

**EXPLORATORY RESEARCH FOR PROCESSED FOOD
MANUFACTURERS FOOD TESTING METHODS USED, PAIN-
POINTS AND IMPROVEMENT AREAS**



**A THEMATIC PAPER SUBMITTED IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS FOR
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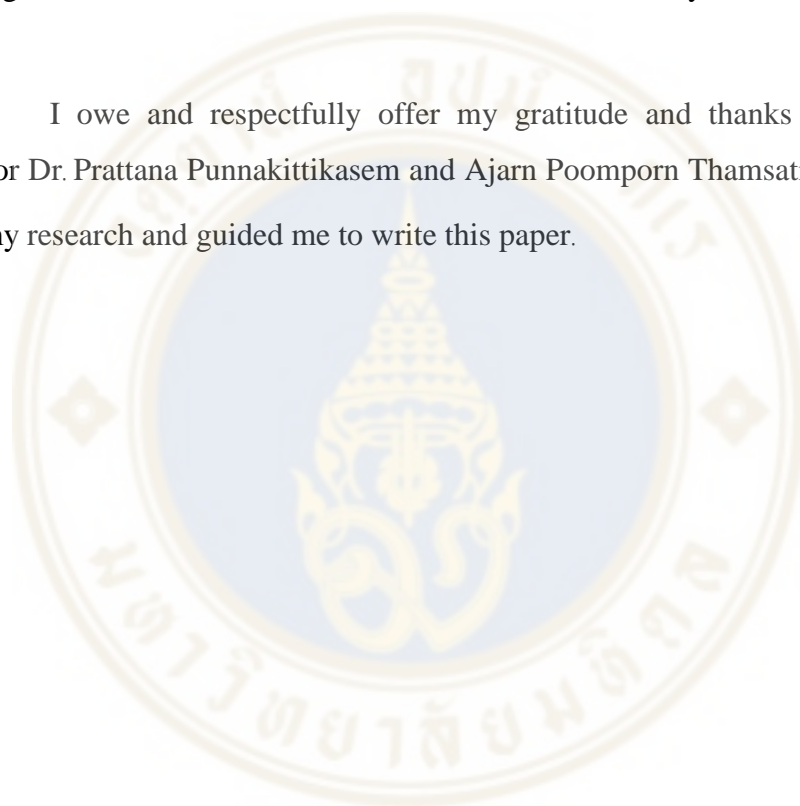
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ABSTRACT

Food Safety is one of the main components of the Food Industry. With the passage of time, changing consumer expectations, higher regulatory requirements and newly discovered harmful pathogens and microbes have made the Food Safety Testing more important than ever for the industry. Safe food production is complex and much needs to be done in Food Safety Testing (IFT, 2002). A leading engineering MNC (here by referred as CoX.) wants to contribute its share in Food Safety by knowing methods that are employed by food manufacturers in food testing and then finding the pain points of food producers when they use the food testing services and how can these pain points can be solved. This is the bases of this paper. CoX Thailand asked CMMU to collaborate with them on this exploratory research project and the findings of this paper are part of that collaboration.

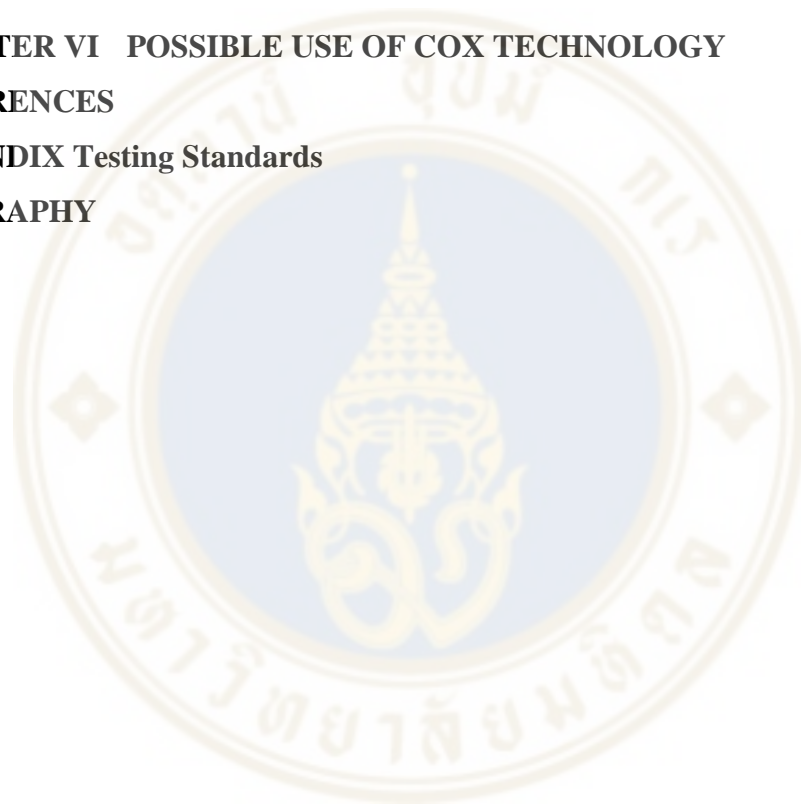
For this paper, a total of 7 interviews were conducted. The interviewees are all professionals connected to the food industry, performing different functions. They were selected to get cross-section views of the food industry in Thailand. CoX wanted to see if there is a need in the food industry for all in one automatic lab tool to conduct food test at the food production site and decrease time lost during normal procedural testing. The result from interviews shows that exporters of food products have to do 3rd party lab food testing as it's required by regulation and having a technological tool in-house will not change the procedure. In the end, recommendations have been suggested on how the technology can still be used to make food testing more efficient.

KEY WORDS: Food Safety/ Lean Management/ Food Testing Technology

34 Pages

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CHAPTER I

OBJECTIVE OF THIS STUDY

Co.X WANTED TO FIND OUT THE PAIN POINTS OF THE FOOD MANUFACTURERS WITH RESPECT TO FOOD TESTING PROCESS AND SEE IF THOSE PAIN POINTS CAN BE SOLVED BY SOME TECHNOLOGICAL SOLUTION

1.1 Study Background

Food Safety is set of procedures, rules and handling methods that ensure delivery of food products to the end consumer without any health hazards and prevent spread or occurrence of food born disease. Food Safety is an integral part of the food production systems. All the modern food producing units have food safety measures integrated in their production system. Food testing on the other hand is a checking process that's carried out to ensure that food products are made with contaminated free raw material and when finished and packaged have no contamination.

