



Shrimp packaging specifications while exporting it from Mexico to the United States.

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<p>Report/Thesis Title Shrimp packaging specifications while exporting it from Mexico to the</p>
<p>Number of pages and appendix pages 41 + 6</p>
<p>This thesis aims to demonstrate how transportation and timing affect shrimp packaging while exporting it from Mexico to The USA; the author explained that the US is the world's leading shrimp importer, followed by Mexico's role in exportation to the U.S., transportation specifications, and expected time. Knowing the specific packaging requirements for shrimp will help all Mexican shrimp exporters get the shrimp to their final destination with the required quality and reduce their losses on this product while exporting it to the U.S.</p> <p>This thesis is a research-based investigation in which the author used qualitative and quantitative research methods to present compelling and precise data concerning shrimp packaging specifications. The author conducted desktop research using relevant and trustworthy data from interviews and surveys administered to selected companies across various industries. The testers were interviewed individually depending on their job positions in every company. These industries included cardboard packaging producers, transportation companies, Mexican shrimp exporters, and importers from the U.S.</p> <p>The writing describes the different transportation methods for this perishable product and the right one for exporting shrimp from Mexico to the U.S. Going through the characteristics needed. The informants confirmed the opinion that temperature plays an essential role in the exportation process of shrimp as it must be shipped and stored at -18 °C (0°F) or below. After recovering the information, the author explains and analyzes the results obtained, concludes, and responds to the R.Q., "How do transportation and timing affect shrimp packaging when exporting it from Mexico to the USA?"</p>
<p>Keywords Packaging, transit time, transportation, specifications, exportation, shrimp.</p>

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1 Introduction

The shrimp packaging process is a highly specialized and critical aspect of the industry. Several requirements must be met to successfully export shrimp from Mexico to the USA, such as maintaining the appropriate temperature during transportation and ensuring timely delivery. This thesis aims to provide Mexican shrimp exporters with a comprehensive understanding of how transportation and timing impact shrimp packaging when exporting to the USA. To thoroughly understand the packaging requirements, the thesis will first examine the USA's role as the world's leading shrimp importer and Mexico's role in exporting to the USA. Furthermore, the transportation specifications and expected time will be discussed, leading to specific packaging requirements for this product.

This thesis will delve into all the specifications of shrimp packaging that need to be met when exporting from Mexico to the USA, including transportation transit timing and specifications. Additionally, the importance of packaging in the supply chain will be explained to help readers understand each part of the process. Packaging plays a vital role in the supply chain, getting the products to their destinations and protecting them during transport to ensure they safely reach their destination without damage. Packaging allows companies to optimize the space available on delivery vehicles so the correct number of products can be shipped to distribution centers, fulfillment centers, retailers, and customers to save on fuel/transportation costs. The role of packaging in the supply chain expands into protecting the environment, product traceability, item handling, distribution, and marketing campaign potential. These factors can be grouped into three primary packaging functions: marketing, flow, and environment.

The author selected shrimp packaging as the focus of the study for several reasons. Firstly, within the broader supply chain, shrimp packaging stands out as one of the most specialized and specific types of packaging. Unlike more generic packaging solutions, shrimp packaging demands precise characteristics and features tailored to the unique requirements of this particular product. Given the perishable nature of shrimp, maintaining optimal freshness and quality throughout the transportation process is paramount. Hence, the packaging must be meticulously designed to ensure that the shrimp reaches its destination in pristine condition, meeting all quality standards and customer expectations. Thus, exploring the unique characteristics of shrimp packaging offers essential insights into the difficulties and factors to be considered while maintaining product integrity and quality across the seafood industry's supply chain and exportation process from Mexico to the U.S.

1.1 Research question:

This thesis aims to provide the shrimp packaging specifications to all the exporters from Mexico to the USA, helping them know which factors directly affect the packaging. The research that will be conducted will be based on the following research question (R.Q.):

How do transportation and timing affect shrimp packaging when exporting from Mexico to the USA?

To have an efficient development for this thesis, this research question is backed up with the following investigative questions:

IQ1: What is Mexico's role in the shrimp import market in the U.S.?

IQ2: Which specifications does the transportation need to cover?

IQ3: How does timing in transportation affect packaging?

IQ4: What specific requirements does the shrimp box need?

In this study, the Overlay Matrix is a complete tool that provides an organized framework for investigating each research subject. Each question is followed by a description of the precise topics it will cover, page numbers correlating to those categories, and a statement about whether a qualitative or quantitative method will be used. By providing such clarity and organization, the matrix is vital in guiding the thesis research and facilitating the analysis of collected data. The matrix's systematic layout enables the author to navigate the various research components effectively, ensuring that each question is thoroughly examined and addressed coherently. Additionally, it improves the paper's general coherence and readability by providing readers with a clear outline of the research process and the connections between each section of the study.

Table 1. Overlay Matrix (Author 2023)

Investigative Questions (IQs)	Theoretical Framework	Methods	Data Analysis / Results
<p>IQ1. What is the role of Mexico in the shrimp import market of the US?</p>	<p>2.2, 2.2.1</p> <p>The role of Mexico in the U.S. shrimp import market, Shrimp production in Mexico, and how Mexico applies sustainability and responsible techniques to obtain the required certifications to export shrimp to The U.S.</p>	<p>Quantitative and qualitative.</p> <p>A desktop research survey was applied to a shrimp exporter company from Mexico to the U.S.</p>	<p>P. 23, 24</p>
<p>IQ2. Which specifications does the transportation need to cover?</p>	<p>2.5</p> <p>Analysis of which is the best transportation method for exporting shrimp to The U.S. and which specifications the vehicle needs to fulfill so as not to damage the packaging and the perishable product</p>	<p>Qualitative.</p> <p>Observation and desktop research.</p>	<p>P. 25, 26</p>
<p>IQ3. How does timing in transportation affect packaging?</p>	<p>2.3, 2.5</p> <p>Transportation and packaging requirements inform the reader that if both are well developed, timing delays may or may not affect the packaging.</p>	<p>Quantitative and qualitative.</p> <p>Observation and desktop research</p>	<p>P. 27, 28, 29, 30</p>

IQ4. What specific requirements does the shrimp box need?	2.3, 2.4 Packaging is vital in the supply chain, and the characteristics of shrimp cardboard packaging include the flute type, ECT, measurements, and coating.	Quantitative and qualitative. Observation and desktop research. Zoom interview applied to a company in the cardboard packaging producer industry.	P. 30, 31, 32

1.2 Demarcation:

This thesis will cover various types of packaging employed in the process but focus on cardboard packaging as the optimal choice for exporting shrimp and all its specifications (size, thickness, endurance, and the needed covering) depending on the product, in this case, shrimp. In this thesis, the author will focus on the exportation of shrimp from Mexico to the USA, not any other seafood or any other country; the author will explain and investigate the required certifications to export shrimp from Mexico to the U.S., not any other kind of certification, ground transportation (truck) specifications will be explained as well, not any other type of transport method. It will include the required transportation time to avoid getting the packaging damaged.

1.3 International aspect:

As the research question of this thesis says, the main objective is to know how transportation and timing affect shrimp packaging when exporting it from Mexico to the USA. That is why the USA, as the world's leading shrimp import market, will be investigated, as will Mexico's role in the USA shrimp market. This will help the readers know which certifications as a Mexican exporter are needed to successfully fulfill this process and avoid product and money loss, as well as know which are the main things that affect the shrimp packaging in the supply chain and the export process, and to know the specific characteristics the packaging need to fulfill to carry out this process successfully.

1.4 Benefits:

The finished research thesis is expected to benefit the author as a sales manager of cardboard packaging, knowing exactly which specifications need to be fulfilled for shrimp packages and improving the quality of its products on the company. Shrimp packaging manufacturers will also benefit from this thesis by understanding the packaging specifications and knowing which company can deliver this packaging for their products, preventing product loss. Shrimp importers and exporters from Mexico and the USA will know which certifications, terms, and conditions are required for exporting and importing shrimp to their countries, saving time and money loss in all aspects.

Shrimp exporters benefit significantly from a comprehensive understanding of the various transportation methods available for perishable goods. They can choose the best kind of transportation for their particular products and logistical requirements by carefully weighing the pros and cons of each choice. With this understanding, they can safely handle the intricate shipping logistics, guaranteeing that the finished product and packaging reach their destination in top shape. Additionally, being well-versed in transportation methods allows exporters to anticipate challenges and implement effective strategies to mitigate risks, ultimately enhancing the efficiency and reliability of their export operations.

1.5 Risk and Risk Management:

As it is a research project, the author comes across some difficulties; the following chart explains and shows some of the risks and challenges in making this thesis. The risk scale is based on the author's experience and knowledge of quantitative and qualitative research on different topics, such as the time-lapse to deliver the final research and Insufficient sources for the study; this will be evaluated on a scale from zero to five (0-5) making 0-1 "very unlikely to happen," 2-3 "could happen," and 4-5 "very likely to happen ."Although risks are very likely, the author is committed to solving all challenges in writing this research thesis, performing a well-structured investigation with valuable information from different sources and interviews.

Table 2. Risk matrix (Author 2023)

Risk	Severity	Occurrence 0-5	Management method
Timelapse to deliver the thesis.	High	2	Make all the assignments on time and start investigating. Since now, even in the internship, do not postpone any assignment or advance.
Inconsistence of the information	High	5	Get information from reliable sources such as experts and books and schedule the interviews with enough time.
Grammar and format of the thesis	Medium	3	Check the grammar in dictionaries and download Grammarly to have more tools.
Insufficient sources for the study	High	4	Schedule with enough time interviews with the experts to have sufficient sources for the study and information to finish it on time.

1.6 Key concepts:

Some keywords or concepts are explained to help readers better understand this research thesis topic. They are related to the packaging specifications, including the transportation specifications and timing that can affect the final product, shrimp.

Packaging: Materials used to wrap or protect goods. The science and technology of enclosing or protecting products for distribution, storage, sale, and use. Packaging also refers to designing, evaluating, and producing packages. (Cambridge 2023)

Packaging specifications: Master data. The packaging specification defines all the necessary packing levels for a product in order, for example, to put away or transport the product. For a

product, a packaging specification mainly describes in which quantities someone can pack the product into which packaging materials in which sequence. (SAP 2020)

Exportation: Sale of products and services in foreign countries that are sourced or made in the home country, sending goods to another country to sell them there and to take or cause to be taken out of the partner state. (Cambridge 2023)

Transportation: Transportation refers to moving goods, people, or animals from one place to another. It involves the use of various modes of conveyance, such as vehicles, trains, ships, aircraft, or pipelines. The primary purpose of transportation is to facilitate the transfer of goods and individuals between locations, whether for personal travel, commercial trade, or the distribution of resources. It is crucial in connecting different regions and communities, supporting economic activities, and enabling social interactions. Transporting someone or something or the process of being transported, the movement of people or goods from one place to another. (Cambridge 2023)

Transit time: is the time it takes for goods, persons, or vehicles to travel from one place to another. It is the interval during which a shipment must wait to be delivered once picked up at the point of departure. Logistics frequently use transit time to indicate how long it takes to get from one place to another.

