



Design of a GMP system for the seafood market in the Pedro Carbo

Diseño de un sistema de BPM para el mercado del cantón Pedro Carbo, en el área de mariscos.

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Abstract.

The present research work carried out in the municipal market of the Pedro Carbo canton in the area of seafood, to each and every one of the merchants settled in the place, has as its main objective the design of a Good Manufacturing Practices (BPM) system whose fundamental purpose is to cover all the shortcomings found in the workplace, thus strongly improving the way in which these are developed in their work area both in the handling, reception, refrigeration, transportation of everything that is sold in the place. For the analysis of the breaches, a diagnosis was made using an Ishikawa diagram in the area of shellfish to know the current status of the same and establish actions at the points required based on the standard. The purpose of the design is to establish a feasible solution to the problem based on the current BPM regulations in the seafood area of the Pedro Carbo canton market.

keywords: Product, Good Manufacturing Practices, Prevention, Hygiene, Normative, Food, Consumption, Seafood, Shortcomings.

Resumen:

El presente trabajo de investigación realizado en el mercado municipal del cantón Pedro Carbo en el área de mariscos, a todos y cada uno de los comerciantes asentados en el lugar, tiene como objetivo principal el diseño de un sistema de Buenas Prácticas de Manufactura (BPM) cuyo propósito fundamental es de cubrir todas las fallencias encontrados en el puesto de trabajo, de esta manera mejorar rotundamente la manera en la que estos se desenvuelven en su área de trabajo tanto en la manipulación, recepción, refrigeración, transporte de todo lo que se expende en el lugar. Para análisis de los incumplimientos se realizó un diagnóstico mediante un diagrama de Ishikawa en el área de mariscos para conocer el estado actual del mismo y establecer acciones en los puntos que se requieran basados en la norma. El propósito del diseño es buscar establecer una solución factible a la problemática basado en la normativa vigente de BPM en el área de mariscos del mercado del cantón Pedro Carbo.

Palabras clave: Buenas Prácticas De Manufactura, Prevención, Higiene, Normativa, Alimentos, Consumo, Mariscos, Falencias.

1.- Introduction.

The project arises from the observation in the Municipal Market of Canton Pedro Carbo, showing that the tenants of the seafood section do not comply with Good Manufacturing Practices in the handling, preparation, preservation, and sale of seafood. This lack of knowledge leads to the sale of products that can cause food poisoning, including bacteria such as salmonella, staphylococcus, and Clostridium botulium, which causes botulism. In response, a technical improvement plan based on Good Manufacturing Practices is proposed, which includes training for market personnel, with the aim of safeguarding consumer health and preventing possible food poisoning.

The diagnosis of the problem is based on direct observation, information provided by market personnel and clients, and the use of the Ishikawa tool to identify symptoms and causes. Despite the evolution of markets, significant risks persist in the handling and sale of seafood, posing a threat to consumer health [1]. The risks identified include disorganization in the location of stalls, inappropriate areas for seafood sales, inadequate food handling and hygiene practices, deficiencies in the training of cleaning personnel, lack of adequate materials and equipment, shortage of cleaning personnel, and a market administration lacking structure and order [2].

This diagnosis reveals a series of shortcomings ranging from the layout of the space to the training of personnel and the lack of inputs necessary to ensure hygiene and safety in the handling of seafood. These deficiencies represent a serious risk to public health and call for urgent and systematic intervention to improve market conditions, implementing measures to address the problems identified to safeguard consumer health. [3].

Historical review of the Pedro Carbo Canton.

The Pedro Carbo Canton, located on the inner coast of the Ecuadorian coast, has a population of approximately 45,706 inhabitants, distributed in 46.6% in the urban area and 53.6% in the rural area. Its extension of 492 km² is bordered to the north by Paján in the province of Manabí, to the south by Santa Elena, to the east by Isidro Ayora and Colimes in the province of Guayas, and to the west by the Santa Elena Peninsula. Its history, marked by different names and changes, culminates with its cantonization in 1984.