This study was started as a collaboration of CoX Thailand and CMMU. CoX wants to find out the pain points of food manufacturers with respect to their food safety testing process. By finding their pain points and solution to those painpoints CoX wanted to see if there is an opportunity in making food testing more efficient and cost effective.

1.2 Problem Statement

Like all other manufacturing businesses, food manufacturing has the raw material procurement, production and finally packaging of finished product batch as 3 basic processes. Once the final batch is finished and ready to be shipped, manufacturers quarantine the batch in storage, take samples from that batch and send those samples to a laboratory for testing of possible contaminations. The laboratory, which is a 3rd party organization (recognized by international & government agencies) can take 3-10 days

for contamination testing. While the tests results are being waited the quarantined batch cannot be shipped to consumers. This adds to time and money cost to the manufacturer.

1.3 Research Objectives

Food tests cause delays by waiting-time for lab test results. Test-waiting-time costs in storage charges. Test-waiting-time means produce can't be shipped to customers. **Would Food Product Manufacturers want a new testing tool-solution that can decrease the Test-waiting-time, therefore decreasing the cost of storage and wait time?**

1.4 Scope

Prior to asking CMMU to collaborate in this research, CoX had compiled data on the processes that are involved in food testing, like the kinds of food tests carried out, what processes companies follow when testing food and which sector of food testing would be best for CoX to enter and offer their products/services.

Thus, this research was done by interviewing professionals connected to food products production and food safety testing, in the greater Bangkok metropolitan area, to build on the data collected by CoX. Those who were interviewed are food manufacturers, food trader, food scientist/academic and a consultant of food startups. All were asked about the food testing procedures in the food industry and what can be possible problems. Possible solutions were also discussed with them and their opinion was noted.

1.5 Study Benefits (potential)

This study was initiated because CoX felt that the way food testing is carried out in the industry is not efficient enough and resulting in time and resource wastage. By exploring different aspects of the testing procedure, cause(s) of this waste can be identified and proper solution can be proposed. These solutions will be beneficial for all those involved in food manufacturing and create more value for the consumers.

CHAPTER II

FOOD SAFETY TESTING

2.1 Food safety

Safe food supplies support national livelihood and economies, contribute to food and nutrition security. Urbanization and changing in consumer lifestyle habits have made global food supply chain more complex and longer (Axelson, 1986). Increasing population and industrialization of food supply chain have created numerous challenges in terms of safe food supply. Food safety risks in food production, storage and distribution are ever present and evolving. These risks means greater responsibility on the food suppliers to ensure food safety for changing demographic which demands more healthy food (Kinsey & Senauer, 1996). Food safety is described as handling steps that prevent food-borne diseases during storage, handling and preparation of food.

With changing demands, the food industry, with push from governments, has also responded by incorporating appropriate steps in the food production system to ensure that supplied food is not contaminated (Busch & Bain, 2004) . According to Australian Institute of Food Safety “Food contamination refers to food that has been corrupted with another substance – either physical, biological or chemical” (foodsafety.com.au).

To have a good idea of how food can get contaminated during food production, let’s examine how a typical food production unit functions.

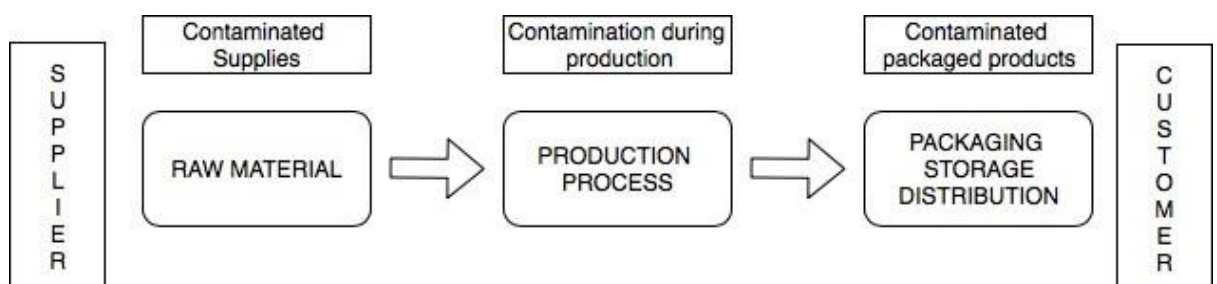


Figure 2.1 Food Production Process and Risks

figure 2.1 shows a typical food production process flow from suppliers of raw material to final delivery to customers. The raw material is processed in a production facility to a finished consumable food product. Figure 2.1 also shows the dangers of how might the products get contaminated in each stage. Contamination of food products can happen when

- Suppliers supply raw material that might have contaminations.
- The production plant is not kept clean/hygienic during production process.
- And finally, the product can get contaminated in the packaging stage.

With these potential points of risk, food producers apply safety measures to ensure that the final product is safe from contaminations in all the steps of production.

- For safe raw material, ensure that all suppliers have tested their product and its contaminated free. Do observation and physical testing to test the freshness of the supply.
- To make sure that no contamination occurs during production process, application of good hygienic/manufacturing practices (GMPs) and enforcing HACCP system throughout the food chain (Commission, Programme, & Organization, 2001) (ICMSF, 2002) ensures high-quality production. FDA regulations of the administrative area also ensures that the production facility has all the checks and measures for a clean and hygiene production process.
- For ensuring that final packaged products delivered to customers are free of any contamination, food producers conduct Food Safety Testing on the final product samples before shipping out the products. Food safety testing for detecting pathogens is the best way to ensure safety (Doyle, Beuchat, & Montville, 2001)

2.2 Food Safety Testing Process

Food Safety Tests have become an integral part of the food production systems. Business processes are defined as “set of activities and tasks that, once completed, will accomplish an organizational goal” (Appian.com). Food safety test is a **business**

process which although not part of actual production flow, is a checking process, and is needed to ensure that customers are getting a prepared food product that is free of contamination and pathogens, so that they don't get sick consuming that product. To understand how food safety testing is carried out let's look at the contaminations and the testing process in more detail.