2 Shrimp market

In this second chapter, the author will provide detailed information on how transportation and transit time impact shrimp packaging during the export process from Mexico to the U.S. To achieve this, it is crucial to establish a foundational understanding of both markets. The author will interview cardboard packaging producers, shrimp carriers, and Mexican shrimp exporters and importers in the United States.

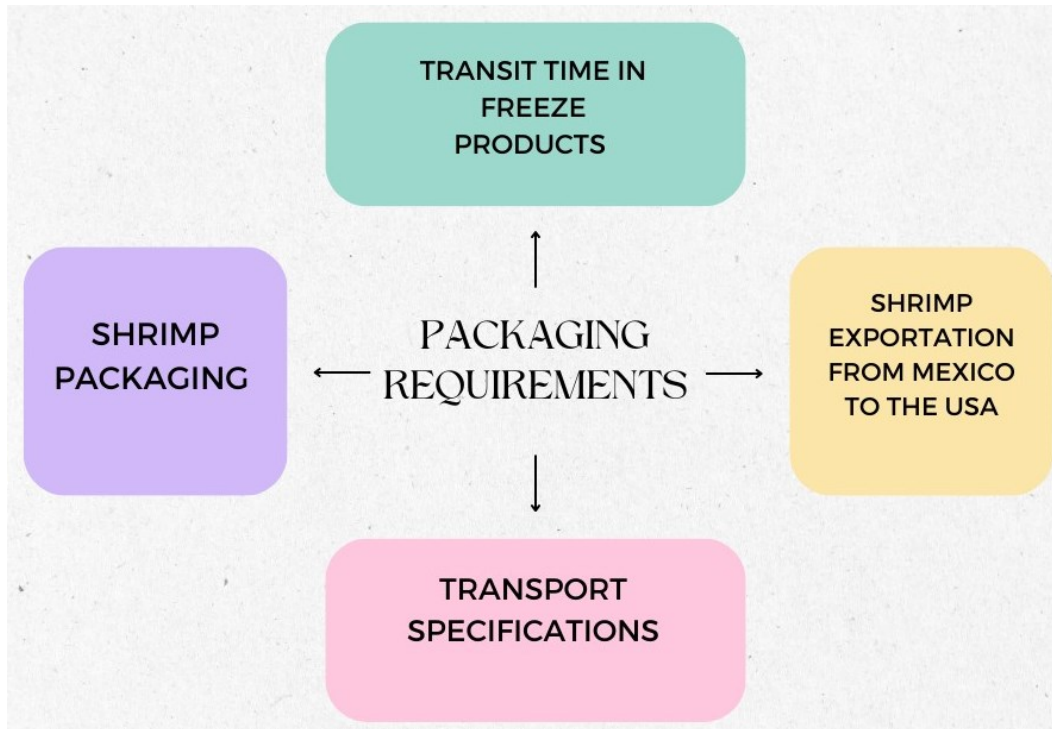


Figure 1: Packaging requirements (Author 2023)

Therefore, researching the U.S. shrimp import market, including its annual growth, economic impact, and pertinent details, is vital for the thesis development. This investigation should cover Mexico's contribution to shrimp export to the United States, emphasizing the necessary certifications mandated by both countries, the various types of packaging employed in the process, and its importance, and ultimately focusing on cardboard packaging as the optimal choice for exporting shrimp. The objective is to provide readers with thorough insights regarding the necessary specifications for shrimp packaging, the chosen transportation method, the associated transit time, and how it affects the export process of this specific perishable product. The author aims to thoroughly analyze the difficulties and aspects involved in the exporting process by investigating these crucial elements, particularly regarding maintaining the integrity and quality of shrimp packing during transportation. By offering a comprehensive grasp of the complexities of

exporting shrimp, this strategy empowers stakeholders to make well-informed decisions and implement efficient solutions to maximize product transportation and preservation.

2.1 The USA is the world's leading shrimp importer

In the past few years, consumers' awareness of the health benefits of products has grown; there has been a notable escalation in this regarding the health benefits associated with various food products, creating health-consciousness and preference over healthier food options and healthier protein sources, such as shrimp, which also acclaim for its distinctive flavor profile and exceptional culinary adaptability. The rising number of restaurants and their utilization of shrimp in their menus offers numerous opportunities for the market. Among these, shrimp has emerged as a particularly favored option, strengthening the shrimp market because of the high protein content and low levels of calories, fat, and cholesterol in this specific seafood, which is recognized as a nutritious seafood choice. Shrimp held the top spot of the most-consumed species, with each American eating 5.9 pounds of shrimp per person on average – a 0.90-pound increase over 2020.



Figure 2: Top 10 list of seafood Americans consumption in 2021. (NFI 2023)

Shrimp offers a compelling combination of health advantages that align with the contemporary emphasis on well-being because of its essential vitamins and minerals, such as selenium and omega-3 fatty acids, which promote heart health and cognitive function, addressing real health concerns prevalent in the United States. Consequently, consumers increasingly incorporate shrimp into their diets, driven by a heightened understanding of its nutritional value. This change in consumer behavior has led to a notable increase in the consumption of shrimp, which has resulted in a remarkable expansion of the shrimp industry in the United States. Shrimp's popularity has been driven by the convergence of health-conscious eating, nutritional consciousness, and its alluring qualities, positioning it as a significant participant in the modern American food scene.

"In 2019, U.S. seafood imports were valued at \$22.4 billion (USD) assigned across the categories shown in Figure 2 (NOAA 2021). Shrimp imports were valued at over \$6 billion in 2019, corresponding to 27 % of all U.S. seafood imports". (US/IFAS 2022)

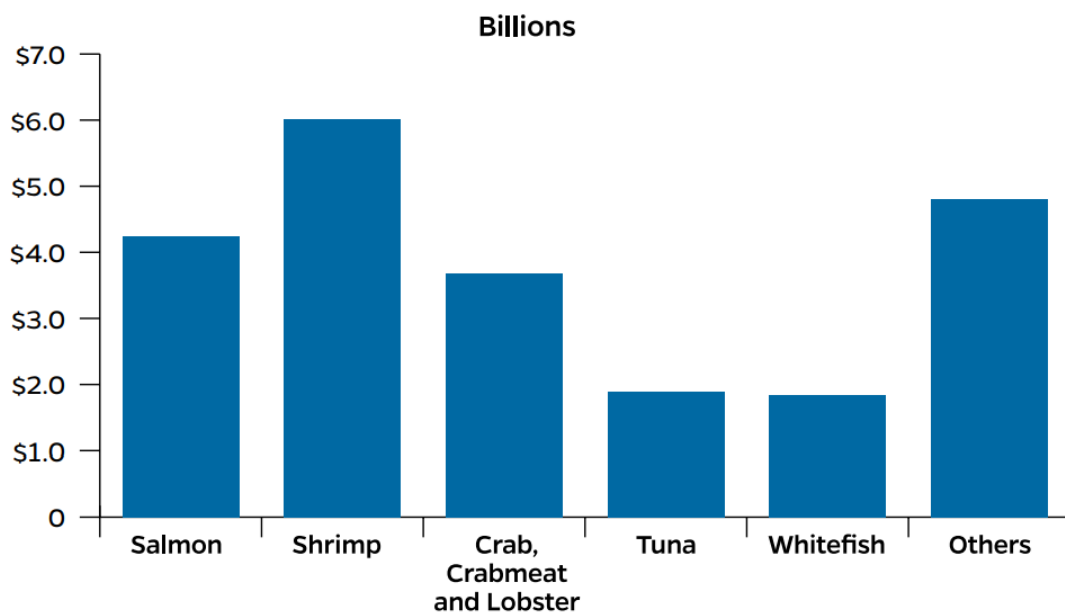


Figure 3: U.S. seafood imports by type of seafood. (NOAA 2021)

The United States of America is the second largest global shrimp consumer after China. Shrimps are the most consumed in the US, holding 25 % to 30 % of all the seafood market in this country. Still, the commercial fishing and aquaculture industries cannot sustainably produce the amount of seafood that U.S. consumers demand. The United States relies heavily on imported shrimp to meet consumer demand, and it is estimated that between 65 % and 85 % are imported. Shrimp was mainly imported from Latin American countries, meaning the product was caught or raised

outside U.S. territory. Importing shrimp helps bridge the supply-demand gap, ensuring that the market can meet the needs of consumers. (Seafoodsource 2023)

Moreover, imported shrimp frequently offers cost benefits in contrast to domestic production. Imported shrimp can be more reasonably priced due to lower labor costs and advantageous trade agreements, making it an attractive alternative for businesses and customers. This cost-effectiveness improves market accessibility, fostering demand and consequently fueling market expansion. Trade agreements and favorable import policies mentioned before directly and significantly impact the expansion of the U.S. shrimp market because they reduce trade barriers, tariffs, and other restrictions, making it more cost-effective for businesses to import shrimp. Furthermore, Trade agreements support fair trade principles, guaranteeing that imported shrimp satisfies requirements for safety and quality. Assuring product purity, increasing buyer trust in the shrimp industry, and global shrimp sourcing ensure a consistent supply that helps customers demand satisfaction.

Additionally, the rapid advancements in aquaculture technology create a positive outlook for the market. These developments have improved production efficiency, producing a steady supply of high-quality shrimp products. Expanding e-commerce platforms and online retail channels further stimulates the market. From 2016 to 2020, the US value of shrimp imports ranged from 5.7 to 6.5 billion USD, and the import volume ranged from 606,000 to 749,000 tons. Then, in the following year, the US shrimp import volume outpaced 800,000 tons for the first time, and the value exceeded the \$7 billion mark for the first time; according to a National Fisheries Institute analysis using data from 2021, the average person consumed 2.67 kg of shrimp, an increase of nearly one pound from the year before. In addition, The United States Shrimp Market Size was valued at 945,190 Tons in 2022. (Spherical Insights 2023)

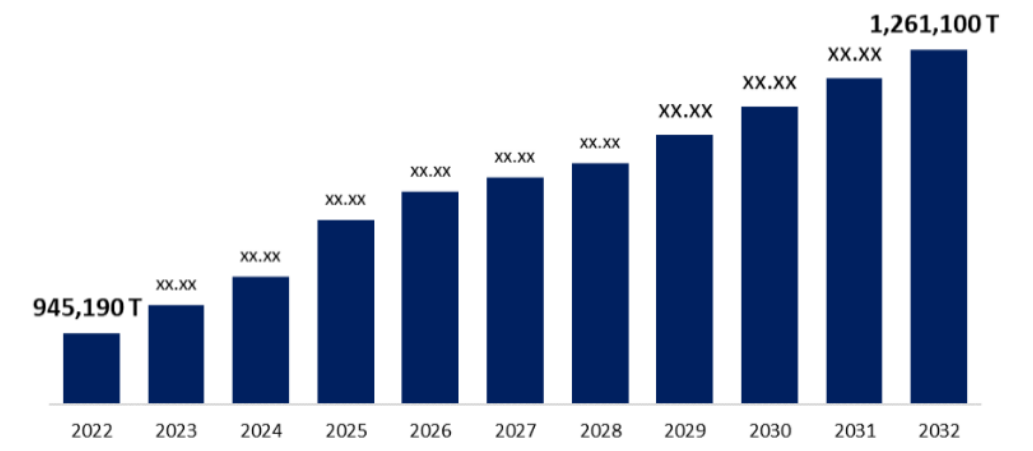


Figure 4: United States Shrimp Market (Spherical Insights 2023)

This graphic shows the expected growth of the shrimp market in the US, which is expected to reach 1,261,100 Tons by 2033 at a Compound Annual Growth Rate (CAGR) of 2.93 % during the prognosticate period 2023 to 2033. (Spherical Insights 2023)

2.2 Mexico's role

Mexican shrimp farming has grown significantly in recent years, showing a significant transformation in production and demand, both domestically and internationally; the country has established itself as one of the leading global producers and exporters of shrimp, being the USA, European Union, Japan, and China the largest importers. Shrimp production in Mexico in recent years has not only experienced remarkable growth. Still, it has also evolved towards more sustainable and responsible practices, establishing the country as a reference in international aquaculture. The adoption of responsible aquaculture practices has led to the certification of farms and processing facilities, and as a result, Mexican shrimp's reputation has solidified in international markets. Transparency in production methods and a focus on traceability have strengthened consumer trust, positioning Mexico as a critical player in the global shrimp industry.

