Course Name: Canning Technology and Value Addition in Seafood
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History of canning technology- Part 2

Welcome. In this session, we will be dealing with the history of canning, particularly how this technology evolved over the years. So, in 1884, the Ball Corporation, still they are in the industry. So, the Balls Corporation now starts manufacturing glass jars for home canning. Now also, the most preferred glass containers for home canning are by the Ball Corporation. In 1884, they started manufacturing glass containers for home cooking or home canning processes.

And another intervention was in 1866 by E.M. Lang, who was granted a patent for sealing the cans by casting or dropping bars also. Basically, what he found out that earlier it was by metal, flexing the metal and stamping the metal together. That was a method used for closing the container before that. But what E.M. Lang found out that actually the soldering technique could be used for closing the canning. That also was a significant invention at that particular period of time. But later it was replaced by double seaming process because this soldering resulted in incorporating lead into the food and which resulted in lead poisoning. So, it was not preferred after that particular period of time. But at that particular point, it was a very significant intervention because you could solder the cannons perfectly together.

And also, another intervention in 1866 was by J. Osterhaut. He received a patent for a tin can with its own key opener. So, the concept of easy opening, the convenient opening without utilizing any tools was invented by J. Osterhaut in 1866. He received a patent for his tin can with its own key opener similar to the sardine cans of today. Still this kind of key openers are used in many sardine containers. The consumer could easily rotate the key and easily open that without any tools. Even a can opener was not required. Such cans were introduced. And another significant intervention or invention that happened is during 1870 when William Lyman patented a better can opener. He patented a modified can opener which has a rotating wheel which cuts along the top room of the container.

Such can openers are still in practice because it developed the production of hinged lid tin cans. Now we understand that there is something called countersink depth at the top and end of the tin can container. There is a ridge or hinge surrounding that opening of the container. This particular opener could be run along that hinge and it will cut through the metal easily. It was an improved can opener which could be used for cutting or

opening the metal containers without much effort. That was also a significant intervention. Another intervention that happened was in 1875 by Arthur A. Libby and William J. Wilson who developed the tapered can for corned beef in Chicago. So, the significance of this invention is that the people started thinking about different shaped containers. According to the food that we are using or based on the convenience of packaging or it may be some kind to make an identity to their products. So, a particular shaped, different shaped containers were introduced during 1875. So that particular shape is still in use, the tapered container. So that was a very popular product at that particular period of time. During 1877, a significant invention happened which was the introduction of the concept of side seaming.

Earlier, we discussed that stamping and soldering process were there. But there was an issue with soldering like because lead was used for soldering and there is a chance that led poisoning may happen to the food or lead may react with the food. So that was an issue at that particular period of time. This was solved by the invention of double seaming process. Double seaming process is basically a process through which we systematically bend the ends of the can body and the lead together so that it forms an air tight seal in a particular fashion. So, that was a very significant technology developed. And for that purposes we need specified machines called double seaming machines.

So, in 1877 a simplified side seamer for cans had operated, side seamer was developed in 1877 so that the home metal cans can be even sealed during the home canning processes. And another important intervention happened is during 1880 and 1890 when automatic can make machinery was introduced because that particular period of time whether it may be double seaming or any other process it was mostly hand operated. When it was automated the productivity increase obviously the speed of the sealing of the container increased so that was revolutionized the production of the containers used in canning. That was a very significant invention. And also, in 1894 AMS machine company begins manufacturing locked double seam cans. The AMS machine company basically what they did is that they accelerated the can sealing process. There is an automated a completely can closing line was established by this firm. That further accelerated the process.

Another significant invention happened is during 1898 by George W. Cobb when he introduced that open top sanitary cans. It was also called that hole in the top can. So, initially what happens was, there was no top bottom discrimination in the case of container. It could be opened from any part either from the top or from the bottom. But he invented that a particular side must be used for either introducing the food in the container as well as taking the food outside the container. And also, a small hole was created so that the food could be introduced and taken out from the container. It was called as hole in the top can and further what happened is this hole just expanded and a

complete opening formed to attach the lid at the top of the container. So, this kind of containers which could be opened from the top was named as open top sanitary containers. Open top means it could be open from the top but sanitary means it was more hygienic to open specific area for opening the container easy for cutting the container.