The three most common categories of stated contaminators which are tested in food safety labs are

Contamination Type	Analytes	Examples
Contamination - Bio	Pathogens	Salmonella, Listeria
Contamination - Chemical	Pesticides	DDT, organophosphate
	GMOs	soy, corn, rice
	Allergens	Gluten, nuts
Physical	Foreign substances	hair, glass, insects

All physical contaminators are removed by the application of GMP/HACCP practices. To make sure that no contamination occurs during production process, and final products are free of any contamination, good hygienic/manufacturing practices (GMPs) and HACCP system is applied throughout the food production process (Commission et al., 2001; ICMSF, 2002)

But to make sure that their final products are 100% free of contamination, and that production processes comply with regulations, samples from the finished batch are sent by the producers, to the laboratories (3rd party) to test for the presence of Biological or Chemical contaminations. That testing process and how it fits in the whole food production, is explained by figure 2.2

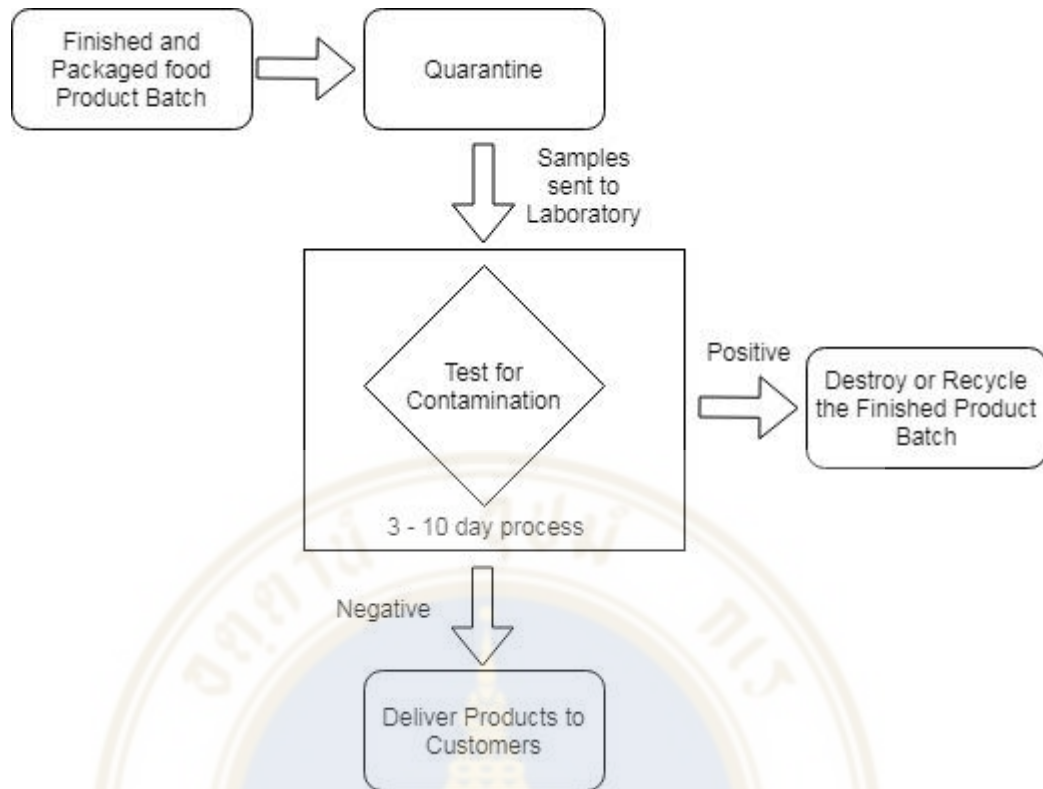


Figure 2.2 food safety testing process and time consumed

As seen in the figure 2.2, once the production is finished, a batch of food products is quarantined in storage and samples are sent to a 3rd party laboratory for testing. Testing of samples, waiting queue time and getting the reports take from 3-10 days. Once the results are received, depending upon the test results, either the whole batch is recycled/destroyed or delivered to the customers.

2.3 Food Safety Test Types

There are 2 main types of food testing. Food Processing companies perform these tests on their finished products either in their in-house labs or send samples to outsourced labs for testing.

Culture-Based

Culture is a solid or liquid medium designed to support the growth of micro-organisms so that their presence can be detected in a sample (en.wikipedia.org). Normally growth of micro-organisms and bacteria takes anything from 12 hours to more than a week. Its good both for qualitative as well as qualitative testing of bacteria or microbes as it can detect the presence of bacteria (qualitative) as well the provide information about number of the organisms present (quantitative) in a sample.

Polymerase Chain Reaction (PCR)

This method relies on the DNA of micro-organisms to detect their presence in a food sample (Fung, Wang, & Menon, 2018) . PCR is a more rapid testing method and the testing time is reduced from days to hours. It involves more advanced equipment and detection is done by matching with pathogen database. This is the predominant testing method used in most of the labs around the world.

PCR testing has the following steps (figure 2.3)

- 1) Food sample pre-preparation
- 2) DNA (biological) sample preparation (e.g., lysis, purification)
- 3) Biochemical testing assays for detection and analysis (e.g., real-time PCR, etc.)

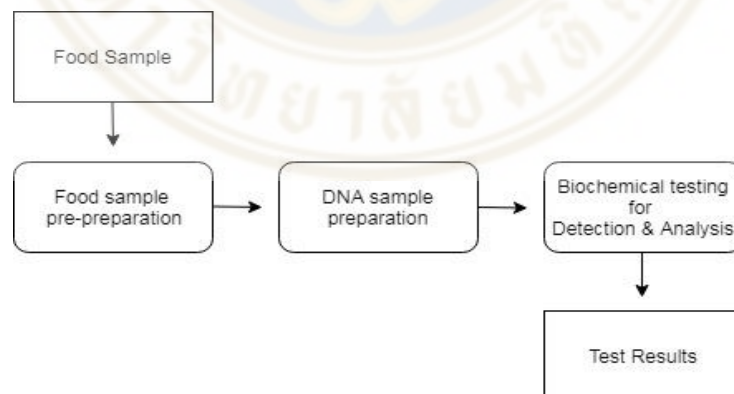


Figure 2.3 PCR testing

Each of these tests requires specialized tools and equipment and must be performed by a trained professional to get the proper results.

CHAPTER III

FOOD SAFETY TESTS AS BUSINESS PROCESS

3.1 Examining Food Safety Tests In terms of Business Process

As the food testing is already described as a business process, Operation Management can be used to look closely and analyze this process. Figure 2.1 shows how the whole process of food production is carried out and Figure 2.2 clearly shows that due to the way food testing is conducted, 3-10 working days are spent just in getting the test results. This waiting time is non-productive, non-value creating and by assessing this waiting time in terms of Lean Manufacturing, is a waste.

3.2 Lean Manufacturing

A concept of manufacturing that came from the Toyota Production Systems (Holweg, 2007; Womack, Womack, Jones, & Roos, 1990), Lean Manufacturing is a set of principles that aim to increase value for the customer by reducing or even getting rid of the different types of waste from manufacturing processes. In Lean Manufacturing

- waste is defined as anything and everything that don't add value for the customer and
- value is any action or process that a customer would be willing to pay for.