The economy of the canton is based on agriculture, livestock, and some handicrafts, with a warm and humid climate in winter. Tourist attractions such as the Parque de la Madre, monuments, parks and rivers, as well as religious festivities, such as San Pedro and San Pablo, Nuestra Señora

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de la Merced, and the cantonization celebration, are an important part of the culture and life of its inhabitants. [4].

The canton is characterized by its industrious population dedicated to agriculture and livestock, representing 50% of the labor force. In addition, local artisans are dedicated to works such as carpentry and toquilla straw weaving. Religious festivities are vital in its calendar, celebrating events such as masses, festivals, and processions, such as those of St. Peter and St. Paul, Our Lady of Mercy, and the feast of cantonization. Tourist attractions include natural spaces such as rivers and parks, which attract local inhabitants. These aspects characterize the identity and daily life in this Ecuadorian canton [5].

What does the Good Manufacturing Practices Manual contain?

To comply with the GMP manual, every food industry must have a basic sanitation plan; the plan contains the procedures that a food industry must comply with to reduce the risk of contamination of manufactured products in each of the industries, as well as to ensure the management of the basic sanitation plan programs that include:

- Cleaning and Disinfection Program
- Drinking Water Supply Program
- Integrated Pest Management Program
- Integrated Solid Waste Control Program [6].
- Integrated Liquid Waste Control Program
- Maintenance and Calibration Program
- Food Handler Training Program [7].

Quality Assurance

Quality assurance represents an evolution of quality control, overcoming its limitations by preventing defects in specific products. It consists of an organized set of planned actions to ensure that a product complies with technical specifications, seeking to satisfy consumer needs. It is a fundamental requirement in the Good Manufacturing Practices (GMP) Regulations, where methods and techniques are planned for operations in the Quality area, with the elaboration of an Action Plan that ensures its compliance in established times. [8].

Characteristics of Quality Assurance

1. Error prevention: costs associated with quality.
2. Total quality control.
3. Emphasis on product design.
4. Uniformity and conformity of products and processes.
5. Commitment of workers.

Quality Control

Quality control comprises a set of methods and tools designed to ensure that products or services meet customer expectations, based on previously established technical specifications. Its function is to ensure compliance with predefined standards, correcting possible deviations before

the products or services are marketed and may cause inconvenience to the consumer [9]. In Good Manufacturing Practice (GMP) standards, quality control is the cornerstone to determine the final quality of products or services, seeking to satisfy consumer needs. Therefore, it is a fundamental requirement to be fulfilled by the quality department [10].

SSOPs (Standard Operating Procedures for Sanitation).

The definition according to Decree 1500 of 2007 highlights the importance of the procedures that an establishment must carry out both before and during operations to prevent direct contamination of foodstuffs. This definition distinguishes two critical moments: pre-operational, which involves actions prior to the start of work, and sanitary operations, which refer to the cleaning and disinfection of surfaces and equipment that do not have direct contact with food, with the aim of avoiding unhealthy conditions and contamination. Thus, it is established that the Sanitation Standard Operating Procedures (SSOPs) apply to all surfaces that are in direct contact with food, clarifying the areas of focus of these operations to ensure food hygiene and safety. [11].

What are the benefits of following SSOPs?

Sanitation Standard Operating Procedures (SSOPs) and cleaning and disinfection programmes provide a number of key benefits to food production. These include the assurance of safe food by reducing microbiological counts, which preserves quality and shelf life, reducing complaints of defective products. In addition, compliance with sanitary legislation ensures higher productivity by avoiding production delays and possible sanctions from inspectors. SSOPs also function as preventive measures for pest control by maintaining clean environments, preventing their entry and proliferation, which reduces contamination risks and preserves product quality [12].

What is the basic objective of SSOPs?

The Standard Operating Procedures for Sanitation (SSOPs) are primarily aimed at reducing the direct or indirect contamination of food products, a terminology that, although initially linked to meat products according to decree 1500, can be applied to various types of foodstuffs. This regulation focuses on ensuring the cleanliness of food contact surfaces and facilities, as well as the care of equipment before and during operations to prevent any type of contamination [13].

2. Materials and methods

Survey: The survey was addressed to the tenants and their collaborators, it is worth noting that it will only be carried out in the seafood area of the same market.