That created more hygienic or sanitary way of filling or removing the containers from the can. Because previously that opening or filling the can was a messy process. So, this sanitized the process of filling and opening the container. So that is a very significant intervention. And also, in 1901 American can company was formed that was a very significant turn of like American can company was a very big can manufacturing group. That actually revolutionized consumption of can products in America. That is a very important turn of event. And also, in 1909 tuna canning begins in California. The production of tuna canning is very significant because tuna is one of the most popular canned seafood that actually opened up a new market for the seafood canning. And this tuna was very well received by the consumers also because of the peculiarities of the meat and also due to the characteristic changes was brought in by the Canning Technology to the tuna meat. Tuna meat was well received by the consumers for canning. It was well accepted and it was resulted in creating a higher demand for canned products.

The most significant invention regarding understanding the concept of canning was put forward by Louis Pasteur who lived between 1822 and 1895. So, what he did was that he tried to explain the process behind the spoilage. Before Louis Pasteur what happened was that even we could understand that after canning also some kind of spoilage was happening. At that particular period of time, it was understood that some kind of spontaneous generation of microbial life or some kind of organisms spontaneously generated inside the container and caused spoilage to the food. That was the understanding before Louis Pasteur. But Louis Pasteur introduced the concept of biogenesis. He explained it that some kind of live organisms either already present in the container or got access into the container after the processing. Multiplied- that is the meaning of biogenesis. That means they multiplied and grow into a larger number and spoiled the food. The scientific process of spoilage was clearly defined by Louis Pasteur. He also developed the pasteurization process. Pasteurization is also a kind of thermal preservation technique or thermal processing technique where we use temperatures below 100 degrees Celsius and then it was cooled down but the issue with pasteurized products that still the pasteurized products need to be stored in chilled temperatures. That was a drawback of pasteurization.

But the pasteurization is used in heat sensitive foods like milk products. Such heat sensitive foods were preferred to be pasteurized than can. That also a very significant intervention. How we could define is that pasteurization is a process in which water and certain packaged and non-packaged food such as milk or juice are treated with mild heat

usually to less than 100 degrees Celsius to eliminate pathogens and extend shelf life. The process is intended to destroy or deactivate organisms and enzymes that contribute to spoilage or risk disease including vegetative bacteria but not bacterial spores. So pasteurization even though it killed the bacteria alive organisms present but it is unsuccessful to kill any bacterial spores. So, for inactivating bacterial spores we need a higher level of temperature that we practice in Canning Technology. So, contribution of Louis Pasteur in the history of canning is that he successfully explained the post-process spoilage. The advantage is that once we clearly defined an issue, we could further research on that and further find a solution for that. So, Louis Pasteur has a special role in addressing the spoilage issues of canned products.

Another important period which is very significant to the development of the canning industry is during the First and Second World War. So, in 1941, First World War begins. During that period, there was a huge demand for packaged food especially for soldiers. In USA, all women were actually home canning the products and that home canned food products were transported to the battlefield. So that was a very patriotic and very important feeling. Canning or canned products were closely associated with the public emotion of the people of especially in the USA. In that particular period of time a lot of promotion was given to the canning processes and also in 1915 there was a significant intervention in the case of home canning like Alexander H. Kerr is granted a patent for his two-piece disposable metal canning lid. So, he introduced a metal canning lid for glass containers. So that further revolutionized the home canning. So, earlier, what the food which was home can could not be transported or store for a longer period of time. It has to be stored in the house itself. But by the intervention of this particular metal lid which could be fitted in the glass container basically it increased the efficiency of the canning process over the glass container so that the products could be stored much longer. So that was a very significant intervention.

Another important point or another important turning point is that the use of pressure-cooking process in the canning. That is very significant because the pressure cooking or the concept of pressure cooking introduced the use of steam for canning. Earlier what happened is that we usually they used water baths for heating the food products. But the importance of utilization of steam as a heating medium was later understood and actually there was some other technologies already in place which could be adopted by the canning industry because high pressure cooker was actually invented by French physicist Denis Papin in 1679. And also, the autoclave was invented by Charles Chamberlain in 1884. So, all these inventions even though not developed for a cooking process the canning industry adopted so that they could be utilized for the cooking of the can products or metal containers. That was very important.

In the 1970s actually the US Department of Agriculture determines that pressure canning is the only safe way to process low acid food. So, the US FDA in 1971, recommends

pressure canning as a safe process for canning. So, they found out that the pressure-cooking process is a safer process than water bath heating. So that was a very important so that a lot of home pressure cookers were developed which could be utilized for home canners. So, a lot of small kinds of pressure kettles were developed which could be safely utilized for home canners. That also increased the efficiency of the canning process. One of the important issues with metal containers used for canning is that especially when we use low acid foods for canning in a metal tin can or something like that there was something a specific spoilage was happening at that particular period of time called iron sulphide blackening. So, iron sulphide blackening happens because most of this low acid food contains Sulphur containing amino acids. So, this Sulphur containing amino acids or the Sulphur in this food especially in the protein rich foods was reacting with the iron because even though a particular layer of lacquer was applied at tin coated steel containers, due to aberration and many other mishandlings, etc. some of this iron layer or tin layer gets exposed and the iron in the tin reacts with sulphide and creates black patches of iron sulphide. That was very deterrent for the consumer and when the consumer opens a container, they used to see this black patch and it was resulted in rejection of many containers, many kinds of consumer litigations and all. It was a common spoilage issue at that particular point of time.