Mexico is the second largest shrimp producer globally. In 2019, it reached 30,000 tons, worth 300 million dollars, and closed 2021 with 227 thousand metric tons, representing a 3.7 % increase compared to 2020. Of this production, 22 % is captured in bays, and the remaining 78 % is caught in aquaculture farms. Shrimp farming contributes to an annual economic income of one billion dollars. (Veterinaria Digital 2023)

The strategic geographical proximity of Mexico to the United States, particularly along its southern border and coastal regions, facilitates the efficient transportation of shrimp products. Consequently, Mexico plays a significant role in the shrimp import market of the United States, contributing substantially to the country's seafood consumption. In Mexico, most of the national shrimp production is concentrated in the northwest region, specifically in Sonora and Sinaloa; during the late 1960s, shrimp farming started in these crucial states mentioned before, initially artisanally led by fishermen and farmers. Its momentum grew significantly due to the economic stimulus resulting from increased exports to the United States. As the state with the highest farmed shrimp production, Sinaloa produced a record-breaking 95 thousand tons in 2021. Sonora and Nayarit are the following two states in position because shrimp farming is carried out in coastal areas to use seawater efficiently.

Mexican shrimp has become a staple in the U.S. seafood market, providing consumers with diverse options. Wild-caught and aquaculture-produced shrimp are part of Mexico's abundant shrimp

economy, providing a year-round supply of shrimp to satisfy the US market demands. Shrimp is marketed in the following ways: Fresh/frozen shrimp with shell and head, prawns in brine, both with and without the head, frozen shrimp, with or without the head, cooked and peeled shrimp without the head, and dried shrimp. Frozen shrimp without the head is the form that achieves the highest sales volumes.

Mexican shrimp farming is a high-growing industry that has seen consistent productivity development in the last few years. Protecting this vital food-related activity is essential since it is necessary for meeting the protein demand of a constantly growing population. Shrimp farming affects the ecology, just like any other human activity, so using all available tools and technologies to make shrimp farming increasingly sustainable is essential. These nutrients improve productive performance by strengthening immunity against infections (like gregarines) and enhancing response to various stressors. This contributes to the reduction of the environmental cost of the operations.

2.2.1 Needed Certifications

As with every exported product, shrimp also requires specific certifications to accomplish this process and to fulfill the shrimp offer and demand efficiently, so one of the most crucial aspects that significantly influences the success of shrimp exports is the attainment of required certifications and awareness of external factors that can affect this offer and demand, such as environmental requirements, permits, environmental impact assessment, concessions, and water use permit. Regulations are required for import and export; the United States relies on the FDA for health, safety, and process traceability analysis. FDA is responsible for ensuring that the country's local and imported seafood supply is healthful, clean, safe, and accurately labeled. It has a program called the FDA's Imported Seafood Safety Program, designed to provide importers with information about all the safety regulations that apply to seafood shipments. The program offers instructions on how importers can stay updated and informed, including details about rules set by NMFS. These agencies collaborate to ensure that their shared objective of guaranteeing the safety, hygiene, and accurate labeling of all seafood entering the United States is met.

These certifications serve as indispensable tools, ensuring that exported shrimp meets the stringent standards of Mexican and U.S. regulatory parties. Therefore, Mexican shrimp exporters must thoroughly understand the importance of these required certifications to facilitate market access and uphold the integrity of the product, ensuring consumer safety and satisfaction, as well as external factors that may be affected by shrimp fishing, such as Mexican sea turtles.

Product specifications are one of the crucial requirements for every seafood importer. When a product is received from those countries without an active Memorandum of Understanding, product identification or definition is needed for the product specifications for fresh frozen green headless and pud shrimp. Green headless is defined as the six tail segments of the shrimp, complete with shell, tail fin, and vein. It is the shrimp in the shell without the head. The term 'green' refers to fresh or raw and does not indicate the color of the shrimp. (J.J. McDonnell S.A)

High-quality fresh, raw, headless, shell-on or peeled undeveined (PUD) tail-on or tail-off shrimp shall be quickly frozen only once. The flavor shall be that of a freshly caught shrimp of the desirable species specified in the workmanship requirements. Shrimp shall not have any detectable, objectionable odor or discoloration (J.J. McDonnell S.A)

. Bacteriological standards are crucial in this kind of seafood product; specific sanitary procedures require implementing good manufacturing practices at all times to ensure the production of a good quality and wholesome product.

Mexican shrimp exporters needed to follow and fulfill the required processes for exporting this specific seafood; as a result, in April 2021, the USA suspended the importations of shrimp from Mexico because Mexican fishermen were not protecting sea turtles as they were supposed to. Mexican government mandated to establish protections to ensure that sea turtles are no longer in danger and to follow up on this high-priority issue, the Mexican Government released on June 9, 2021, a "Plan of Emergency Actions implemented by the Government of Mexico for the conservation of marine turtles," which is still in effect to date. The Training and Awareness Plan for Small Boat Fishermen was also initiated to raise awareness about the care and protection of various marine species. This is achieved through the proper and efficient use of shrimp fishing gear. It is worth noting that, with both plans, over 9 thousand individuals have been trained from 2021. Thanks to these training sessions, Mexico continues demonstrating its commitment to marine life protection measures comparable to those of the U.S., particularly in safeguarding turtles during crustacean captures.

Finally, after a TED verification visit in March 2022 in Puerto Chiapas, Chiapas, and Salina Cruz, Oaxaca, on May 13, 2022, the US published in the U.S. federal register that Mexico's TED program is comparable to that of the USA, so shrimp caught in Mexico was recertificated to enter the US market. Notably, over 107 thousand fishermen benefit from this certification, and over 430 thousand Mexican families depend on them.

2.3 Packaging

Packaging plays a vital role in the supply chain process; it gets the products to their destinations and protects them during transport, ensuring efficient and secure movement from manufacturers to end-users. This protective role is essential to ensure that goods satisfy customer expectations and quality requirements and reach their destinations in optimal conditions. In this way, packaging acts as a frontline defense against the challenges posed by the unpredictable nature of transportation and handling throughout the supply chain. Its significance extends beyond simple protection; it serves various purposes that enhance the supply chain's overall performance and cost-effectiveness.

Well-designed packaging not only protects the product but also serves as a visual representation of the brand, conveying information about the product and attracting consumer attention; that is why the role of packaging in the supply chain expands into protecting the environment, product traceability, item handling, distribution, and marketing campaign potential. In a market that is becoming increasingly competitive, as is happening nowadays, packaging becomes a tool for differentiation, creating a memorable consumer experience, enhancing brand visibility, attracting people to your products, and serving as a communicator to provide product information.

Customers have become more aware of how the supply chain and products in general impact the environment, which is why flow function takes an essential role in the supply chain; it focuses on how packaging allows the item to move during distribution and logistics tasks, the packaging is a strategic tool for space optimization, as well as the environmental impact of packaging function, considers how packaging is created, used, and disposed of for the betterment of the environment.

In this process, the packaging is viewed as a dynamic component that affects the flawless distribution and transportation of products. The design and efficiency directly impact the use of space within the delivery vehicles, guaranteeing that the appropriate number of goods can be delivered efficiently and well-organized to different locations. It allows companies to optimize the space available on delivery vehicles so the correct number of products can be shipped to distribution centers, fulfillment centers, and retailers. By minimizing wasted space and reducing the number of required shipments, packaging helps companies cut down on fuel and transportation costs, contributing to the sustainability and profitability of the supply chain.

Corrugated cardboard, also referred to as corrugated fiberboard, is defined by the combination of two structural elements: sheets of smooth cardboard, also known as liners, which are placed on the outside or act as separators between different layers of flutes, and one or more sheets of corrugated paper, also known as the flute or medium, which serves as the central nerve and gives

corrugated cardboard extra strength. Corrugated cardboard is highly versatile. Therefore, it can take various forms, including boxes. Due to sustainability issues, flexible plastic bags and other packaging materials are gradually being replaced. Furthermore, corrugated cardboard boxes make an ideal base for various printing methods. As a result, businesses typically prefer corrugated packaging as they employ it for marketing. Corrugated cardboard packaging material is highly sustainable. It stands as the shipping material of choice due to its affordability, lightweight, practicality, and adaptability, making it the most frequently used shipping material. Corrugated cardboard is the primary raw material employed in manufacturing packaging materials; owing to its remarkable strength and ability to support loads up to 800 kg, this material is well-suited for a wide range of applications. The fluted medium of the corrugated cardboard serves as a cushion, protecting packaged goods from outside impacts.

Corrugated boards are made from pulp and paper; therefore, they are highly recyclable, renewable and decrease solid waste disposal; compared to plastic packaging, it is one of the few materials that never has to go to waste and can be recovered for recycling through an established healthy market. The recycling rate of corrugated packaging in 2021 was 91,4 %, and the average corrugated box is made with 52 percent recycled content. Old corrugated containers, or OCC, contain valuable fiber in high demand domestically and internationally. They are mainly used to create new paper products, allowing less new raw material and generating revenue for the end-user.

"96 percent of corrugated boxes are made with material supplied by certified fiber sourcing programs such as Sustainable Forestry Initiative® (SFI), Forest Stewardship Council (FSC), and American Tree Farm System (ATFS). Program participants are committed to sustainable forestry in their forests and must encourage their suppliers to practice sustainable forestry." (Fibre Box Association 2024)



Figure 5: The corrugated recycled symbols (Fibre Box Association 2024)

According to a survey by Stora Enso, 59 % of millennials believe packaging should be sustainable throughout the value chain. The demand for sustainable packaging products is a critical factor in processed food packaging, positively influencing the growth of the corrugated board packaging market.