Seven types of waste commonly recognized are

- Transport
- **Inventory (finished product not being processed)**
- Motion
- **Waiting (finished products waiting to be delivered, machines waiting to be fixed or a document waiting for signature etc.)**
- Overproduction
- Over Processing

- Defects

Of the Seven Wastes, Waiting and Inventory are two wastes that are connected to this study (Womack & Jones, 1997). Waiting time is anytime goods/products are not worked-on or not transferred. As this time is consumed doing nothing, it is not adding any value for the consumer, its only waste. In the same way as Inventory is finished goods not being processed, just kept in stock quarantined inventory is not adding any value for the consumer as well. Therefore, wait-time for an Inventory that cannot be delivered to consumers, is waste and should be decreased or removed.

This concept of waste will be used to evaluate the food testing process.

Looking at figure 2.1 and figure 2.2 again and examining the processes, it is quite clear that waiting time spent for getting the lab reports is a waste that is creating no value for the customers.

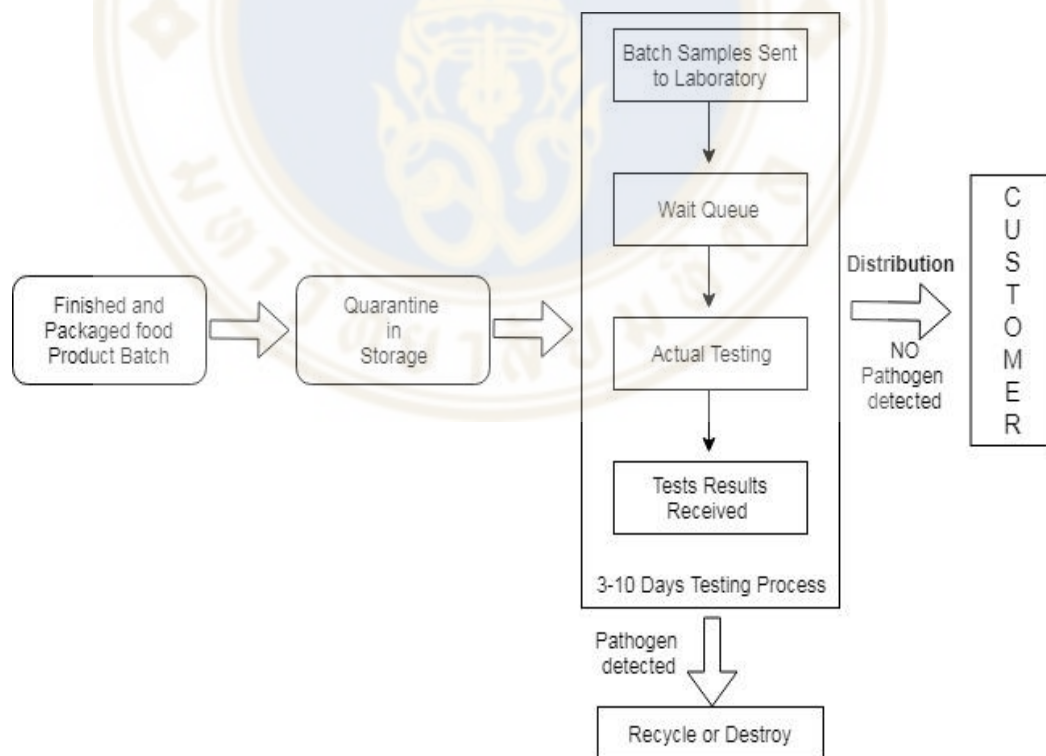
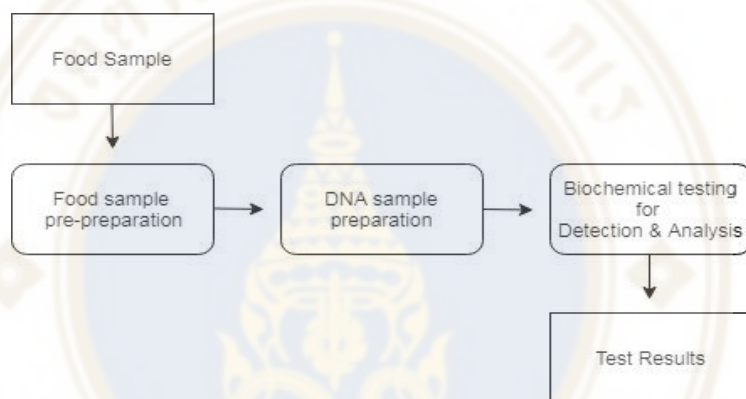


Figure 3.1 Identifying waste in the food production process which is result of time (3-10 days) taken for getting lab reports.

Therefore, if this waste i.e time spent in getting the lab reports is removed or decreased in the production process then automatically, by the principles of Lean Manufacturing more value can be created. Is there a solution that can remove/reduce this waste? Can some new technological solution be offered that can remove/reduce this waste?

3.2 Proposed Solution By CoX.

CoX wants to introduce a fully automatic device that can automate food testing and convert the process from this 3 step model which requires fully trained staff