In 1921, a significant intervention by the industry happened when they understood that zinc oxide and other zinc compounds could be used in the enamel coating or the lacquer layer which prevented the iron sulphide blackening. How it prevented means instead of iron, the zinc actually reacted with Sulphur and formed zinc sulphide. Zinc sulphide was basically white in colour. Since it is white in colour, it was not that much visible by the consumer even though the compound is formed it is not visible by the consumer unlike the black iron sulphide. So, the addition of zinc and zinc compounds inside the lacquer of the container will prevent this iron sulphide blackening. That was a very important invention at that particular period of time.

In 1926, also another very iconic product which is called Canned ham was introduced. This is called "SPAM". SPAM is still in the industry, is still in the market. It is a very popular product. It was there, canned ham pieces. In 1926, it was introduced and in 1931, there was a significant introduction of electrical can opener. Earlier, it was the can openers developed was all hand operated and in 1931, electrical can opener was introduced. It contains a serrated edge which cuts along the top rim of the container. So easy and fast removal of the container lid was possible due to the invention of electrical can opener. Another significant turn of events was that during 1931, there was a very important event happened because around 12 people, including children, died after consuming improperly home canned food at a dinner party in North Dakota. This was almost a very shocking news to the industry. It was a blow to the industry even though it was a home canned food accident which significantly affected the consumer perception

about the canned products. Some flaws were there in the process since it is home canning. They may be lesser experienced or something like that. There was significant amount of *Clostridium botulinum* spores which survived the process during that particular home canning and when the people consumed food with Clostridium botulinum spores at a significant higher level they died. Because, botulin is a very neurotoxic chemical that is generated by *Clostridium botulinum*. It is a highly fatal disease. So, it is a very significant turn of events.

That was a very particular point of time in the canning history when around 12 people lost their life due to canning related spoilage. As the time moved, further in 1957, there is a significant invention like Aluminium was introduced in metal can making. Earlier, as we discussed that the metal, we used to be tin coated steel but the introduction of aluminium actually revolutionized the can making process, especially the beverage can make process, because tin can was not much flexible at that particular point of time and it was very difficult to make cans in different shape because of the lack of flexibility of the tin container. But aluminium, even though it was as strong as tin containers, it was also strong at the same time highly flexible and also it required less amount of metal to make compared to tin coated steel containers.

Aluminium as a metal is a highly revolutionary step taken by the canning industry when they introduced and in 1960 also another important invention is, easy open cans were introduced in 1960. In 1962, beverage can pull tab was introduced. The beverage cans pull tabs were like a lever mechanism. If you pull the tab, a small opening was created. Through the opening, you can either drink the beverage directly or you can pour it through that particular opening. In 1962, beverage can pull tabs were introduced and in 1960, easy open can introduced. Without using any kind of can opener mechanism you can easily open that container. And also in 1964, two-piece cans were developed. Before that it was all three-piece cans. We had a can body; we had a container lid and we have a can bottom. So, basically three pieces needs to be joined together to form a container. But in 1964, two-piece cans were developed. So, basically it is a drawing process. Using a particular die, metal was drawn into a particular body shape and only lid needs to be placed over it, that is why it is called a two piece can. In 1964, two-piece cans were developed. They found to use less metal than the traditional three-piece cans. So, since the metal is drawn into the shape, they use less amount of metal. And also in 1967, drawn and wall ironed aluminium cans were introduced in the US that was a very significant intervention because DWI or Drawn and Wall Iron containers were then later used for production of beverage containers. So, that was a very important turn of event.

