Course Name: Canning Technology and Value Addition in Seafood
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Canning Technology and Value Addition- Canning process - Part 1

Hello everyone, welcome to the fourth session of Seafood Canning Technology. In the previous sessions for understanding this particular subject, we have divided it into three components: the concept, the container, and the process. We have described it as a CCP. So, in the previous sessions, we have discussed the basic concept of this technology, and in the last session, we discussed the container. In this session, we will be dealing with the process.

The canning technology is divided into different processes. It is a highly standardized process. So, it has been classified into different technologies, and by following the step-by-step procedures, then only we can achieve a final well-defined product at the end of the process. Each procedure will have standard operating procedures, which has to be carefully followed so that any defect in any one of these procedures can result in a faulty product or the faulty process, which is going to create problems for the consumer as well as the manufacturer.

If you consider step-by-step processes, the first process is always as any proper seafood or food processing technologies in general. It will be the collection, handling, and preparation of the raw material. Then particularly in canning, the enclosing of the raw material in the container is one of the important processes. The preparation of the container is a very important process. There is a crucial container closing process, like different sealing processes are there. Then obviously the thermal processing process, the post-preservation process and labeling, storage, etc. So, just like any other well-defined food preservation or food processing methodologies, the canning technology also has a well-defined process.

First and foremost, important component for any process to start is the availability of the right variety and right quality of raw materials. In the case of seafood, a variety of

materials are used for processing. In the case of major fishes, like if you see the total canning industry of the world, the major fishes canned are majorly tuna is one of the popular seafood canned products, then sardines, salmon is also highly preferred for canning, then there is mackerel, cod is there, anchovies, herrings, etc. So, these are some of the popular species which are normally used for canning.

According to the variety of the raw material, the preparation procedures are going to vary, that has to be planned accordingly. Then it will be the pre-processing of the raw material, which is usually salting, either salting, blanching, or pre-cooking depending on the type of the raw material. And then the third process will be filling the container; there are standard procedures for filling the container. Then exhausting the container to remove the air, then sealing the container, either it can be hermetical sealing or double sealing or double seaming or thermal sealing or heat sealing, like depending on the type of the container we are going to use. Then it is going to be washing the container, then the thermal processing, the major process which is heating or thermal processing, then cooling and drying and finally labeling and storage.

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There are eight or nine steps in the canning process. Each of these steps must be completed according to standard operating procedures to ensure a safe canned product for the consumer. The first step in canning technology is the selection, handling, and preparation of raw materials. This initial stage is crucial because it is where Critical Control Points (CCPs) can be applied. Considering the quality perspective of any food processing technology, there is a possibility of quality issues, damages, or hazards. These can be rectified by establishing specific CCPs according to the Hazard Analysis and Critical Control Points (HACCP) plan.

The selection, handling, and preparation of raw materials are among the first Critical Control Points (CCPs) that need implementation in any food processing technique, including canning. The initial process in canning involves the selection, handling, and preparation of raw materials. This is crucial because the quality of the canned product depends on the quality of the raw material. There is a saying that a great product cannot be made from substandard raw material. To achieve a high-quality product, the process must start with excellent raw material. The selection process is crucial, influencing the quality of the canned product. Raw material quality stands out as a primary parameter, impacting both processing efficiency and the final product's quality. The connection between raw material quality and the end product's quality is significant. The factors determining raw material quality revolve around the selection of high-quality raw materials, emphasizing its utmost importance. The selection process is crucial. Employ standard procedures to ensure only high-quality raw materials enter the production process; this is vital. Proper handling, transportation, and storage of the highly perishable seafood raw material are essential factors influencing its quality. Following standard procedures, transporting the raw material to the processing unit, and ensuring proper preservation further impact raw material quality. These three factors—selection of high-quality raw material, proper handling, transportation, and storage, along with adequate preservation—affect the overall quality of the raw material.

The quality of the raw material significantly influences the product quality, especially when dealing with fresh seafood. Fresh seafood, known for its richness in nutritional components, carries a high bacterial load due to the harvesting environment's bacterial concentration. Ensuring high raw material quality is crucial as the bacterial load, though inevitable to some extent, can be minimized. The intensity of this bacterial load directly impacts the process conditions during canning. In the case of canning technology, the initial bacterial load plays a vital role. The use of various preservation techniques is also integral to maintaining raw material quality. Upon receiving the raw material at the production unit, preservation methods such as salting, chilling, and cold storage are applied.