to a fully automated one, by which anyone can perform food testing figure 3.2

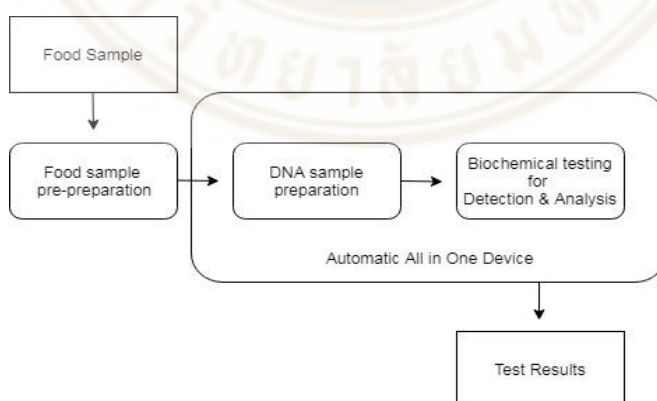
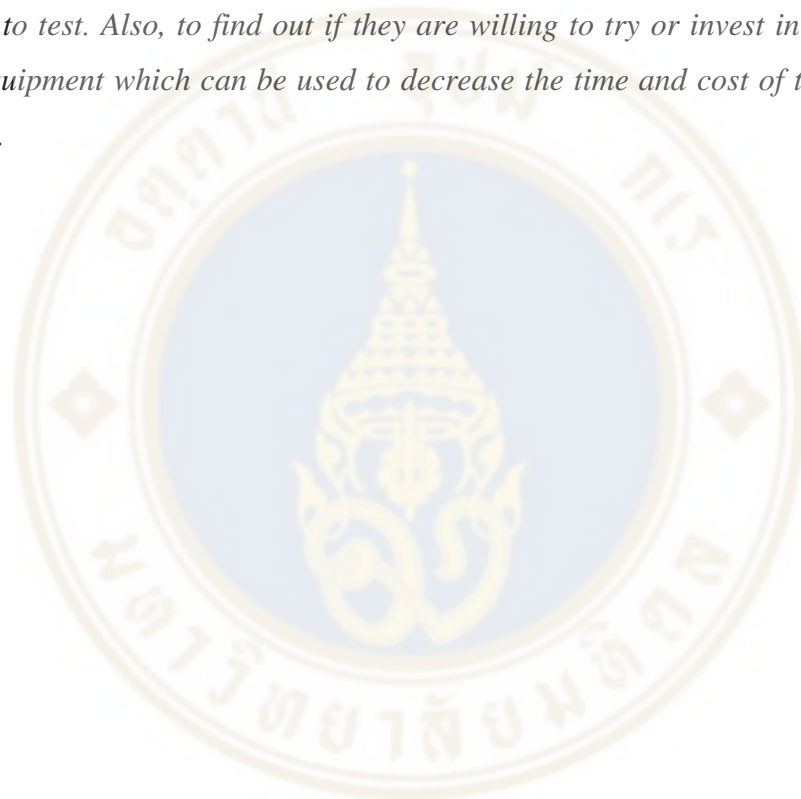


Figure 3.2 CoX fully automated solution

CoX device will be fully automatic and very user friendly without the need for highly trained professionals to carry out test procedures. So, the Food Manufacturers can carry

out their test in a fast reliable and low-cost manner. And the fact that it will be at the food manufacturers facility, it removes the wait time lost when sending to the 3rd party labs for testing manufactured food samples. So according to this solution by CoX, the food testing will become more efficient and create more value for the customers.

Therefore, the task of this research was to collect data by interviewing professionals connected to food manufacturing. Ask them about the methods they use to test their products. Find out how many use in-house labs and how many have to send their product outside to test. Also, to find out if they are willing to try or invest in any new testing tools/equipment which can be used to decrease the time and cost of the whole testing process.



CHAPTER IV

METHODOLOGY & DATA COLLECTION

4.1 Research Methodology

This study was a Case Study Qualitative Research.

Qualitative Research uses “inductive data analysis” to learn about the meaning that interviewees hold about a problem or issue by “identifying patterns or themes”. Open-ended questions are always used when collecting information, and this collected information is combined to form themes. This type of research is best when one wants to understand the context of a problem (Lewis, 2015). Qualitative Analysis allows a loop like research, in which additional questions emerge during the research process as more phenomena are explored and more understanding of the topic develops. Qualitative Analysis is an iterative process (Berkowitz, 1997), making the understanding of the phenomena a continuous process.

Case Study researches allows for exploratory, explanatory and description of an event. One of the Case Study that (Stake, 1994) identified was “*Collective Case Study* - a number of cases are studies jointly in order to understand a phenomenon, population or general condition”. As this research was to find how food producers are affected by the food testing and what their pain points are, first step was to learn about the different stages of food production and how food testing is involved in it. As (Stake, 2005) underlines: “Case study is not a methodological choice but a choice of what is to be studied”. Case study analysis focuses on cases that share some common character and also have their distinct context. One big advantage of Case Study is while collecting data, the understanding of the problem deepens and new aspects are discovered. Answers from one interview will help design the questions for the next one.

4.2 Sample Selection

For this study the selection of cases and data sources had only one criterion, i.e. a data source “that best help us understand the case” (Stake, 1995). The source selection criterion was not fixed. That is why “Opportunistic or Emergent sampling” was used. So after each interview some knowledge is gained about the food production and food testing procedures and next interviewee approached will be someone who can answer questions that came up after previous interview. So both selecting the new source and designing new questions were done in the light of knowledge gained from previous interview. This approach allowed to get different perspectives from professionals working on different areas of food production rather than just the manufacturers.

As the research was Case Study Qualitative in nature, so the sample size need not to be very big, but enough to understand the case properly. Quoting Sandelowsk “determining adequate sample size in qualitative research is ultimately a matter of judgement and experience” (Sandelowski, 1995), so by the 7th interviews, information collected was enough for understanding the case with respect to research objective.

4.3 List and Details of the Interviewees

#	Company	Designation	Responsibility
1	Small Food Producing Company	Product Innovator	Take care of production and new product development
2	Tapioca Manufacturing Company	Production Manager	Take care of the production
3	Thai Culinary School	Teacher and In-charge cafe	Teaching and managing the cafe
4	Food manufacturer & exporting Co	Innovation Manager	Create innovative measures & increase efficiency

5	Seafood exporter	Exporter	Trading
6	Food engineering department of an internationally renowned University	Food scientist and academic	R & D
7	Startup consultancy	food-startup consultant	Scouting and grooming food startups

4.4 Data Collection

Except the Seafood Exporter, before each interview, an email explaining all the topics that are to be discuss with the interviewee was sent. The Seafood Exporter asked for direct interview and discussion.

Following topics were in that list

- Food Safety (Bio and Chemical) Testing -- optional Quality Testing
- Areas in the production process where testing is carried out
Raw material. Production equipment. Final product.
- Why is testing needed?
- Any industry-specific or business-specific testing that is needed?
- In house testing or outsourced?
- PCR or Culture-based testing? Automation?
- Difficulties in carrying out the test?
- Time/financial cost issues?
- HACCP GMP implementation?
- Changing testing needs in the future both in short term and long term?

All the interviews were conducted in an open-discussion manner. All the interviews were semi-structured. According to Bernard, if there is only one chance to interview someone, then semi-structured interviews will be the best way to collect data (Bernard, 1988). Semi structured interviews allow for learning and understanding while interview is begin conducted, which helps a lot in making new questions.

4.5 Data Collection Technique

Data collection was done in steps. CoX provided a data card which could be used for each interview conducted. The card is more like a CASE ANALYSIS FORM that will have the summary of each interview. After each interview, all the important points from that interview were jotted on a modified version of that card.

