area.

D. Utensils and equipment stored with food debris.

E. Cooked food with raw food.

F. Food consumption inside the meat area and storage area.

G. Personnel in the meat area without the use of nets and masks.

H. Chemical products stored with food.

I. Equipment failures.

J. Failures in waste and shrinkage control.

K. Rags in the meat washing and cutting area.

Applying equation (1), table 4 shows the results according to the risk activities:

As can be seen, the category of critical hazards includes direct hand contact with ready--to-eat foods and rags in the meat washing and cutting area, emphasizing that critical hazards can cause irreversible damage to consumers. In the classification of acceptable risks include packaging material stored with personnel items in the warehouse area, cooked food with raw food, food consumption within the meat and storage area, personnel in the meat area without the use of nets and masks, chemical products stored with food and equipment failures; these reflect that a plan should be made to minimize these possible risks that have a minor impact on the health or safety of consumers. In the notable risks are the packaging material stored on contaminated surfaces and the use of utensils and equipment stored with food remains, these represent a minimal risk, finally, in the classification of high risks is only the activity of failing to control waste and shrinkage, which involves taking actions to reduce these practices that can result in economic losses, these results are shown in Figure 1.

CONCLUSIONS

In a broad sense, the technique applied by William T. Fine is pertinent for the detection of operational risks to guarantee food safety in the meat area of a service provider, contributing to the timely identification of actions that contribute to good manufacturing practices and that determine the implementation of ISO 22001. With this research, it is possible to identify in a meat establishment the factors of greatest risk and the preventive measures that should be implemented to guarantee that products minimize or avoid phytosanitary risks, cross-contamination and even diseases. In addition, the application of the William T. Fine technique has been shown to be totally pertinent for the determination of risk variables and not only for administrative applications in labor or human resources areas.

Determination of Severity of consequences (C)		
Catastrophe	May result in numerous deaths	100
Disaster	May result in several deaths	50
Very serious	May result in one fatality	25
Serious	Serious injury	15
Major	Disabling injuries	5
Slight	Minor sequelae	1
Determination of Exposure Frequency (E)		
Continuous	May cause death	100
Frequent	Once a day	6
Occasionally	Weekly	3
Unusual	Monthly	2
Rarely	Few times a year	1
Very Rarely	Annually	0.5
Probability Scale (P)		
Almost certain	Most likely outcome	10
Very possible	Almost possible, 50% probability	6
Possible	In a rare but possible coincidence	3
Not very possible	In a very rare coincidence	1
Remote	Extremely rare	0.5
Almost impossible	Never happened	0.1

Table 2. Determination of values according to William T. Fine.

Source: Own elaboration.

Value of the degree of danger (GP)	Risk classification
0 < GP< 200	Acceptable risk
201< GP< 600	Moderate risk
601< GP< 2000	Remarkable risk
2001< GP< 4000	High risk
GP≥ 4001	Critical risk

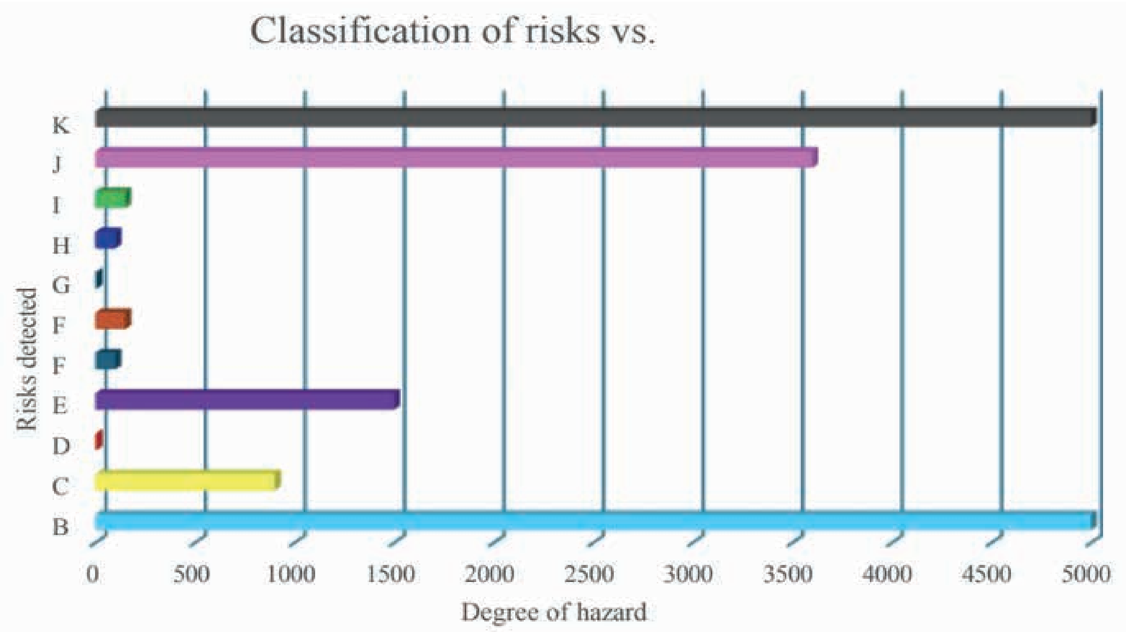
Table 3. Determination of risk values.