Various techniques are employed to preserve raw materials. The maintenance of a cold chain is crucial for raw material preservation, particularly in the context of efficient canning premises or units. Cold chain maintenance holds significant importance, especially when dealing with fresh raw materials used in canning. The entire process, from the initial point to the final stage, requires careful handling through a properly maintained cold chain facility. Maintaining a specific time and temperature combination is essential. Ensuring a steady market of quality raw materials at reasonable prices is also vital for the successful operation of a canning unit. Therefore, maintaining reasonably priced raw materials of good quality is crucial for the overall efficiency of the unit.

In handling the raw material, after properly receiving and procuring high-quality raw material, the subsequent stages involve careful handling and preservation. Grading becomes a crucial step, emphasizing the significance of size grading in canning. Uniformity in the size of the fish or seafood intended for container filling is essential. This uniformity ensures consistent process conditions, pricing, and consumer acceptance. Maintaining uniform size and appearance is particularly crucial when consumers open a container. Size grading plays a pivotal role in achieving this consistency. It not only affects the choice of container size but also influences the container's shape and the filling process. Automation is commonly employed for the filling process, ensuring efficiency and precision in the overall canning procedure.

Filling machineries to function properly, the size of the raw material should be of uniform. So, size grading is of very important. The most common kind of size grader that we use is of that roller type graders, especially the sizing, the smaller fishes like sardine, mackerel, cod, etc. The roller type of size grades is most commonly used. After grading the fishes, the proper washing of the fish is very important, one of the parts of serving and cleaning processes.

According to the packaging styles, it has to be properly cleaned. The cleaning processes is one of the important steps because it actually plays an important role in reducing the bacterial load. And other debris and other quality hazards can be significantly reduced by properly washing the raw material. So, different kinds of perforated drum washing

machines are used for washing the raw material. After washing the raw material, next step is going to be cutting or dressing the fish.

Preparing the fish involves ‘cutting’ the process to match the container size or the chosen style of packaging. The cutting and cleaning procedures depend on the fish variety, introducing variability. In the case of large fishes like tuna, bleeding is a crucial step to prevent blood clots within the meat. Additionally, the removal of dark meat is essential when canning tuna. This is imperative to maintain the desired appearance of the meat, as the presence of blood clots can result in dark patches, which are not favored by consumers. Hence, proper bleeding of tuna is of utmost importance in the canning process.

In the case of small fishes like sardines, etc., nobbing is a vital process. Nobbing involves the simultaneous removal of the head and gut in a single operation. Specially designed nobbing machines are employed for this purpose, efficiently removing the head, gut, etc., of fishes like sardines and mackerel in a single operation. Nobbing is a crucial step in processing smaller fishes.

For shrimps, peeling is practiced, as they are typically canned without shells. The shell removal process for shrimps is referred to as peeling. This process can be carried out manually or with the use of machines. In the case of clams, mussels, etc., shucking is performed, which involves the removal of the shell and the extraction of the clam meat from it. These dressing or cutting processes are adapted based on the specific characteristics of the raw material.

According to container size, raw material type, container size and shape, etc., the success of this operation depends. For cleaning and cutting fish, the subsequent steps involve salting, blanching, or pre-cooking. These are essential pre-processing steps in canning.

Certain fish, such as salmon, are packed raw, eliminating the need for this type of pre-processing. However, freshwater varieties like cutler and carp require flash frying before packing. Frying is also employed as a pre-processing step at times. The firmness of flesh

in freshwater fish is lower compared to saltwater counterparts. Consequently, when canning freshwater fish, flash frying the pieces is generally practiced. This process is particularly employed for large fish like tuna, where a pre-cooking procedure is performed. Pre-cooking offers several advantages, including moisture removal, reduction of bacteria load, enhanced color, and improved texture. These are some of the advantages.

Especially in the case of large fishes like tuna, pre-cooking facilitates the removal of dark meat. Pre-cooking is a key procedure. However, in the case of sardines, blanching is generally involved, which can be done in two ways: cold blanching and hot blanching. Usually, the process involves packing, pre-cooking after packing, decanting, and then decanting again after blanching. Fresh brine can be filled in after the decanting process. Cold blanching is performed in 6% brine without any heating. Hot blanching also uses 6% brine, with a boiling time of 5 to 10 minutes in the case of steam blanching. Hot blanching can be done either by boiling or steaming, with the addition of 6% brine. Cold blanching involves adding 6% brine and treating for 15-20 minutes without boiling. These are the available types of blanching methods.