During the first quarter of 2022 in Mexico, the production of cardboard packaging increased by 5.3 percent annually and 5.7 percent compared to 2019, before the COVID-19 pandemic.

Manufacturing costs had an annual increase of 17.9 percent and a 26.7 percent increase over the same time in 2019. A record-breaking 38,500 million square meters of corrugated cardboard were manufactured in 2021 by this industry, which was used to make boxes, displays, and other corrugated cardboard packaging. This was equivalent to 40 billion packages shipped to customers.

As corrugated cardboard packaging keeps moisture away from products and can withstand extended shipping times, companies are increasingly adopting this packaging to deliver better outcomes to the customer, particularly for secondary or tertiary packing. Single-use packaging materials are necessary for processed meals, including meat products, bread, shrimp, and other perishables, which increases demand.

2.4 Shrimp packaging specifications

Shrimp packaging represents a highly specialized branch in the packaging industry due to the stringent temperature requirements for preserving shrimp quality. Implementing packing regulations is essential, mainly when preparing shrimp for exportation and to protect the products from moisture and aroma loss. In all this shrimp exportation process, the product must be shipped and stored at -18°C (0°F) or below to keep shrimp quality intact for the final customer. A plastic unit pouch or wrapper is used as a primary pack, but to meet these specific temperature demands, corrugated shrimp packaging as the secondary packaging goes through a precise procedure where the cardboard is covered with special coatings; the corrugated cardboard has a water-resistant coating inner and outer side, which is biodegradable, this makes the packaging suitable for use in semi-wet environments. These coatings can be made from water, plastics, or other materials. However, they usually consist of a mixture of polyamides, natural or synthetic plastics, and ethylene acrylic acid copolymers, a type of polymer. One of these coatings, the most used in this type of packaging, is the Michelman coating, a global developer and manufacturer of specialized sustainable chemistry used in agricultural coatings.

This procedure is essential in addressing the challenges of low temperatures and moisture. These coatings enhance the packaging's resistance to humidity, safeguarding the shrimp from potential damage or degradation during transportation and storage. There is an increasing awareness and demand for sustainably sourced and packaged seafood products. Consequently, choosing packaging materials and coatings becomes crucial in preserving the product and meeting eco-friendly and sustainable packaging criteria. More corrugated cardboard boxes with recyclable alternative coatings are being shipped than those with traditional wax coatings. The total volume of waxed corrugated cardboard was only 2.14 % of the total volume of corrugated cardboard produced in 2020.

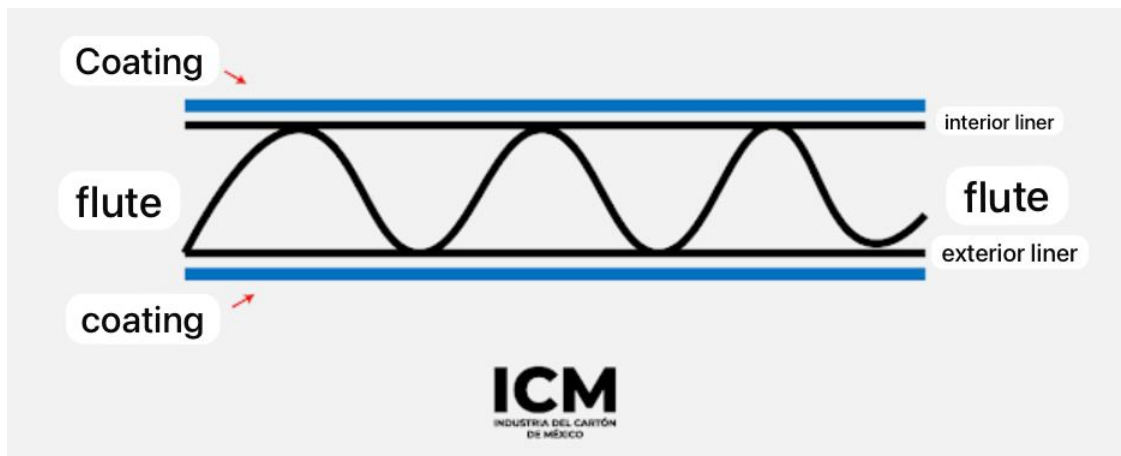


Figure 6: Coating system (ICM 2020)

A standard box for exporting shrimp has internal dimensions of 440mm in length, 290mm in width, and 275mm in height. It needs to have a strength rating of 55. ECT, which stands for Edge Crush Test, measures the corrugated board's resistance to compression along its edge. This is evaluated by compressing a predefined board section between two rigid plates on its edge. The corrugated cardboard used for these boxes should be of the C flute type. Flutes are the wavy part of the cardboard. This flute has so much of a bearing on the structural integrity of the cardboard and, therefore, defines what it can and cannot be used for. C flute typically ranges between 3.5mm and 4mm, slightly thicker than the usual B flute. This increased thickness offers superior crash protection, making it a preferred choice for standard moving and shipping boxes as secondary or tertiary packaging. This specific choice of C flute corrugated cardboard enables the box to withstand a weight of up to 20 kilograms of shrimp. Combining the box's dimensions, ECT rating,

and flute type ensures that the packaging meets the necessary export standards and provides robust protection for delicate cargo during transportation and storage.

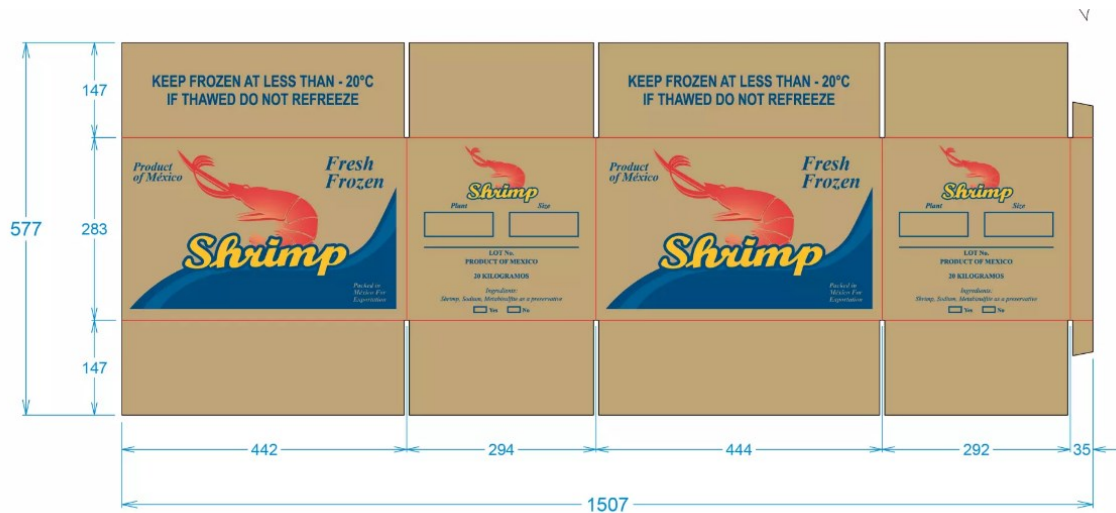


Figure 7: Shrimp box internal measures (CARTON.COM 2023)

2.5 Shrimp transportation specifications

Perishable food can be exported using various transportation methods depending on the product. Each product requires a vehicle specifically designed to meet its needs; the modern world would drastically differ without such cars. These vehicles have an enclosed compartment that prevents heat transfer and sufficient temperature control systems. These regulations are governed by the 1970 Geneva Agreement on International Transport of Perishable Goods and Special Vehicles.

This kind of product has four primary vehicles; typically, refrigerated international land transport vehicles consist of trucks with different features and sizes: isothermal, refrigerated, heat-insulated, and refrigerated/ reefer. The isothermal vehicle features insulated walls in the box, which helps prevent the transmission of temperatures between the interior and exterior. The doors also meet this criterion. They are ideal for short-distance transportation and quick turnaround. The refrigerated vehicle is similar to the isothermal but equipped with a cooling system or source. In this way, it limits the entry of external heat and maintains a stable temperature range. They can reach -20°C without significant problems. Then we have the different heating vehicle because, as the name says, instead of being cold, it is heated as it has a heat source so it can reach 12°C and

maintain it for a minimum of 12 hours. Finally, reefer transport is similar to refrigerated transport, but the difference is that the temperature ranges are more flexible. It refers to transporting products that require specific controlled temperature conditions to keep them fresh or frozen. The cooling system allows temperatures to reach between 12 and -20°C, even in external conditions of 30°C.

When exporting shrimp from Mexico to the USA, reefer transport is the best option. Shrimp are delicate products that require specific care during transportation, such as precise temperature and humidity settings. As mentioned earlier, according to the Cold Experimental Center of the CSIC, since shrimp are frozen, the ideal temperature for transport is -18 degrees.

Temperature is the most critical factor because if it is too high, it can spoil the product we are transporting. Reefer transportation has grown internationally in the last few years due to globalization, which enables any product to be shipped at any temperature to all corners of the world. It has fundamental attributes that must be considered, starting with hermeticism, which refers to storage that relies on the modified atmosphere concept, where oxygen levels are reduced to a point where they cannot sustain life (microflora and insects) and could harm stored items. This vehicle should be made from highly corrosion-resistant materials and completely waterproof to ensure that goods do not deteriorate during transit. Following air circulation, The units' surfaces should be arranged to facilitate proper airflow, allowing for appropriate ventilation tailored to each product type. Finally, isolation: for the products to not suffer any damage, there must be no direct connection between the cargo unit and the driver's cabin; therefore, an appropriate insulation system must be in place.

This type of container is highly recommended for long distances and is enormously efficient in moving large volumes of goods at a notably lower cost. There are many reefer container types. The closed reefer is a container used in maritime transportation for perishable single-piece items. A unit capable of producing either cold or heat is used depending on the needs of the product, provided it is plugged into an electrical power source. The second type is the reefer with a controlled atmosphere; in this case, the container maintains a constant atmosphere on the inside, which also depends on the needs of the transported product; this atmosphere can be sustained due to an air inlet that replenishes the oxygen consumed by the product. Last but not least, there are Automatic Fresh Air Management Containers. These containers feature a system that automatically adjusts the air mixture scale to regulate cold air exchange. Another system controls the blend of oxygen, carbon dioxide, and other factors, potentially impacting and prolonging the cargo's shelf life.

Each product is transported via land, air, or sea based on specific requirements. Land transport is preferred for exporting shrimp from Mexico to the United States. Ensuring temperature control

during transit, pick-up, and final delivery is crucial. That is why, when getting any refrigerated transport service, it is imperative to make sure that the unit has been previously cooled, and regulate the temperature appropriately for each product inside the vehicle, ensure that the goods are packaged correctly before being shipped and loaded the goods onto the car as quickly as possible and without leaving the doors open for too long and this will help the cold chain.

