

FOOD QUALITY ASSURANCE

GENERAL SCOPE AND OVERVIEW

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Hak cipta terpelihara. Tiada bahagian daripada terbitan ini boleh diterbitkan semula, disimpan untuk pengeluaran atau ditukarkan ke dalam sebarang bentuk atau dengan sebarang alat, sama ada dengan cara elektronik, gambar dan rakaman serta sebagainya tanpa kebenaran bertulis daripada Politeknik Tun Syed Nasir Syed Ismail, Kementerian Pengajian Tinggi Malaysia terlebih dahulu.

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Food Quality Assurance

For persons who want to understand the scope and overview of Food Quality Assurance

And

For students at higher education (pre-university level, diploma level, degree level) who are pursuing in Food Technology course



Thank you to all persons that directly or indirectly involved
during the production of this e-book





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PREFACE

Food Quality Assurance (basic scope and overview) is a book that explains the job scope of food quality officers in industry, brief explanation on total quality management system and daily routine in an industry that controlling the quality, hence producing a good product.

This book can be a guideline for the newbies in the food industry to get some ideas before working in industries.

Also, the end of the chapter will show how to analyze data gathered during processing.

Enjoy your reading!

01

INTRODUCTION

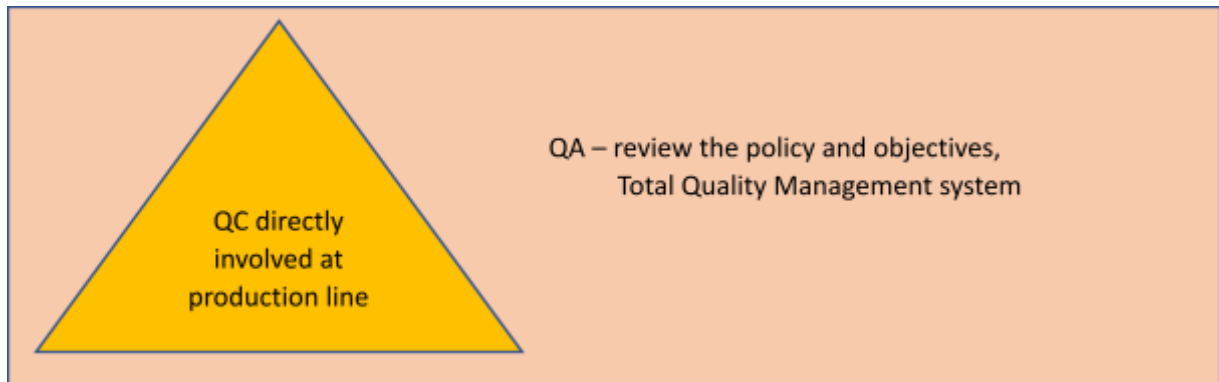
“

ONE DAY OR DAY ONE. **YOU**
DECIDE

”

Quality Assurance Department is a must-have department in all industry including the food industry. There are huge job scopes for quality assurance officers who are controlling quality from supplier to the customer. Meanwhile, the quality control job

scope is specific, which involves the production line only. The job scope of quality assurance was larger than quality control, but both positions were important in the food industry.



Quality - Degree of excellence
(oxford definition)

Quality analysis definition in food industry

Combining food products attributes to follow the specification that determine acceptable degree of consumer

Food Quality Analysis in food industry

Continual and regulated process where the sample or product compare with specification

PURPOSE OR IMPORTANCE OF FOOD QUALITY CONTROL

Food product follow regulation (public health regulation, labelling regulation, food act 1985)

Raise the quality (quality of the food deteriorates when processing begins)

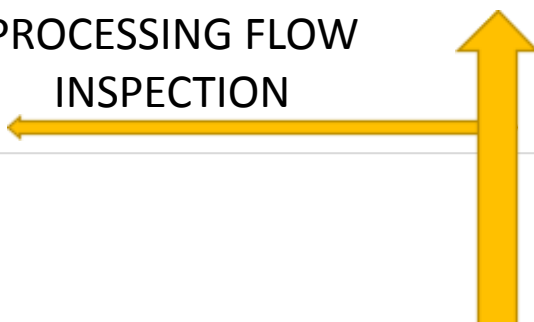
Increase profit due to good quality product produced