Source: Own elaboration.

Risk	C	E	P	GP	Risk Classification
A	50	10	10	5000	Critical risk
B	100	3	3	900	Significant risk
C	1	2	3	6	Acceptable risk
D	25	10	6	1500	Significant risk
E	100	1	1	100	Acceptable risk
F	100	3	0.5	150	Acceptable risk
G	1	2	3	6	Acceptable risk
H	100	w1	1	100	Acceptable risk
I	25	2	3	150	Acceptable risk
J	100	6	6	3600	High risk
K	50	10	10	5000	Critical risk

Table 4. Risk Results.

Source: Own elaboration



Source: Own elaboration: Own elaboration.

Graph 1. Classification of risks according to hazardousness.

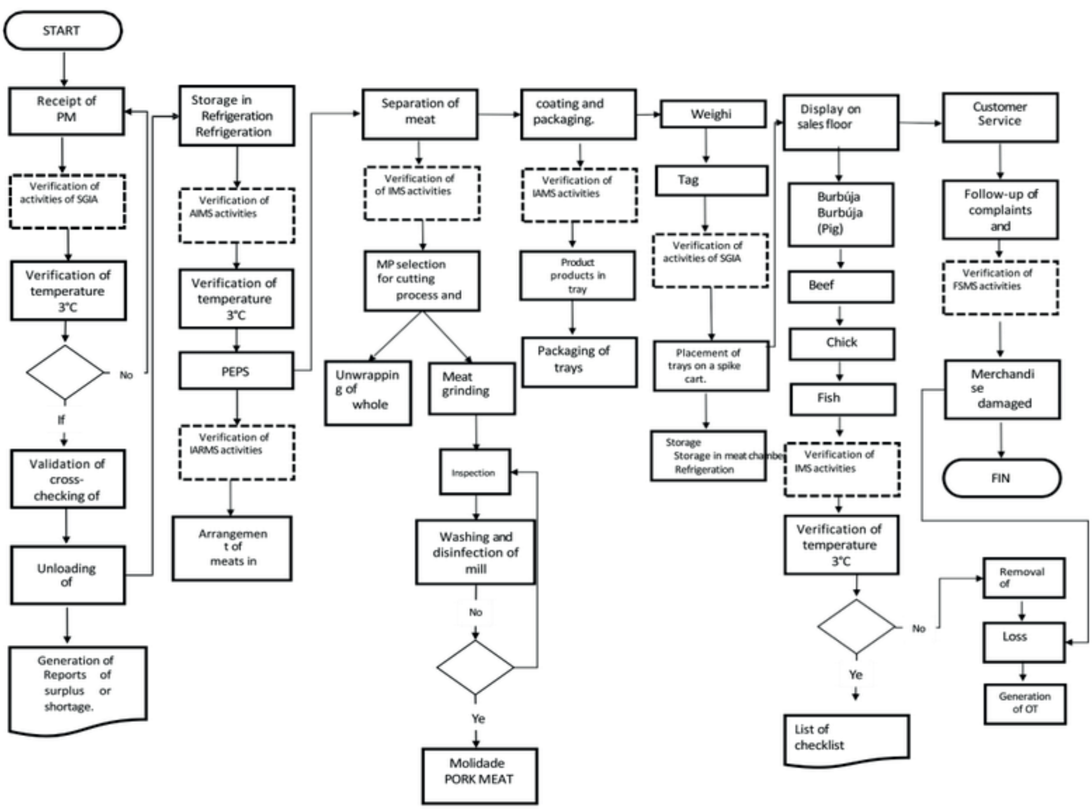


Figure 1. Process diagram

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