Organizing data in those data cards helped a lot in planning for the next interview. As one purpose of the interview was to learn about food production and food safety testing, interviewees were asked about their food production and testing methods. As it was a very diverse sample set, each food product producer had their own way of ensuring food safety, meaning more things to learn and more news things to ask in the next interviewee. Organizing data into this way into the data cards was the major part of analyzing the data.



CHAPTER V

INTERVIEWS

5.1 Interviews

List of the interviewees and information collected from them

5.1.1 Interviewee #1: Product Innovator in a small food production company.

Manufacture food products for the local Thai market as well as occasional export order. The main product is Japanese Dim Sum bun with a slight difference for the Thai consumers. Their main sale point is Bangkok city but they are expanding in the overseas market slowly.

For supplies, they require supplier assurance and guarantee that the supply is contaminated free. This is made sure by physically checking supplied raw material for looks, taste and color and texture. Any packaged food must have Thai FDA logo.

For their sale in Bangkok city, they don't need food testing. They have license for production and for marketing their product from FDA. As their product is not sold in any supermarkets and not packaged, they don't have to conduct food safety testing for the local market. But they have to comply with Thai FDA rules in their production, stocking and point-of-sale handling of food items. FDA officials do periodic inspection to ensure that the production facility is maintained as per FDA rules. If otherwise their production license can be cancelled.

This company uses food safety testing only when their sale involves exporting of products. They have exported to Canada before, and that was the first time they carried food safety testing on their products. They always use 3rd party labs for food safety testing.

For me this interview was most important as interviewee#1 taught me most about the food processes and how every step of food production is related and importance of food safety issues.

#1	Product Innovator				
Topics Discussed	Production and testing procedures	Key Insight		Topics for next interview	Production and testing procedures
	Testing supplies	Only test Export Orders			Testing supplies
					Export order requirements
		Additional Info			HCCP & GMP
		About HACCP and GMP			
Conclusion: Only export orders are sent for testing. Out-source because it's the norm.					

5.1.2 Interviewee #2: Production manager in a Tapioca Manufacturing Company.

One of the biggest Tapioca manufacturers in Thailand. Main product is Tapioca Starch that's used for processed food products in different industries. They have many markets along with local Thai market. In fact, their export market, in terms of sales, is far more important.

As their supplies is roots of the cassava plant, coming directly from fields, no food safety tests are conducted on supplies. Only physical testing for texture, color, shape etc. are carried out on the cassava roots.

Same as Interviewee#1, for local sales they don't need any food testing. Production is licensed from FDA and they do periodic checking on the production facility to ensure that manufacturing unit is maintained properly and production is done with the required

hygiene conditions. But they don't need to test locally sold goods. Its only when they have exports, they need to do food safety testing on the produced batches and provided lab reports where needed. As exports is major part of their sales, they do regular food safety tests of the finished products. But they also only use 3rd party laboratories for their food safety testing.

#2	Production Manager			
Topics Discussed	Production and testing procedures	Key Insight		Production and testing procedures
	Testing supplies	Outsourcing suits their production style		Testing supplies
	Export order requirements			Export order requirements
	HCCP & GMP	Additional Info		HCCP & GMP
		Certificate of Authenticity		
Conclusion: Only export orders are sent for testing. Out-source lab is best way to do testing.				

5.1.3 Interviewee #3: Teacher of traditional Thai food in a world renowned Thai Culinary School and in-charge of the café in that school.

This school is world renowned teaching students from all over the world different type of cuisines. They have to teach many types of different foods to their students, which means that they require many types of different ingredients every day. Also for the café

continental foods/snacks are prepared, therefore many imported ingredients are purchased as well.

The school buy supplies only from those suppliers who comply with the FDA rules and regulations. For the imported food ingredients, as they are all packaged goods, logos of GMP/HACCP are checked on the packaging. For any fresh vegetables, meat, fish etc. physical testing of the ingredients is done for texture, color, smell etc.

This school don't use any of the food safety testing for the items sold in the cafe. According to the interviewee #3 there is always chance of human error when checking for quality of fresh supplies. There is no tool or equipment that can help to make better assessment. He gave example of paper test for checking "ph level". The "*pH test strips*" tool helps in better assessment of freshness by telling the acidity or alkali level, thus allowing the tester to make better judgment. That's why if there is a handheld/portable tool or equipment that can help them to do their raw material supply checking quicker and better, they would certainly invest in that technology.

#3	Cooking Teacher and In-charge Kitchen			
Topics Discussed	Production and testing procedures	Key Insight		Production and testing procedures
	Testing supplies	Believe supplier or observe testing		Testing supplies
	Export order requirements			Export order requirements
	HCCP & GMP	Additional Info		HCCP & GMP
	Equipment cleaning	Test are not conducted		
Topics for next interview				
Conclusion: Would invest in any portable device(s) that can aid in testing supplies				

5.1.4 Interviewee #4: Innovation manager in a food manufacturing and exporting company

This Company sells its products in local and many export markets. Their product line is diverse and include canned seafood products, ready to eat items etc. They sell in more than 50 markets all around the world and all their products are packaged, which requires proper labelling with information about every aspect (quality, ingredient etc.) of the product.

The main raw material for this company is raw sea food which comes from many areas of the world via boats. Special raw material teams are there who go to the boats and check if the fish/shrimp etc. are up to the required the quality. This checking is again physical checking for quality by testing the shape, color, texture etc.

As this is a very big company, there is an in-house laboratory which checks for contamination of samples taken during production process. This lab is just to make sure that no contamination has entered the production process. GMP/HACCP is followed in their production process and all the locally sold goods will have FDA, GMP/HACCP logos on them as a sign of quality and assurance to customers that the products are safe for consumption.

For export orders, which is their main sales area, each finished and packaged batch are tested by 3rd party laboratories. This company uses only the government laboratories as they are more cost effective. Besides, as this company is very big and important for Thai government, they get special service in terms of time to generate lab reports and cost of lab services. They have special staff that have only one function to deal with the government laboratories.

After talking to the academic/food scientist, the issue of regulations was again discussed with Interviewee#4 and he confirmed that 3rd party lab testing is part of the regulation (appendix)

#4	Innovation Department				
Topics Discussed	Production and testing procedures	Key Insight		Topics for next interview	
	Testing supplies	3 rd party labs are must.			Choosing suppliers
	Export order requirements				Testing supplies
	HCCP & GMP	Additional Info			Export order requirements
		Govt labs are cheapest 3 rd party lab			HCCP & GMP
	<p>Conclusion: Testing with 3rd party is a requirement. This company keep staff just to deal with govt labs on daily bases. Non govt labs are twice as expensive as govt labs so they prefer govt labs.</p>				

5.1.5 Interviewee #5: Seafood exporter based in Samut Sakhon.

This exporter buys seafood products from different companies and sell them to foreign clients around the world. He buys from local suppliers and then export.