In order to collect as much information as possible, a survey of 47 people was carried out to identify existing deficiencies and to design a Good Manufacturing Practices System [14].

The following is a process flow for the collection of information regarding Good Manufacturing Practices (GMP):

1. Definition of the Scope:

- Determine which aspects and areas of the seafood market will be included in the information collection.

2. Identification of Sources of Information:

- Determine sources, whether interviews, inspections, or documentation, such as manuals, guidelines, or local regulations.

3. Development of Collection Instruments:

- Creation of forms, questionnaires, or checklists to collect information.

4. Application of Instruments:

- Use of forms or methods to obtain data. They may include market inspections, interviews with traders or authorities, or review of documentation.

5. Analysis of Data Collected:

- Organizing and processing the information collected to identify areas of non-compliance or potential improvements.

6. Preparation of Report or Findings:

- Presentation of the findings obtained during the collection process.

7. Implementation of Changes:

- Based on the results, corrective measures are implemented, or guidelines are established to improve existing practices.

This process flow allows for the collection of vital information to support the implementation of GMPs in the seafood market of Canton Pedro Carbo, ensuring safer and healthier practices in the handling and sale of products.

3. Results.

Survey of 47 workers in the seafood market.

Table 1 Do you know what Good Manufacturing Practices are?

Response	Frequency	%
Yes	10	21,28
No	37	78,72
Total	47	100,00

These data underline a notable lack of knowledge about GMPs among the respondents. Approximately four-fifths of the sample are unaware of these practices, which could have significant implications in terms of safety, quality and efficiency in the production and handling of products,

specifically in the area of seafood manufacturing, such as shellfish. This lack of awareness highlights an urgent need for education, training, and awareness of GMPs in the studied environment in order to improve quality standards, food safety and competitiveness in this industrial sector.

Table 2 Have you recently received any training or lectures on GMPs?

Response	Frequency	%
Yes	12	25,53
No	37	74,47
Total	47	100,00

These data highlight a significant gap in terms of GMP education and training in the surveyed environment. The majority of respondents have not been exposed to any recent GMP training programmes. This highlights a critical opportunity to improve and strengthen GMP training and awareness initiatives in the industrial sector. Lack of participation in recent educational programmes could impact operational efficiency, quality, and safety in manufacturing processes, emphasizing the need for corrective measures and training actions to improve the understanding and application of GMP in this specific context.

Table 3 Do you have knowledge of how to handle food properly?

Response	Frequency	%
Yes	12	25,53
No	37	74,47
Total	47	100,00

These data reveal a significant lack of knowledge about proper food handling in the study group. The vast majority of respondents lack this information, which underlines a significant deficiency in terms of proper practices for handling and preserving food safety. This lack of knowledge could impact food safety, increasing the risks of contamination and degradation of product quality, highlighting the urgent need for education and training programme in this area to ensure the correct application of Good Manufacturing Practices in food handling.

Table 4 Do you consider that personal cleanliness is necessary for proper food handling?

Response	Frequency	%
Yes	40	85,11
No	7	14,89
Total	47	100,00



These results highlight a strong perception of the importance of personal cleanliness in food handling, with a clear majority recognizing the relevance of personal hygiene practices in ensuring food safety. This perspective highlights awareness of the direct influence that personal cleanliness has on food safety and therefore the importance of implementing standards of cleanliness and hygienic practices in food handling environments. The minority who do not consider this connection to be necessary highlight an area of focus for educational programmes focused on highlighting the importance of personal cleanliness in the prevention of food risks.

Table 5 Do you consider it necessary to frequently clean the utensils and equipment you use in your workplace?

Response	Frequency	%
Yes	30	63,83
No	17	36,17
Total	47	100,00

These results indicate a significant proportion who value the importance of maintaining regular cleaning of work utensils and equipment. The higher percentage endorsing the need for cleaning suggests an adequate awareness of the relevance of hygiene and equipment maintenance in food handling environments. On the other hand, the minority proportion who do not consider this practice to be necessary is evidence of an area for focus and improvement, highlighting the need for awareness raising and education on the importance of cleaning to prevent food hazards and ensure food safety in food handling.