The cold chain is essential for the quality of the shrimp and the shrimp packaging; in seafood exportation, it refers to maintaining a controlled and constant temperature from when the seafood is captured or harvested until it reaches the end consumer. This means ensuring the seafood remains at low and consistent temperatures throughout the transportation, storage, and distribution stages to maintain its freshness and quality. The problem arises when the cold chain is interrupted because thawing frozen products, even briefly, creates a more favorable environment for microbial activity due to increased temperature. As a result, food quality is compromised, leading to a shorter shelf life and a higher risk of foodborne illnesses. Similarly, despite meeting coating specifications, cardboard packaging will degrade upon contact with liquid, contributing to overall losses.

3 Research Methods

This chapter describes the steps taken to design the research. It offers validation for the overarching research structure alongside the utilization of precise data collection and analysis methodologies. The author chose a qualitative and quantitative approach for this thesis, collecting data by observing and interviewing key stakeholders and analyzing and reporting data concerning the essential components of the thesis. The author will contact stakeholders and key companies surrounding the packaging industry and the shrimp exportation market to obtain the desired results.

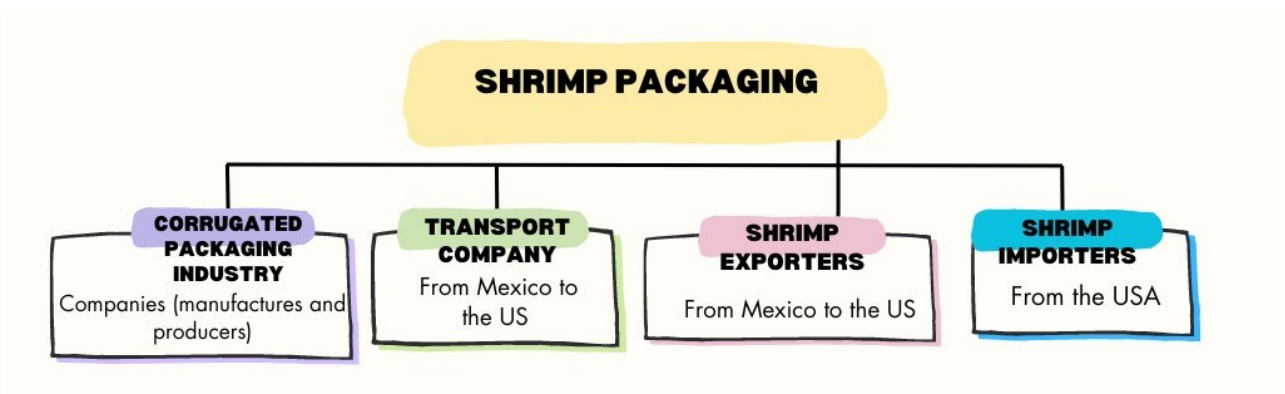


Figure 8: Mapping structure (Author 2024)

The information the author expected to gather from these stakeholders was related to the shrimp packaging specifications that must be fulfilled to avoid damage during the transportation method of the exportation process from Mexico to the USA. The significance of the viewpoints expressed by the previously mentioned stakeholders is vital to the credibility of the information the author would gather. Potential interviews, questionnaires, observation, and the necessary desktop research were used to get this data.

The author may encounter challenges during data collection if interested parties decline to provide operational details or specify that shared information cannot be made public. Before conducting interviews, the author must inform them that the data is solely for academic purposes and establish effective communication between both parties. Additionally, allowing stakeholders to remain anonymous in the paper may alleviate concerns.

To ensure valuable and trustworthy information on which the reader may base their research and have confidence in the author's work, the author will directly interact with stakeholders to procure information for this paper. The research will rely on direct interviews or similarly directly

administered surveys where the questions are specifically designed to help the author validate the information given before and aim to obtain quantifiable information to enable the proper analysis of such data; the table presented down below shows how the author aimed to conduct the research.

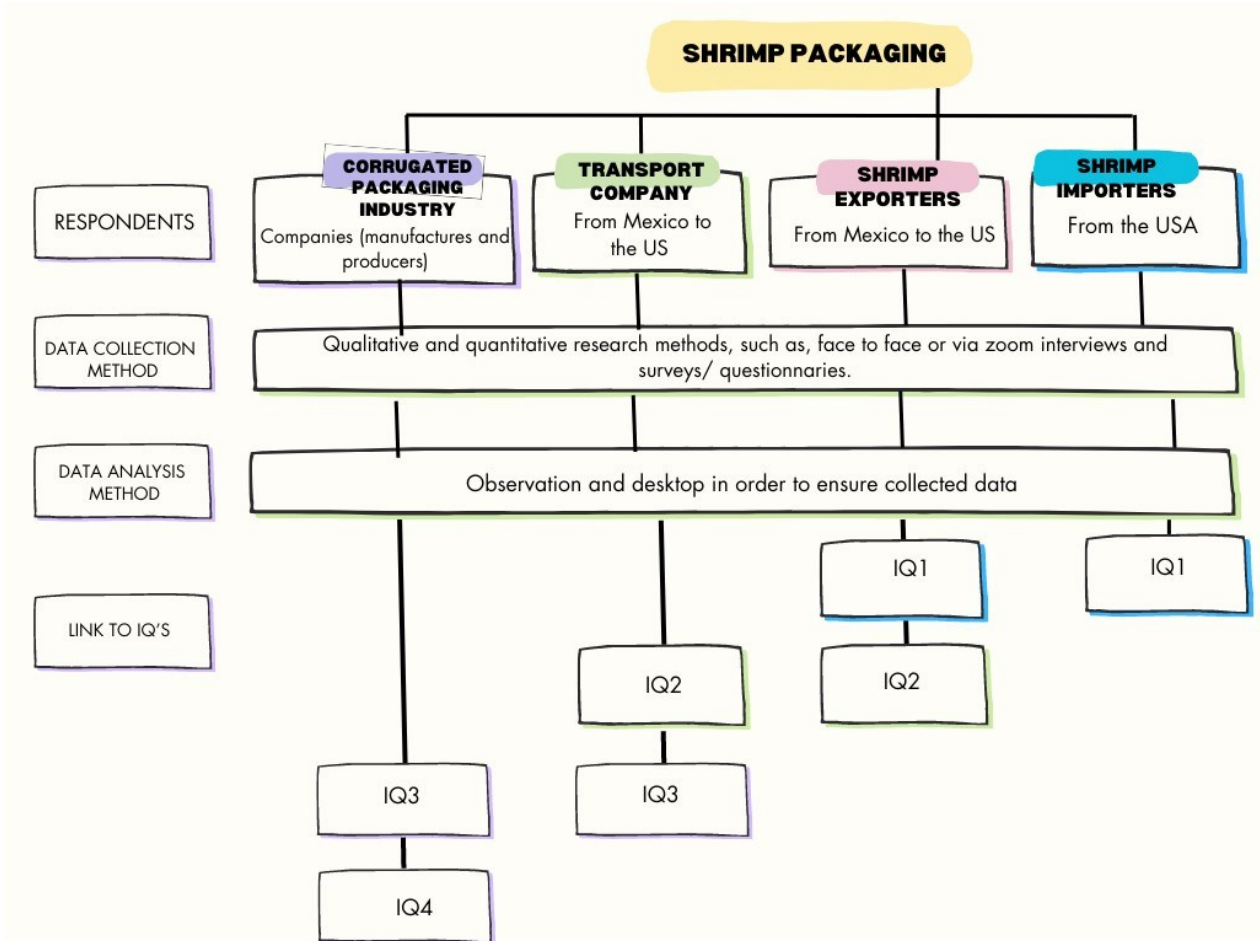


Figure 9: Research Methods Design chart (Author 2024)

3.1 Data Collection

Qualitative and quantitative research methods were used to gather valuable information; as mentioned before, interviews and surveys were applied. For the reader to have more certainty on the data collection process or a more precise idea, the author will give chronological details on the undertook of the gathered information with each stakeholder.

The first company interviewed was "Company A" from the corrugated packaging industry. Different employees were selected depending on their positions, and most managers, directors, and supervisors were interviewed directly by the author. The author recorded a face-to-face interview

and transcribed it to analyze the results. The questions were formulated in an open-ended manner to gather as much information as possible about the details and specifications of the shrimp packaging. As most stakeholders are from Mexico City, the surveys and interviews were done in Spanish and translated to English by the author for the final analysis. Every stakeholder was targeted on LinkedIn since it is a widely used social network oriented toward business.

For "Company B" (Transport Company), Company C (Shrimp exporters), and Company D (Shrimp importers), the approach to the participants was via email, aiming to schedule a virtual meeting potentially, but due to the difficulty of contacting the participants, their location, since Company D is from the US. With their tight agendas, the survey was the primary tool to gather the necessary information. The survey's questions, primarily multiple-choice, rating scales, and a few open-ended questions that let the author quickly assess and report the results were applied in Webropol and designed so that both the participants and the author could easily read and understand them.

4 Data and Results

Information collected at the beginning of the study will be used in this chapter to support and clarify the findings from stakeholder surveys and interviews. We aim to interpret notable findings and seamlessly incorporate them into our analysis. It is imperative to emphasize that, to uphold the privacy and confidentiality of the businesses involved and respect the interviewees' interests, specific names and additional information they provided will not be disclosed. The findings are intended to address the four investigative questions formulated by the author for this study. Consequently, each research question will be discussed in detail subsequently. The author conducted interviews with respondents and surveys created in Webropol, focusing on providing open-ended questions that addressed each of the investigation's issues after conducting a comprehensive analysis.

IQ1: What is Mexico's role in the US shrimp import market?

For this IQ, "Company C" From the Shrimp Exporters company was asked, **"What do you think is Mexico's role in the shrimp import market of the United States?"** Most of the participants' answers support what the author mentioned in Chapter 2.2, where Mexico's role in the shrimp import market of the US is explained. Company C mentioned that there has been significant growth in Mexican shrimp farming in recent years, indicating a notable shift in domestic and international production and demand. Mexico plays a substantial role in addressing shrimp consumption needs, thanks to the proximity and quality of its products and its commitment to required certifications. Participants highlighted a verification visit by officials from the United States government, with Jared Milton from the Department of State and Aaron Blake from the National Oceanic and Atmospheric Administration (NOAA) forming part of the inspection team. They visited the ports of Topolobampo and Mazatlán in Sinaloa from November 7th to November 17th, 2022; during this time, Mexico obtained a global grade of 94, which contributed to the country maintaining its Mexican shrimp certification for the upcoming years. The second open-ended question from this survey is **"How significant is Mexico's role in supplying shrimp to the U.S. market compared to other countries?"** many participants answered that Mexico plays a highly significant role in supplying shrimp to the U.S. market compared to other countries. According to Westmeyer's best estimate based on Mexican and U.S. government statistics, the United States annually imports around 25 to 30 million pounds of wild-caught Mexican shrimp.