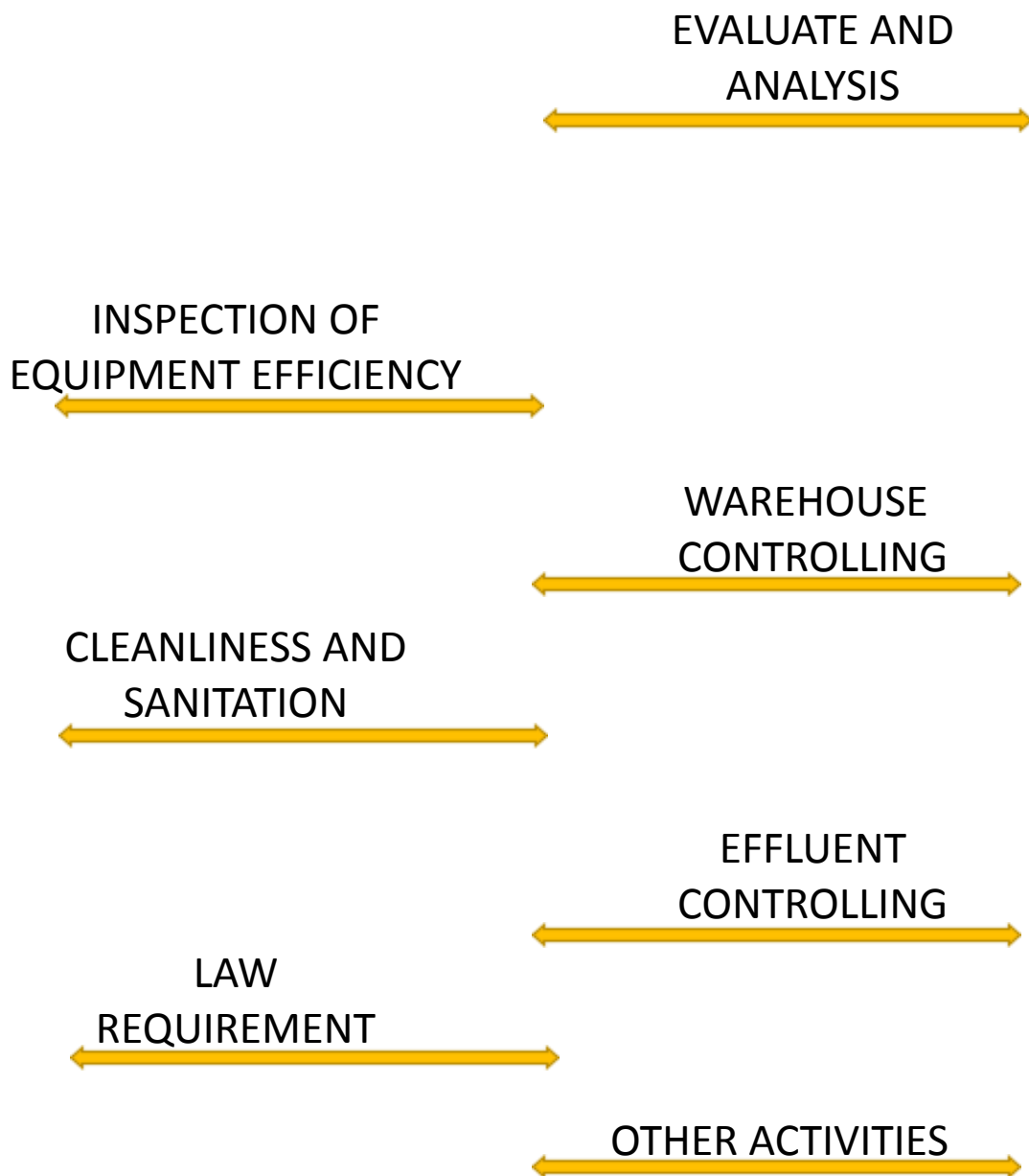
Decrease wastage since all the product and procedure well managed



Avoid large amount of product failure with smooth processing

PROCESSING FLOW
INSPECTION





QC Responsibilities

PROCESSING FLOW INSPECTION

Quality Control Officer must check the processing flow from raw materials until the finished product, especially before running the production. Firstly, ensure that raw materials follow the specification, usually by referring to the checklist form. Besides, the daily routine before production is checking the equipment efficiency. Some of the equipment needs calibration to maintain efficiency and ensure all the equipment's clean and functions well for the production. Moreover, the operation procedure should be systematic and follow the flow by referring to the processing flow chart specified. Finish product also should follow the specification that has been specific by using the checklist form.