Table 6 Do you wear your uniform in a hygienically appropriate manner on a daily basis?

Response	Frequency	%
Yes	31	65,96
No	16	34,04
Total	47	100,00

These results show that a relative, though not overwhelming, majority ensure that the uniform is worn in a hygienically appropriate manner on a daily basis. However, the presence of a significant percentage not following this standard is of concern, as the uniform is an essential barrier to maintaining hygiene during food handling. This finding highlights the need to address the importance and hygiene guidelines in relation to the use of uniform, highlighting the relevance of ensuring its proper use and maintenance in food handling environments.

Table 7 Do you have adequate storage of cleaning products to avoid contamination with seafood?

Response	Frequency	%
Yes	35	74,47
No	12	25,53
Total	47	100,00

These results indicate that a significant proportion of respondents, although not a majority, claim to have adequate storage space for cleaning products, suggesting an attempt to maintain separation between these items and foodstuffs, particularly seafood. However, the existence of a group that does not have such a space points to a concern about preventing cross-contamination. This highlights the need to raise awareness and ensure adequate infrastructure to minimize the risk of contamination in the handling of seafood.

Table 8 Are there the necessary facilities in the market for proper refrigeration of seafood that has not been sold on the day?

Response	Frequency	%
Yes	47	100,00
No	0	0,00
Total	47	100,00

These data show a positive and homogeneous condition in terms of the availability of resources for refrigeration of non-marketed seafood, suggesting a full capacity in the market to preserve the freshness and quality of these products. This adequate provision of refrigeration emphasizes a concern for food safety and highlights a favourable practice in the handling of seafood to maintain high standards of quality and freshness.

Table 9 Do you think that the infrastructure of the Municipal Market of the canton Pedro Carbo is adequate for the adequate commercialization of seafood?

Response	Frequency	%
Yes	5	10,64
No	42	89,36
Total	47	100,00

These data suggest a widespread and strong perception among the majority of respondents that the current market infrastructure is not suitable for seafood marketing. This result could imply a deficiency in the existing infrastructure,



which could affect marketing efficiency and food safety. This discrepancy in perception highlights the need for structural improvements to meet the optimal standards required for the handling and sale of seafood.

Table 10. Analysis of GMP Checklist Results

	% de cumplimiento
Raw materials and inputs	61,4
Production Operations	62,5
Equipment and utensils	69,2
Of the facilities	69,3
Packing, Labelling and Packaging	72,2
Personnel	73,7
Quality Assurance and Quality Control	75,0
Storage, distribution, transport, and marketing	75,0

The results of the analysis show that the overall GMP compliance rate is 71.2%. This percentage is relatively high, indicating that the Pedro Carbo municipal market is generally compliant with GMP.

However, there are some points for improvement. The percentage of compliance is lower in the areas of raw materials and inputs (61.4%) and production operations (62.5%). These areas are important to guarantee the quality and safety of seafood.

Compliance rates are highest in the areas of equipment and utensils (69.2%), facilities (69.3%), packing, labelling and packaging (72.2%), personnel (73.7%), quality assurance and control (75.0%) and storage, distribution, transport and marketing (75.0%). These areas are also important to ensure the quality and safety of seafood.

The results of the analysis show that the Pedro Carbo municipal market is generally compliant with GMP. However, there are some points for improvement in the areas of raw materials and inputs and production operations.

It is recommended that the Pedro Carbo municipal market implements actions to improve GMP compliance in these areas. These actions could include:

- Training of personnel in GMPs
- Implementation of quality control systems
- Implementation of cleaning and disinfection procedures

The implementation of these actions would help to guarantee the quality and safety of the seafood marketed in the Pedro Carbo municipal market.

Gantt Chart Analysis (Tabla 11)

The Gantt chart presented here becomes a fundamental guide to ensure the systematic execution of the GMP implementation programme. This chronogram highlights a series of crucial stages that will be developed throughout the stipulated period, maintaining a rigorous time sequence.