His only criteria for accepting a seafood production company's product is that the producer must comply with GMP/HACCP standards and get food safety lab reports for each supplied batch.

#5	Sea Food Exporter				
Topics Discussed	Choosing suppliers	Key Insight		FDA	
	Testing supplies	Testing cost is supply cost		HCCP & GMP	
	Export order requirements			Export order requirements	
	HCCP & GMP			Topics for next interview	Inline testing (?)
	FDA	Additional Info		Can bypass the 3 rd	
	Lab reports	HCCP & GMP is surety		party with in-house ?	
Conclusion: For the traders HACCP & GMP logo with 3rd party lab reports are must.					

5.1.6 Interviewee #6: Food scientist who was before working in a food product manufacturing company and now working as an academic in food engineering department of internationally renowned university.

I meet her not to ask what procedures are carried out in food testing but rather why food producers have to use 3rd party laboratories for their food testing services rather than establishing in-house laboratories. She confirmed it's a policy of government and all the importing countries custom laws to have un-biased safety reports for all the food products. And if the safety reports are from the producer, there is always a chance of the report being biased.

#6	Food Scientist			
Topics Discussed	FDA	Key Insight	Topics for next interview	FDA
	HCCP & GMP	Govt policies require 3 rd party testing		HCCP & GMP
	Export order requirements			Export order requirements
	Inline testing (?)			Can bypass the 3 rd
	Can bypass the 3 rd	Additional Info		party with in-house ?
	party with in-house ?	In-line testing not possible		
<p>Conclusion: This interview was more for the policy and regulations. To explore possibility of in-house labs. Turn out that 3rd party labs are must for export and Govt regulations so that there is no bias in test results.</p>				

5.1.7 Interviewee #7: A food-startup consultant who has extensive knowledge about the regulations concerning food industry in Thailand.

My question to him was same as why the food producers have to take service from 3rd party laboratories rather than doing it in house. Like the food scientist, he said its required regulation that food safety tests are conducted by outsider labs to avoid any biases in the reports.

#7	Food Tech Accelerator			
Topics Discussed	FDA	Key Insight		Topics for next interview
	HCCP & GMP	Export requires 3 rd party testing		
	Export order requirements			
	Can bypass the 3 rd party with in-house ?			
		Additional Info		
		Not all test needed are PCR based		
Conclusion: In Export regulations 3rd party testing is a must. It cannot be avoided.				

5.2 Identifying a Theme in the Interviews.

Interviews were conducted by starting from the information provided by CoX. The research objective was finding the pain point of food producers when they use food testing services. As there are no specific ways of analyzing the data (Willms et al., 1990) there must be some central idea on which data is collected and analyzed. Pain points of the food producers was focus on which all the topics were highlighted and interviews were conducted. The quarantining of finished and packaged food products, sending samples to laboratory for testing and waiting for lab reports was in the information given by CoX. What needed to be explored was why the food producers have to carry out this procedure for every finished batch and why they don't establish their own in-house labs for food testing. As (Bulmer, 1979) notes that one of the factors that can influence search

for a common theme is the phenomena being researched. In finding the reason(s) behind food producers out-sourcing their testing services following theme appeared in the first five interviews:

- Interviewee #1;
only products sold in supermarkets and for export need testing.
- Interviewee #2;
only products sold in supermarkets and for export need testing. Outsource testing services is best solution for us.
- Interviewee #3;
we don't sell in supermarkets or export any product so we don't do any food safety testing.
- Interviewee #4;
only products sold in supermarkets and for export need testing. Outsource testing services to government labs as they are cheaper. Export orders require 3rd party lab reports.
- Interviewee #5;
all export orders need lab test report from a 3rd lab to comply with regulations.

There are dissimilarities in between how testing services are used for different companies of different sizes. Company #2 and Company #4 are big producers. They have regular export shipments and thus are using the 3rd party testing lab services regularly. But on the other hand Company #1 had used lab services very less as they have not done much exports, rather most of their sales are within Thailand. Considering a company size and the frequency of use of testing services is important, as it affects what kind of testing solution will best suit them.

Another aspect was cost of the testing services. Company #4 considers this cost as important and try to minimize it by using government laborites rather than private labs. Although Company #3 has lots of exports, thus more frequent use of 3rd party lab testing services, it opts with privately owned labs and consider lab costs as part of production cost.

Last thing was how small companies see laboratory services in their business. For them lab test results are either

- 1) Something their supplier must provide (Small food producer, Sea food Exporter and Culinary School)
- 2) If only there is export, they will do food safety testing, for official documentation.

The last 2 interviews re-confirmed the observed theme that only export orders need food safety testing and that as per regulations, to avoid any bias, the report should always be from an outsourced 3rd party laboratory. Both the academic and the food startup consultant repeatedly said that official policy of 3rd labs for food testing report is a must and the only reason it's enforced is because any kind of doubt from report being biased is avoided. If report is generated from an outsourced accredited 3rd party lab, then any importing country will accept that report without any doubts.

5.3 Analysis

From the recordings of each interview, important points were collected, summarized and entered in the data cards. This helped in getting a common theme from the interviews and develop the final analysis.

CoX initial assessment was that the pain points of food producers are from using the 3rd party laboratories, which are causing wastes in terms of Lean Manufacturing principles. Using Lean Manufacturing model, the way to solve a waste problem is to introduce counter measures and make the business process more efficient to create more value for the consumer.

After 4 interviews with the food producers, it was already realized that the pain points are *from the regulative need* of food safety tests. And as confirmed by the policy and regulations experts, food product exporters are bounded by the government regulation to do the food safety tests from 3rd party laboratories (appendix). Having an in-house laboratory will not make the testing process more efficient or save time and won't create

more value for the consumers. Food safety tests from 3rd party laboratories are a requirement of law which can't be bypassed by use of technology.

5.4 Conclusion:

FDA, Thailand governs the rules and regulations of food product manufacturing. All manufacturers get their production license from FDA and by regular inspections FDA ensure that production is done up to the required standard. Local food sale doesn't need food safety testing but as per FDA regulations and international trade requirements, all the export shipments need an ISO/IEC 17025 accredited laboratory safety test reports that certify that the products are contamination free. For Thai manufacturers, when they intend to do export, to avoid bias, it's an official policy that the lab report for their export should be from a 3rd party lab rather than an in-house laboratory. CoX technological solution for making the testing process more efficient is not applicable in the Thai market due to official regulations and policy. But there are other ways that CoX solution can make food testing more efficient and create value by decreasing waste.