Mexico's advantageous location allows for the adequate transportation of shrimp products to the US. One of the participants highlighted Mexico's role as a leading figure in international aquaculture, mentioning it as a significant advantage for shrimp exports to The US. Estimates for 2021 reveal that the country's aquaculture production soared to 247,000 tonnes, representing a

significant rise compared to levels seen in 2000. Shrimp and tilapia are the most critical species produced in Mexico's aquaculture industry. In 2023, aquaculture production in Mexico reached 250 tons, with a total value of 22,400 million pesos. In 2022, the shrimp industry in Mexico grew from 8 to 10 percent. Mexico's shrimp farming industry has demonstrated an increasing tendency over the last four years, increasing from 160,000 to 180,000 tons. Despite the pandemic, the shrimp industry has experienced growth. A two-point increase in production is expected in the coming years.

For a better understanding of this first investigative question, "Company D" was also interviewed where the first question asked, " **What are the main reasons for choosing to import shrimp from Mexico?**" the participants answered that Mexico is now one of the world's top producers and exporters of shrimp due to the substantial growth of the shrimp sector in recent years. This growth, coupled with Mexico's commitment to quality and certification standards, further solidifies its position as a key player in meeting the shrimp consumption needs of the U.S. market. One of the participants highlighted a significant aspect, underscoring the immense significance of the United States as one of the largest importers of perishable goods globally. Particularly noteworthy is that shrimp ranks as the second most consumed product per capita in the United States. Given Mexico's pivotal position as one of the foremost global producers and exporters of shrimp, it assumes a crucial role in the shrimp import market to the United States. This underscores the intricate interdependence between the two countries in the shrimp trade, with Mexico serving as a primary supplier to meet the robust demand for shrimp in the US market.

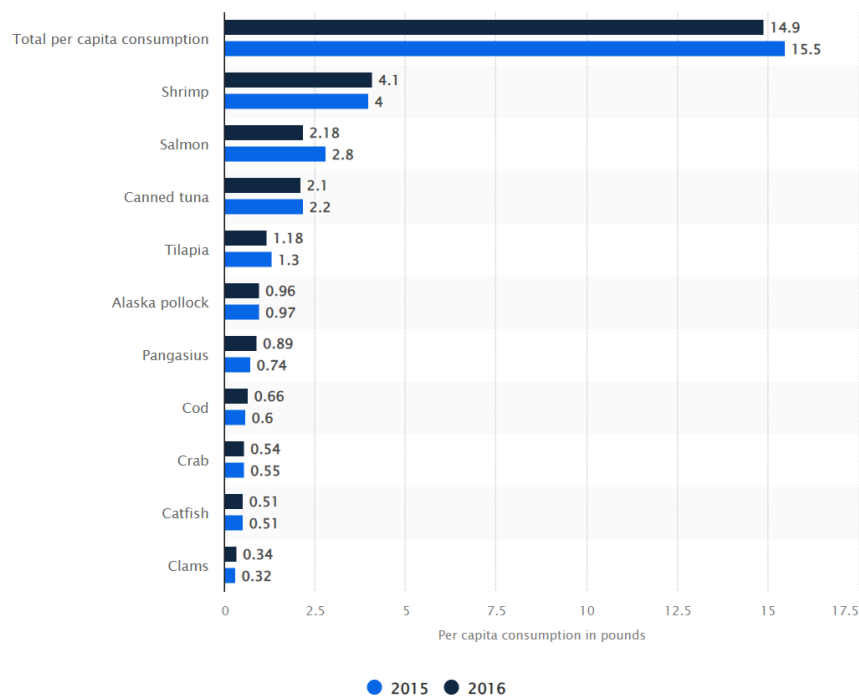


Figure 10: Seafood consumption per capita in the United States in 2015 and 2016 by type of seafood in pounds (Statista, 2024)

As shrimp importers mentioned the importance of the certification standards in their country, question number 3 for the shrimp exporters asks, “**Are there specific regulations or standards that must be complied with when exporting shrimp to the United States?**” the answers show a lot of what was already discussed, Participants noted that it has not been easy for Mexico. In 2021, the United States government suspended the certification of Mexican shrimp due to a failure to meet necessary measures. However, in the latest annual verification in 2023, Mexico achieved a 95 percent technical compliance rate in comparison to U.S. producers regarding the proper use of Marine Turtle Excluder Devices (TEDs), as reported by the National Commission of Aquaculture and Fisheries (CONAPESCA). “We are pleased the Mexican government has taken appropriate steps to assure the U.S. State Department that they have an adequate turtle-protection program in place,” NFI Vice President of Communications Gavin Gibbons said in an email.

Participants highlighted the importance of the FDA (Food and Drug Administration), which the author explained in Chapter 2.2.1. The FDA protects public health by ensuring the safety, efficacy, and security of human and veterinary drugs, biological products, medical devices, our nation's food supply, cosmetics, and products emitting radiation. Moreover, all importers must submit a DS-2031 form to the CBP (Customs and Borders Protection) office for all shrimp imports or shrimp products, regardless of the certification status of the harvesting country.

Based on the participants' responses, obtaining these certifications requires commitment, dedication, and consistency from all parties involved in the shrimp exportation. This includes the Mexican government and the entire shrimp fishing sector of the country. They are committed to the care and protection of marine turtles by conducting their activities sustainably and responsibly. Víctor Manuel Villalobos Arámbula, Mexican Secretary of Agriculture and Rural Development, said that Mexico is committed to the sustainable production of Mexican shrimp through effective and comparable measures that ensure the conservation and protection of sea turtles.

“This certification demonstrates that there is openness, respect, and a strong commitment between the governments of Mexico and the United States to strengthen dialogue and relations in international fisheries matters” (Villalobos, V 2021)

4.1 IQ2: Which specifications does the transportation need to cover?

Through the surveys applied to the stakeholders from the transportation companies " Company B" and the shrimp exporters, "Company C" " the primary conclusions drawn from the study, specifically for this product, which is shrimp, shows that the transportation method needs to fulfill a list of specifications to get the product to its final destination with the required quality. One of the primary and most important specifications is the temperature since the shrimp must be shipped and stored at -18 °C (0°F) or below to keep shrimp quality intact for the final customer. We must consider that if the appropriate temperature is lost, the product ceases to remain stable and begins to decompose.

The interviewees mentioned that the main reason shrimp packaging is damaged or cannot be resisted in the export process is the inappropriate temperature during transportation. This is why the first question applied to the transport companies was, " **What role do temperature variations during transportation play in affecting the shelf life and overall quality of shrimp packaging in the export process?**" As expected, most of the participants found it crucial; one of the most precise and concise answers was, " It plays an essential role, as being a product that is frozen, if it experiences temperature variation, it could thaw, and once it turns into water, completely break the packaging and the loss of the final product."

The author aimed to research the best practices to maintain optimal conditions (e.g., humidity, temperature, handling) throughout the transportation process to ensure the quality of shrimp packaging, which is the second open-ended question from the survey applied to Company B (transport company) applied in Webropol. Some participants responded that the stacking needs to be appropriate, avoiding excess dimensions on the pallet. The answers to this question are backed up by information from Chapter 2.5, where the author mentions some of the shrimp transportation specifications. They all confirmed that in the export process of shrimp from Mexico to the USA, it is fundamental to follow the conservation time, insulation, and temperature factors in an adequate transportation method or vehicle, which is why question number 3 asks, "**Which car do you consider is the best one for exporting Shrimp from Mexico to the US?**" The four different transportation methods were provided as options, but as expected, the reefer vehicle was the most popular choice, with an 83.0 % response rate. Following closely behind was the refrigerated option, which garnered a 17.0 % response rate, as it is similar to the reefer vehicle. The remaining two possibilities received no response, each with a 0.0 % response rate.

The answers show much of what was already discussed. The best option for exporting shrimp is reefer transportation, as it is equipped with a built-in cooling system designed to keep all transported goods at the ideal temperature throughout the delivery process. The goods are

connected via an electrical socket that preserves the required temperature to ensure they remain in optimal condition throughout the journey.

¿Qué tipo de transporte consideran el mejor para exportar camarón de México a Estados Unidos?
Vastaajien määrä: 18

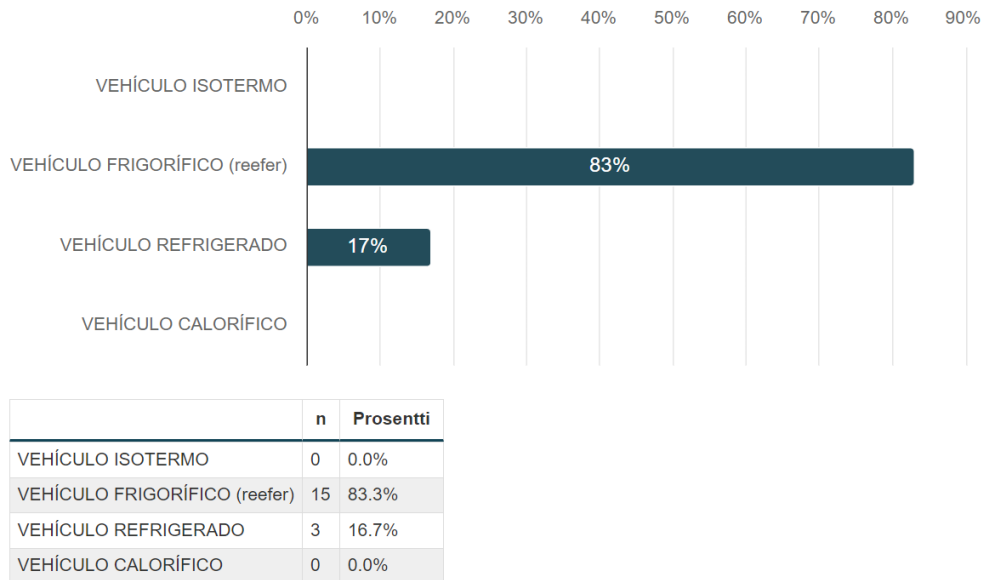


Figure 11: Question number 3, Transport company survey (Author 2024)

Information obtained from some of the participants' answers was that the most crucial aspect when transporting perishable goods is to strictly adhere to the cold chain, ensuring that the properties of your products remain intact at all times. The cold chain comprises various steps that constitute the freezing process necessary to ensure food consumption by the final consumer. It is defined as a chain consisting of different steps or phases. Therefore, a cold chain remains intact if, throughout all stages of production, transportation, storage, and final sale, it provides consumers with optimal temperature control, reducing the capacity for most microorganisms to proliferate.