In 1968, the first Tin Free Steel (TFS) was introduced. So, another metal was introduced in 1968. There were tin coated steel containers, then aluminium cans were introduced and then Tin Free Steel (TFS) cans were introduced. Instead of tin, they used a chromium

coating over the steel. So, it has its own advantages. It was developed in UK and pushed forward by the UK steel industry and also in 1973, Intel introduces one of the first tin plate colorimetric rating system. It was a step towards the qualitative evaluation of the metal container. So, they invented to assess the quality of the tin plate using the colorimetric rating system and the rating system was called as sieve metal. So, that was the first step towards assessing the quality of the container. In 1977, another tragic event happened when the largest recorded outbreak of botulism resulting from home canning that was reported in 1977 so there is around 59 people became ill with botulism after eating salsa prepared with home canned jalapenos at a Mexican restaurant in Michigan. This was the second significant event happening because of the spoilage so that actually forced the USFDA in 1988 the US Department of Agriculture publishes the first complete guide to home canning they explain that what are the precautionary measures a home canner needs to practice to make sure that there is no post process spoilage or any survival of Clostridium botulinum spores. So, after these major two incidents care was taken by the general health department especially, the USFDA in educating the public regarding the risk involved in canning. That was a very important turn of event.

In 1987, the introduction of the 206 diameter cans for beverage soft drink cans: the beverage containers, the 206 is a diameter of the container. That container cans were introduced for beverage cans in 1987. That also highly revolutionized the beverage industry and further the same cans were used for packing beer; then what happened is in 1991, can ends are downsized to 202 and 204 ends reduce the amount of metal required for the end. So, they found out that 202 diameter and 204 diameter ends could be much profitable than 206 containers. In 1997, there was a significant intervention by Quality by Vision and they introduced the first fully automated double seam inspection system.

So, a digital double seam inspection system was introduced by the Quality by Vision in 1997 because previous to that intervention we need to inspect the double seam of a container we need to cut the container and observe the layers using a magnifying glass. So, it was a very tedious process and very time consuming, laborious process. Using this new kind of Quality by Vision technique, a digital camera was provided and the container could be cut and the ends could be placed in front of the camera and camera will take a picture of the double seam and it will be magnified and we can easily take different kinds of measurements of the double seam using the software provided. That was a very significant intervention made. Another significant invention in the case of beverage cans happened in 2001 when Crown Cork and Seal company introduced '202 super end' cans.

This resulted in saving a steel of up to 10 percent by using "202 super end" as well as increased strength and better pourability. So, this kind of "202 super end" containers were introduced for beverage cans which reduce the metal by 10 percentage and it increased the strength as well as the better pourability of the beverages. That was a significant

process. And in 2004, another invention by the Quality by Vision, when they introduced the clearance gauge because, it was a revolutionary new method for improving seamer performance and production quality. This clearance gauge, the advantage is that can double seaming machines are there.

Double seaming machines contains basically rotating can sealing heads. Each rotating sealing heads will come in contact with the can end, withdraw and another head will come in contact so that a perfect double seam is formed. Because of this moving nature of the canning heads or sealing heads what happens is that frequently the distance between the canning heads needs to be measured precisely because, any misalignment in the distance between the canning heads will result in a faulty sealing and faulty container and a faulty product and it will result in huge production loss. Frequently canning ends or the seaming heads needs to be measured manually using different devices. But, by installing a clearance gauge, the advantage is that the distance. This kind of small adjustments could be made automatically and this frequent inspection need was reduced and so what happens is that for this inspection the production needs to be stopped and that frequent breakage between the production processes avoided by the invention of the clearance gauges.

The clearance gauge was fitted among the seaming heads and which made small corrections automatically so that this frequent stoppages between the production need not to be done. So that was a significant intervention. By 2006, there was the revolution regarding the ready to eat products was picking up. In 2006, the industry developed single serve bowl shaped cans with easy open lids to enable the convenient access to ready to eat products or meals or snacks in the tune with the on- the- go lifestyle. So, the people could grab this container it could be easily opened was in the shape of the bowl.

So, you can directly consume from the container itself. Such kind of designer made containers started appearing during the period of 2006 and in 2010 there is a very significant intervention like it is called "SEAM 360"; a 360-degree non- destructive measurement of the can's double seam. So, with this machine, what happened is that earlier we need to cut the container to inspect the cross section of the double seam. So, just need to put the container over the scanner and it will scan and give you a cross section of the double seam. So, it was a non-destructive method.

So cans need not be cut for inspecting so that is a significant achievement in 2010. So, the most recent invention in the canning process is that the invention of the toroid can by the Ankara University in Turkey in 2020. So it is basically a cylinder with a hole inside so that the advantage of this particular toroid can is that as there is a space between the cylinder the heating is more much more efficient and lesser time is required for heating the container so that it will results in a higher preservation of the nutritional component

and lesser processing time so this is under development so that is a recent intervention or advancement in the canning technology that is happening in 2020; that is the toroid can invented by the Ankara University of Turkey.

Thank you.