So how can the principles of Lean Manufacturing be applied to the food testing services and make it more efficient?

CHAPTER VI

POSSIBLE USE OF COX TECHNOLOGY

Possible Use of CoX New Technology in Thailand

The nature of CoX solution relies on the ability to decrease test time. Even if food producers can't use CoX Technology solution to solve all their food testing problems, as they have to use 3rd party lab food testing service as per official policy it can be used in following ways for solving pain points of food producers and creating more value.

1. Big food producers need to have in-house labs for their internal checking. There is always a chance for the food products to get contaminated during production process. If the contamination is checked during production process before packaging, the company can save lots of resources and time by quickly identifying the reason contamination is happening and resolving that issue. With CoX technology, food producing can have quicker contamination check than normal methods, thus preventing waste and creating more value for the customer.

What needs to be done by CoX: CoX needs to market the testing technology also as an in-house tool for the food producers that can create value by preventing future losses.

Gained Value by Customers: by preventing any contamination during the production process before packaging, loss of time and resources will be avoided.

2. CoX can become a 3rd party testing service provider for the Thai food manufacturers by using its new technology and provide lab report service which will be delivered far quicker but as reliable as any other lab service providers. So rather than a tool provider, CoX can become a service provider. The focus of CoX Technology solution is to decrease testing time. All the 3rd party labs have long queues creating time waste and inventory storage costs. By offering same test reports, with same prices but in a shorter time period

CoX can create value and attract business from the food companies. It will require a better system of swifter lab report generation, but if CoX can manage that, it certainly has chance to become a better option for food companies wanting to get quicker lab reports when they test their products. What needs to be done by CoX: CoX needs to market its services for food safety testing by projecting the testing technology as a fast reliable solution, delivering reports that are accepted by any country's food safety authority. The key will be fast, swift and reliable service, minimizing wait time for lab test report generation.

Gained Value by Customers: As CoX will be providing service of lab report generation to the customers in a shorter time period, the time waste and wasted resources in inventory storage charges will be minimized and value will be created for the food producers.

- As suggested by the food scientist/academic, it's also possible for the 3rd Party Labs to install the CoX food testing solution at the food producer's site and the food producers obtain the test results through 3rd party Lab (recognized by international organizations and government regulating body). As the machines are designed to be fully automatic, they don't need highly trained staff to be operated, so client's staff can do the minimum operation required.

How would this work?

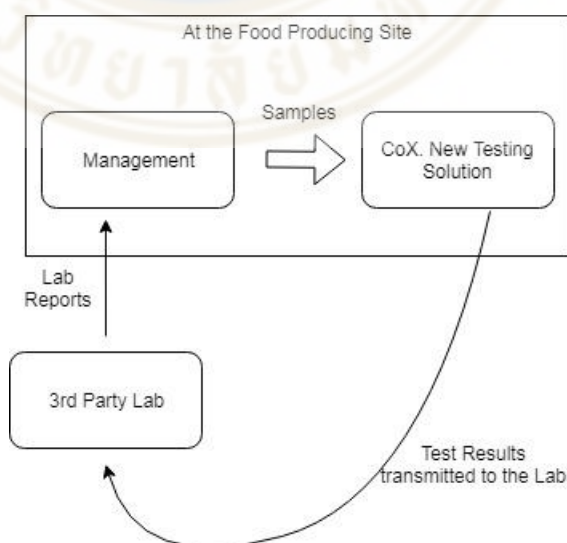


Figure 4.1 CoX solution as IoT

Working:

- 3rd Party Lab will install the CoX testing solution at client's location.
- Sample will be prepared and tested by the machine at the client's location by the client staff.
- The machine will transmit test results to the 3rd Party Lab office.
- 3rd Party Lab will make the reports from those results and give to client.

The testing equipment will be functioning as an IoT (internet of things) for the 3rd Party Lab at the site of food manufacturer. All the producer has to do is to insert the samples into the machine to get tests done. All the waiting queue time and logistics times is removed with this process as the samples are tested at the client's location. This method will need some modification in policies of food safety testing on government level but has potential to increase the efficiency of food testing by many folds.

What should CoX do;

- 1) Lobbying to modify the local food testing policies with Thai food safety authorities, whereas 3rd Party Labs can have their equipment installed on client site.
- 2) Ensure that the process is reliable and trustworthy, so that reports generated are acceptable to all.

Gained Value by Customers: Customers will have their lab reports far quicker compare to normal outsourcing process. They don't need to send samples and wait queue. This definitely will increase efficiency of lab report generation and decrease the cost of storage and wait time wastage.

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APPENDIX Testing Standards

Quoting Wikipedia “International standard ISO/IEC 17025 is the main ISO standard used by testing and calibration laboratories. In most countries, ISO/IEC 17025 is the standard for which most labs must hold accreditation in order to be deemed technically competent”.

A look at the website of all the organization (FDA USA, ESFA Europe, FSANZ Australia etc.), controlling the food business regulations in the developed world, require all the labs to have accreditation of ISO/IEC 17025. If, only, a lab has ISO/IEC 17025, its lab report is accepted as authentic, reliable report.

The issue for all the labs is to be fully compliant with ISO/IEC 17025 whenever it is updated due to technological advancement or new pathogen discovery. This makes the updating of labs to new standards a costly but necessary process, that’s carried out frequently.

Food companies in the developed world have the option of having an in-house lab, provided they have ISO/IEC 17025 from the local food safety authority. But due to frequent and costly but unavoidable updates, a lot of them opt for outsourcing their laboratory services to specialized organizations.

In Thailand Bureau of Laboratory Quality Standards (DMSc), Ministry of Public Health is the issuing authority for ISO/IEC 17025 certificates and updates. Each lab issuing certificates for food producers is assessed by the Bureau of Laboratory Quality Standards (DMSc), Ministry of Public Health, to certify that the lab meets the requirements of international standard ISO/IEC 17025 before they are accredited.

All the importing countries customs require ISO/IEC 17025 accredited lab reports from the food producing companies. Therefore, each importing shipment must have test reports from labs with ISO/IEC 17025 accreditation. In Thailand it is an official policy that even though a food producing company can have its own lab, all the food exports must be accompanied by a test report that is issued by 3rd party ISO/IEC 17025 accredited lab, so that there is no doubt for bias in the issued lab report. There are both government and private labs that provide food testing services and are accredited by Bureau of Laboratory Quality Standards (DMSc), Ministry of Public Health, Thailand.