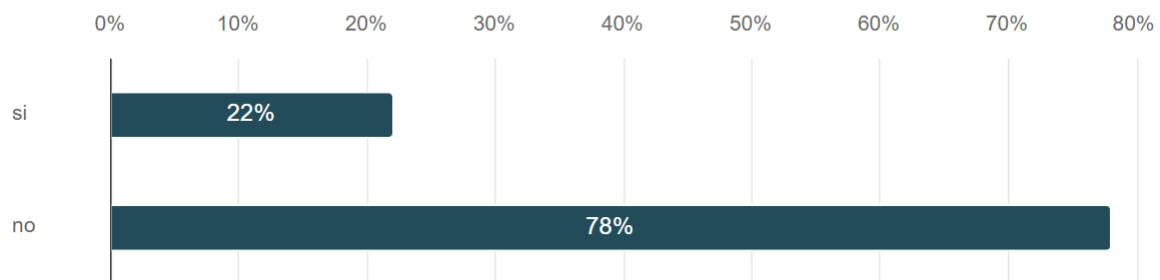
In conclusion, reefer transport is the best option for exporting shrimp from Mexico to the United States because it maintains the necessary temperature conditions, provides a controlled environment, and facilitates efficient delivery. By choosing refrigerated transport, seafood exporters can ensure that their shrimp products arrive at their destination in optimal condition and packaging, meeting consumers' expectations and enhancing their competitiveness in the international seafood market.

4.2 IQ3: How does timing in transportation affect packaging?

Considering that perishable logistics deals with the transportation of items that degrade in quality due to time passage and environmental conditions, the research's main findings indicate that any delay in the timing of the transportation would not be a significant factor in affecting the cardboard packaging of frozen shrimp exported from Mexico to the United States if the packaging meets all necessary specifications and if it is well produced since the beginning. One of the questions asked of the participants was, "If the packaging meets all requirements, but the transportation experiences any delay in reaching its destination, will it still be affected?" As mentioned, 14 of the 18 respondents said it would not be affected.

¿Si el empaque cumple con todos los requisitos necesarios, pero el transporte sufre algún retraso en llegar a su destino, éste de igual forma se verá afectado?

Vastaajien määrä: 18



	n	Prosentti
si	4	22.2%
no	14	77.8%

Figure 12: Question number 4, transport company (Author 2024)

For this investigative question, "Company A" from the corrugated packaging industry was also interviewed, where the participants were asked, "Do you think transportation directly affects shrimp packaging when exported from Mexico to the United States?" almost every participant voted "yes." Considering that all of these companies in the corrugated industry have worked with transportation companies, it is expected that all of them have different perspectives; comparing their answers between both companies, it was analyzed that, indeed, transportation plays a crucial role in the export of shrimp from Mexico to the United States, significantly impacting its quality and

condition upon arrival, however, due to external factors unrelated to the delay time that transportation may experience, participants from "Company A" mentioned that choosing the correct transportation method or vehicle is strategically very important because refrigerated transport is required, as well as short routes, and guarantees of not losing cold during transit. This is why participants were asked to explain their answers to question number 1 in an open-ended question, where the participants' answers were pretty similar.

¿Crees que el transporte afecta directamente el empaque del camarón al ser exportado de México a Estados Unidos?

Vastaajien määrä: 18

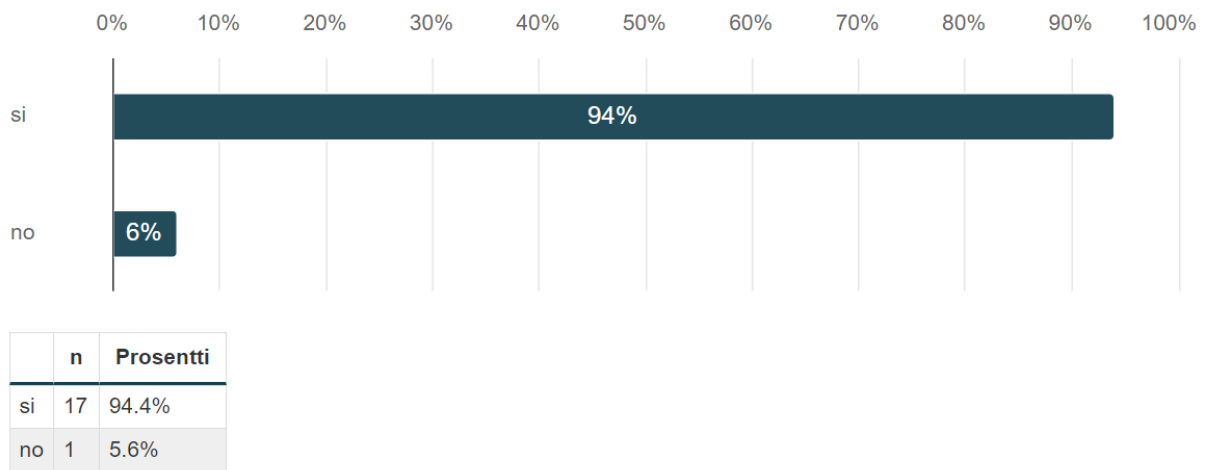


Figure 13: Question number 1, Corrugated packaging survey (Author, 2024)

17 of the 18 respondents answered that transportation directly affects shrimp packaging when exporting it from Mexico to The USA; however, most of the respondents emphasized that there is a crucial factor beyond timing, packaging material, or production methods, it is the proper placement and distribution of goods in a cargo transportation unit, commonly referred to as stowage in the corrugated industry. Proper stowage ensures the safe and secure transportation of goods, minimizing the risk of damage during transit. This is especially important when handling delicate products like shrimp, as any negligence or incorrect cardboard box stacking can damage the products' integrity and quality when they get to their destination. Therefore, meticulous attention to stowage practices is essential to maintain the product's quality and reputation in international markets.

One of the participants mentioned, "There would be no problem as long as the transportation method is the appropriate one; excess weight on the pallet, inadequate stowage, packing more weight than the box specifies, and improper handling will all lead to problems." (Felipe, R 2024). According to the information gathered by the author, there are fundamental rules that warehouse keepers need to follow for proper stacking; the first one is to know that they can not exceed the pallet area, as the participants mentioned. When boxes extend beyond the pallet, it damages that part of the box, leading to a loss of the natural strength of the cardboard box.

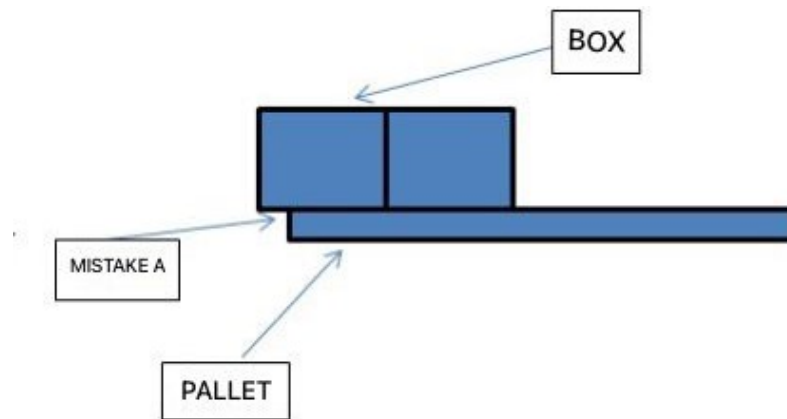


Figure 14: Mistake A while stowage (Cajas et al., 2021)

Cardboard boxes derive their greatest structural strength from their corners. In other words, the most efficient stacking method involves placing one box atop another, leveraging the natural base area to enhance stability and strength. This strategic stacking approach optimizes the structural integrity of the boxes, ensuring they can withstand the rigors of transportation and handling. Furthermore, it is imperative to maintain an appropriate height during stacking for safety reasons and consider the following factors: Product, Packaging Quality, Type of Shipment, and Company Facilities. A proper stacking height can be established by carefully balancing these factors, reducing the possibility of accidents or damage during handling and transportation.

Ensuring that boxes are stacked safely and securely protects the contents during transportation and enhances overall efficiency and productivity within the supply chain. Therefore, companies can uphold safety standards while optimizing the utilization of packaging materials and resources by adhering to proper stacking practices and considering critical factors in the process.

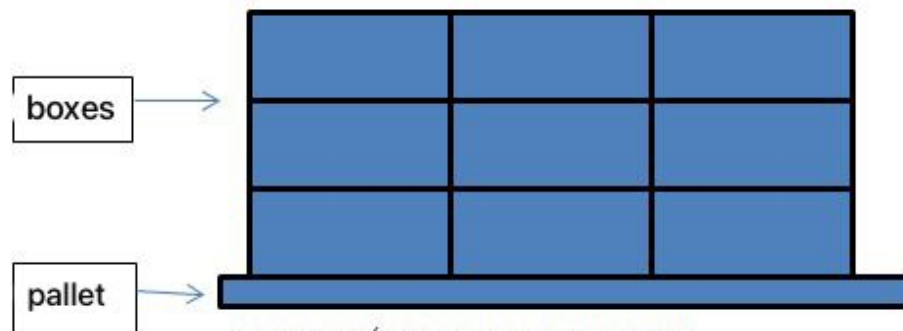


Figure 15: Correct way to stow (Cajas de Cartón El Cedro, 2021)

4.3 IQ4: What specific requirements does the shrimp box need?

The influence of consumer preferences and brand allegiance has prompted the packaging sector to reconsider its approach to waste, resource utilization, and material consumption. Paper packaging often aligns with the principles of the circular economy due to its high recyclability and renewable nature. Global companies recognize the value of sustainability in their supply chain. Therefore, cardboard packaging has been implemented in the last few years and plays a crucial role across various industries. Its versatility, affordability, and eco-friendly nature make it a popular choice for packaging and transporting goods, as it provides protection, organization, and efficiency from manufacturing to delivery; it is an essential component in the supply chain.

As previously noted by the author, shrimp is a specialized product requiring careful transportation considerations. Therefore, the packaging must meet specific requirements to ensure the shrimp maintains its quality for the end customer; that is why question number 3 from "Company A" was **"What would you say are the main specifications that a shrimp box needs to withstand an export process, such as resistance, flute, coating, etc.?"** in which a lot of the participants answered that the American paper is the best one highlighting that paper packaging consumption in North America is expected to grow at the rate of 3.8 % CAGR through the forecast period 2021-2026. The corrugated cardboard used for these boxes should be of the C flute type; it needs a strength rating of 55 ECT and Michelman coating.

This is followed by question number 4: **"Are there specific size or weight restrictions for shrimp packaging destined for the US market?"** Based on the participants' answers, it was concluded that packaging measurements will depend on the customer and the amount of shrimp they are exporting per box to export to the US. However, a standard box commonly used and

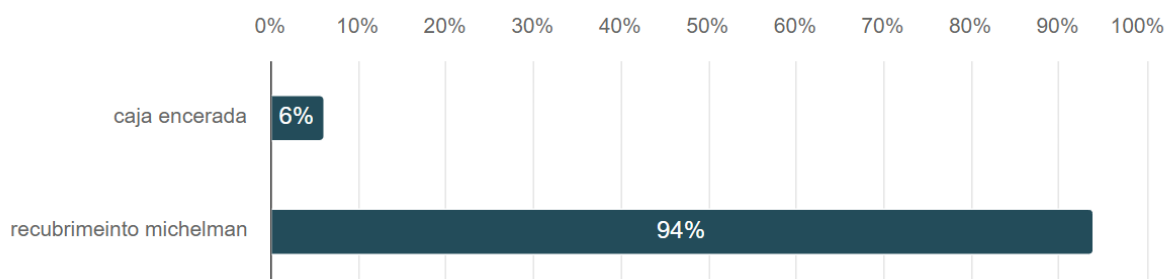
recommended in the market has internal dimensions of 440mm in length, 290mm in width, and 275mm in height. This measurement can accommodate up to 20 kilograms of shrimp.