In the case of pre-cooking tuna, it is generally done at a temperature around 15 degrees Celsius for 15-20 minutes, either under steam or without steam. Typically, it is done under steam at a temperature of around 100 to 115 degrees Celsius in open retorts without applying pressure. The same retorts used for canning or dedicated pre-cooking retorts can be employed for pre-cooking larger dishes, using a temperature of 100 to 115 degrees Celsius for 15-20 minutes without applying pressure.

The advantages of blanching or pre-cooking include a decrease in the initial bacterial load, which affects process lethality. It also improves texture, facilitating easy handling and filling of raw materials. Enzyme action is inactivated, preventing enzymatic spoilage or hydrolysis. Blanching or pre-cooking imparts a preferable color to the product and expels gases from the tissue, resulting in a better vacuum in the product. Additionally, it imparts a characteristic flavor and preheats the food before thermal processing, serving as a preheating step before the thermal processing begins.

When the raw material reaches the thermal processing stage, it is already heated, facilitating the thermal processing process. This heating ensures that the product can reach the reference temperature more rapidly compared to starting with a cold product. These are the primary advantages of blanching or pre-cooking processes. Additionally, this cooking process releases around 15 to 30 percent of water, removing excess moisture.

If blanching or pre-cooking is omitted, during the actual thermal processing stage, water may be released into the container. This can lead to issues such as the creation of a water-oil emulsion in oil packs or dilution of the sauce if the packing material is tomato sauce. Furthermore, released moisture can dilute the tomato sauce. Proper blanching or pre-cooking helps alleviate these potential issues.

However, there are also some disadvantages, such as the leaching of salt-soluble and heat-sensitive nutrients when heat is applied. Product quality can be affected by under-blanching or over-blanching, so the blanching or pre-cooking process requires proper standardization. Under-blanching, under pre-cooking, over-blanching, or over-pre-cooking can compromise the quality of the end product and must be avoided.

After the pre-processing activities, the third stage involves filling the container. Proper filling of the container is crucial. Initially, manual filling was employed, but now automated filling machines are used. Pre-weighed raw material can be filled into the container using these automated machines. It is essential that the can neck is free from solid pack or liquid medium after filling, ensuring the neck of the container is devoid of solid particles or liquid medium.

Another crucial factor is maintaining proper headspace. The filling weight should match the gross, net, and drained weight of the container. The quantity filled is vital, ensuring that the weights on the container label (gross, net, or drained weight) align with the actual filling within the container. Planning and standardization are necessary for this.

During the can-filling stage, solid material is referred to as a solid pack, while liquid material is termed a liquid pack. Typically, solid particles, such as fish, shrimp, or mussels, are added first, followed by liquid particles. The purpose of liquid particles is to

fill up space and create a uniform heating rate. The general ratio for filling contents into the container is 80 to 90 percent solid and 20 to 10 percent liquid. Filling can be manual or mechanical, and various weight categories need to be maintained, including gross weight (total weight of the container plus food), net weight (product weight, calculated by subtracting container weight from gross weight), and drained weight (liquid weight subtracted from net weight).

Headspace is a critical factor in container filling for canning. There are two types of headspaces: gross headspace and net headspace. The gross headspace is calculated using the formula: net headspace+countersink+tin plate thickness. Conversely, net headspace is determined by the formula: gross headspace- (countersink+ tin plate thickness). Different gadgets and spatulas are available to accurately measure the headspace of the container.

According to the container type, the headspace varies. For jams and jellies in glass jars, approximately one-fourth of an inch or 0.635 centimeters (6.35 mm) is generally provided. For fruits and tomatoes, half an inch or 1.27 centimeters (12.7 mm) of headspace is provided. In the case of meat, poultry, and low-acid fishes, around one-fourth of an inch or 2.54 centimeters (6.35 mm) of headspace is provided. Seafood generally has a headspace of 6 to 9 mm, and for metal cans, 6 to 9 mm of headspace is preferred.

The purpose of providing headspace is crucial, as it relates to what happens inside the container during the cooking process. As heat is applied, there is an increase in internal pressure due to the expansion of the internal contents and an increase in water vapor pressure and other gases. Without headspace, this internal pressure is balanced by bulging of the container. Proper headspace allows for the normal bulging of the container, counteracting internal pressure and maintaining nominal pressure. Headspaces accommodate the expansion of contents and contain increasing internal pressure. Headspace also influences the efficiency of exhaustion. Adequate headspace is essential for proper exhaustion. Too little headspace can lead to bulging and faulty process parameters, affecting heat conductivity. Conversely, excessive headspace can result in less efficient exhausting and potential damage to the container, such as paneling, due to external pressure