The tasks include the implementation of a specific training plan for the operational staff of the seafood market, followed by a pre- and post-training knowledge assessment. In addition, the process of traceability of seafood and materials associated with its distribution is envisaged. Adjustments will be made to the market infrastructure, procedures and instructions will be formulated for quality assurance, and a logbook will be implemented to record daily cleaning and disinfection activities at the workstations.

Detailed monitoring of all these activities will be essential to ensure full compliance with the corrections and adaptations outlined above. All these scheduled activities, outlined through the Gantt tool, are planned to be completed within a period of six months.

Administrative Structure.

Organizational chart. -

According to the study work, it is necessary to hire 2 professionals for the operation of the Municipal Market of the Pedro Carbo Canton:

- Market administrator
- Supervisors, food technician, and camera supervisors.
- **Market Manager:**
 - Functions: To monitor, maintain order and supervise commercial activities.
 - Authority to request intervention of the vigilance justice and to report contraventions.
- **Food Technician (Supervisor):**
 - Responsibilities: To ensure the safety of the premises and to report on new developments.
- **Food Technician duties:**
 - Perform microbiological testing.
 - Work as part of a team.
 - Verify quality and safety of seafood.
 - Provide ongoing training to seafood hirers or traders.
 - Advise management on the application of Good Manufacturing Practices (GMP) in the seafood section.



- **Cold Store Supervisor:**
 - Knowledgeable in FIFO inventory method.
 - Control the compliance of measures, ensuring hygiene and proper handling of seafood.



Table 11. Seafood Merchant Training Plan - Monthly

Annual Training	January	February	March	April	May	June	July	August	September	October	November	December
Prevention of food-borne diseases	X						X					
Staff hygiene and habits		X						X				
Prevention of contagion of sick people			X			X			X			X
Safety - first aid						X						X
Cross contamination				X						X		
Correct hand washing					X						X	
Market hygiene and maintenance			X			X			X			X
Cleaning of equipment and utensils				X						X		
Handling Health Emergencies		X						X				
Control and Prevention of Food Borne Illnesses.	X				X							
Proper Storage.			X		X						X	
Handling and Use of Refrigeration Equipment.	X						X					
Food Regulations and Legislation.		X							X		X	



4. Conclusions.

In the cantonal capital of Pedro Carbo, Guayas province, the commercialization of fish and seafood is carried out empirically, lacking a Good Manufacturing Practices System (GMP) in the Municipal Market of Pedro Carbo, specifically in the Seafood area. This absence of a regulated system has been identified as a key need through surveys of the population and traders and is included in the Cantonal Development Plan & Land Use Plan Projects. The comparative study with markets in the northern area of the city of Guayaquil, considering parameters, regulations and facilities oriented to the sale of seafood, has allowed the identification of potential improvements.

The analysis, carried out using the Ishikawa quality tool, revealed non-compliance with Good Manufacturing Practices, while surveys of traders have provided valuable information on the needs of the establishment. In addition, an interview with the manager provided an understanding of the functions currently performed in the Pedro Carbo Municipal Market. A design based on Good Manufacturing Practices is proposed to be applied in the Pedro Carbo Canton market, with the objective of improving the processes of transport, reception, conservation, and sale of seafood.

Through the diagnosis and analysis carried out, it is recommended to implement a design based on Good Manufacturing Practices (GMP) to guarantee food safety in the Municipal Market of the Pedro Carbo Canton. Among the recommended actions are:

1. Implement the GMP system in the market, seeking to modify the current empirical form of commercialization through a periodic training plan to acquire specialized knowledge.
2. Carry out a control and follow-up of the activities in line with the proposed Design, integrating it into the four-monthly planning.
3. Extend the implementation of the GMP-based design to all areas of the municipal market to ensure food safety.
4. Restructure the functional organization chart of the administrative area for a more efficient management oriented to the new procedures.

In addition, it is suggested to incorporate in the Annual Contracting Plan (ACP) the purchase of uniforms, protective equipment, and a cold chamber to ensure proper marketing of seafood. It is proposed to consider a specific allocation in the annual budget for the market's certification in Good Manufacturing Practices.

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