One of the participants provided fascinating data, saying that depending on the product, in this case, shrimp, corrugated packaging producers will decide which coating will be used for resisting the temperatures needed to get the product with the expected quality to its destination and, depending on the needs of the customer. As the product being exported is frozen shrimp, it can thaw quickly if it is not in the right environment; that is why the coating is one of the most important things, which is why in question number 4, the participants were asked: **”What coating is mainly used in shrimp packaging when exporting from Mexico to the USA to withstand the transport temperature (-18°C)?”** As expected, 94.4 % of the participants answered that Michelman coating is the best option for this kind of packaging, as it protects them.

Participants mentioned that Michelman coating would maintain the product in the necessary conditions for its transportation and delivery to the final consumer in the best possible quality; the coating improves the performance and durability of the packaging, preventing early wear of the box, preserving its load-bearing capabilities, and averting damage like moisture, flammability, or contamination from spilled impure liquid solutions.

¿Que recubrimiento es mayormente utilizado en el empaque de camarón al exportarlo de México a USA, para soportar la temperatura del transporte (-18°C)

Vastaajien määrä: 18



	n	Prosentti
caja encerada	1	5.6%
recubrimiento michelman	17	94.4%

Figure 16: Question number 4, Corrugated packaging industry survey (Author, 2024)

Michelman's coating eliminates the need for intricate, expensive, and environmentally unfriendly multilayer combinations. Its application enables the production of recyclable, repulpable, and compostable containers. Moreover, it offers optimal resistance to oil and grease in pulp molding

and various applications within the fiber-based food industry. It holds FDA approval for direct food contact in paper fiber-based food packaging.

The fact that shrimp arrives in optimal consumption conditions from Mexico to the United States depends not only on transportation and exporters but also on packaging. As mentioned earlier by the author, packaging influences the entire process, so question number 5 asks, " **How do different packaging materials and techniques influence the preservation of shrimp quality during transportation from Mexico to the United States?**" The answers vary, but some were that various packaging materials and methods are essential for maintaining shrimp quality during transportation from Mexico to the United States. To ensure the shrimp arrive fresh, it is necessary to use the appropriate containers and packaging materials mentioned before to maintain the correct temperature and prevent spoilage. Also, robust packaging and effective sealing techniques help protect the shrimp from contamination and physical damage during transit. Overall, preserving shrimp quality during transportation relies on selecting the right combination of materials and processes.

The last open-ended question for "Company A" was, "**What measures do you take to ensure the durability and integrity of shrimp packaging during transit?**" The responses were very similar to the answers from the survey conducted with "Company B" from the transportation company, where both companies mentioned that proper stowage is fundamental to ensure the quality of shrimp packaging and the shrimp itself. Correct storage of shrimp boxes is essential to maintaining product quality during export from Mexico to the USA. When containers are correctly stacked and secured in transportation, the risk of physical damage or contamination that could affect the freshness and integrity of the shrimp is minimized. Furthermore, appropriate stowage prevents the boxes from moving around too much while in transit, which may damage the product's packing. Therefore, attention to stowage during transportation is critical to ensure that the shrimp arrives in optimal condition at its destination in the USA.

5 Conclusions

In this chapter, the author will conclude the analysis from the distinct surveys and interviews applied to the selected participants, who were meticulously chosen based on their roles and affiliations with companies. The author will outline the significant discoveries from the research conducted throughout the investigation. Throughout this chapter, the author will address the RQ set at the beginning of this thesis, and it will be answered based on the author's research, results, and analysis. Afterward, the author will present what was learned and reflect on the research process.

The study's research question was, " **How do transportation and timing affect shrimp packaging when exporting it from Mexico to the USA?**" Through the analysis and questions applied to the participants, the author concludes that many factors in the exportation logistics of shrimp from Mexico to the USA can affect shrimp packaging. Among them, the transportation method has more impact, as it needs to fulfill particular requirements as the product being exported is delicate, the temperature's first and most important factor, followed by humidity settings.

As mentioned before, shrimp must be shipped and stored at -18°C (0°F) or below to keep their quality intact and, consequently, the packaging, as shrimp may thaw and ultimately damage it. That is why packaging must meet the necessary characteristics to withstand such temperature levels and the weight of the exported product. If the packaging is well produced since the beginning with the correct flute type, which is C flute, 55 Ect, Michelman coating, and the correct measures to support the appropriate weight, as well as the suitable accommodation or stowage in the transportation method, any delay in transportation will not have a significant impact as these boxes are produced with the required material and techniques to withstand long distances, frozen products such as shrimp and low temperatures.

A reefer truck is a closed van transporting frozen or fresh goods. It is the optimal choice because temperature conditions are controlled based on the product, allowing worldwide shipping. Hence, the United States became the perfect market due to the geographical proximity between Mexico and them, given the complexities in the transportation process. Notably, the integrity of the packaging can be compromised due to various factors encountered during transit and before, as it is a whole logistic process. It is important to emphasize that the transportation and timing directly affect shrimp packaging. However, many other factors can damage the packaging and the product when exported from Mexico to the United States.

One critical aspect is maintaining the cold chain from its origin to its final destination, especially for perishable products like shrimp, where any breakage could lead to spoilage or degradation of

quality. Moreover, the proper stowage of the boxes within the transportation is equally vital. Incorrect stowage could result in shifting or crushing the packaging, potentially causing damage to the shrimp. Therefore, ensuring that the cold chain remains unbroken and that the stowage of packages is appropriate throughout the journey is imperative for preserving the quality and integrity of the shrimp packaging during transportation from Mexico to the United States.

5.1 Learning and Reflections

This thesis represents a significant achievement for the author, marking a closure on a stage with much new knowledge on an exciting topic. The author has undoubtedly learned a lot about shrimp packaging and its importance in the supply chain, from its essential function, which is to prevent product damage, to the types of packaging available and the most sustainable and commonly used in the shrimp export process. This topic interests me as the author used to work for a cardboard packaging company. She feels passionate about how a simple box can vary depending on the product being packaged and everything about it, including its dimensions, form, materials, design choices, and even the technique when being produced. That is why shrimp packaging was chosen for this writing paper, as it is one of the most specialized in the market, needing particular characteristics to keep the product fresh and of high quality while it is being transported.

It was great to investigate how the transportation method affects the packaging and the final product, the importance of choosing the proper transportation, its impact on the whole supply chain, and how many types of vehicles exist for exporting shrimp or perishable goods. Discovering that many factors can also affect the packaging besides transportation and timing delays will be very useful for both the author and the readers since it is a whole process where people who come into contact with the boxes, from storage and transportation to the final delivery of the product to the customer need to be trained and well informed. Therefore, comprehensive training and information dissemination are essential to ensure all stakeholders have the knowledge and skills to handle the packaging effectively. By delving into these additional factors, the research aims to provide a comprehensive understanding of the challenges and considerations involved in the packaging process, thereby empowering stakeholders to make informed decisions and optimize their packaging practices.

One of the challenges the author faced was interviewing and contacting all the participants. Establishing the first contact was hard for her, but once they agreed to be interviewed, it became one of her favorite steps in this thesis. Being in contact with people with the needed knowledge was exciting, as many questions were answered and clarified for the author, which made the subsequent analysis process much more enjoyable and easy to develop.

Appreciations

I express my sincere gratitude to María De Los Ángeles De La Vega Villa, whose unwavering support and guidance have been instrumental throughout my academic journey, particularly during the challenging process of writing this thesis. Her mentorship, encouragement, and insightful feedback have significantly impacted how I perceive and approach the subject matter, and I sincerely appreciate how committed she is to helping me succeed academically. Working under her direction has been an enjoyable and transforming experience, and I am incredibly grateful for the priceless information and knowledge she has provided me.

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I am deeply grateful to all the individuals who generously participated in the questionnaires and interviews for my research. Despite their demanding schedules, each participant enthusiastically approached the process and was willing to contribute valuable insights. Their cooperation and openness greatly enriched the data collection process and provided valuable perspectives for analyzing each investigative question. Their openness to share their knowledge and experiences helped shape the research's conclusion, and I appreciate all they have contributed.

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Appendices

Appendix 1. Surveys questions.

SHRIMP PACKAGING PRODUCERS

1. Do you think transportation directly affects shrimp packaging when exported from Mexico to the United States?

2. What would you say are the main specifications that a shrimp box needs to withstand an export process, such as resistance, flute, coating, etc.?

3. What coating is mostly used in shrimp packaging when exporting from Mexico to the USA to withstand the transport temperature (-18°C)?

4. How do different packaging materials and techniques influence the preservation of shrimp quality during transportation from Mexico to the United States?

5. Are there specific size or weight restrictions for shrimp packaging destined for the US market?

6. What measures do you take to ensure the durability and integrity of shrimp packaging during transit?

7. Which are the risks you consider more important shrimp packaging can suffer during transportation from Mexico to the US?

8. Are there any industry-specific certifications or standards that your shrimp packaging must meet for exportation to the US?

9. Are there any sustainability initiatives or environmentally friendly practices integrated into your shrimp packaging production process?

TRANSPORT COMPANY

1. What role do temperature variations during transportation play in affecting the shelf life and overall quality of shrimp packaging in the export process?

2. What are the best practices for maintaining optimal conditions (such as humidity, temperature, handling) throughout the transportation process to ensure the quality of shrimp packaging?

3. Which vehicle do you consider is the best one for exporting Shrimp from Mexico to the US?

4. If the packaging meets all requirements, but the transportation experiences any delay in reaching its destination, will it still be affected?

MEXICAN SHRIMP EXPORTERS

1. What do you think is Mexico's role in the shrimp import market of the United States?

2. How significant is Mexico's role in supplying shrimp to the U.S. market compared to other countries?

3. Are there specific regulations or standards that must be complied with when exporting shrimp to the United States?

4. Which is the US value of shrimp imports from Mexico in a year?

5. How do customs and regulatory procedures at the US border impact the timing and condition of shrimp packaging upon arrival, and how can these processes be optimized?

6. According to the unit of measurement they use, what is the approximate amount of shrimp exported from your company annually from Mexico to the United States?

7. How much has shrimp exports to the United States grown or reduced from 2020 to 2024?

SHRIMP IMPORTERS FROM THE US

1. What are the main reasons for choosing to import shrimp from Mexico?

2. What measures does your company take to ensure the quality and safety of imported shrimp from Mexico?

3. What percentage of imported shrimp comes from Mexico compared to other countries?

4. Has there been any noticeable change in the percentage of shrimp imports from Mexico compared to other countries recently?

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