EVALUATE AND ANALYSIS

Basically, evaluation and analysis are also a part of QC's responsibilities. However, not all food industry manages to have laboratory inside the factory, especially small-scale industry. Therefore, the test is to be conducted based on the product produced and the importance of the test for the food product. Three types of tests which is chemistry, physical and biological. A Chemical test usually proceeds to the raw material and finished product such as proximate analysis. A physical test is a standard test applied for checking raw material during processing and finishing a product such as colour analysis, appearance, and product size. While for the microbiology test depend on the type of sample such as the test on the egg

(salmonella detection) or on the chicken meat (E-coli detection).

EQUIPMENT EFFICIENCY INSPECTION AND PRODUCTION

During processing, QC also needs to ensure that the equipment and processing are productive. Error on the equipment will delay the production and might affect the quality of the product also. Some of the equipment must be calibrated before use.

WAREHOUSE CONTROLLING

A warehouse is a place that keeps things, supply stock to the processing department, receive and keep stock. This is an important place to control since the warehouse store a large amount of stock.



Raw material and finish product shelf life must be well managed hence must be kept at a suitable temperature. Raw material store must be separate from finish product store. Temperature is an essential factor to be maintained. Environment temperature 25°C (standard temperature), Dry store

temperature 27-28°C, wet store 1-5°C (chiller) and frozen room temperature is 0°C (minimum). Besides, Moisture also must be maintained at 32% and handling stock at the warehouse using FIFO/LILO system. FIFO means First In First Out while LILO means Last In Last Out. This system manages the stock or raw material according to the expired date or date of receiving. The first item that arrived or expired must be used first.

EFFLUENT CONTROLLING

Every factory must have effluent produced from the production. Various types of polluted material are present in the effluent.

CLEANLINESS AND SANITATION

Other job scopes for QC are ensuring the cleanliness and sanitation in terms of personnel, equipment and environment and preventing cross contamination which producing a food product.

Sanitizing is a process of removing dirt, soil and certain bacteria so that the number of germs is reduced to such a level that the spread of disease is unlikely.

➤Cleaning – Removing dirt and soil with water and soap.

➤Cleanliness - is the absence of dirt, including dust, stains, and bad smells. Also, the absence of germs and other hazardous materials

Overcome the cross-contamination

- ✓ Keep raw and cooked food in the refrigerator separately.
- ✓ Keep cooked and uncooked in a separate part in the refrigerator.
- ✓ Keep cooked food above raw food to prevent liquid from raw material spilled overcooked food
- ✓ Put the food that may spill or drip in the pan or suitable container and place it in the bottom of the refrigerator.

- i. Floating solid (paper/sand)
- ii. Colloid solid (organic compound, microorganism)
- iii. Dissolve solid (inorganic salt, organic acid)
- iv. Dissolve gasses (CO₂, H₂S)
- v. Liquid that cannot be mix (oil, grease)

Effluent treatment at the factory can be proceed in 3 ways:

- i. **Physical process** – screening, sediment, filtering, gas transfer.
- ii. **Chemical process** – coagulate, freezing, ion changing.
- iii. **Biological process** – biological filtering, sediment activation.

Before effluent can be released into the environment, treatment process must be applied and measured by using this test:

Effluent testing

- i. BOD - Biological Oxygen Demand
- ii. COD - Chemical Oxygen Demand
- iii. Follow the environmental law

BOD – Biochemical Oxygen Demand (amount of oxygen used by microbial in oxidizing of organic pollutant)

COD – Chemical Oxygen Demand (amount of oxygen consumed when the water sample is chemically oxidised).

LAW REQUIREMENT

Numerous laws must be complied by a company in producing good products for the consumer. Producing safety food must refer to the Food Act 1983 and Regulation 1985, including law that involved Halal and Haram in food and common law such as labelling requirements.

OTHER ACTIVITIES

- Staff training
- Consolidate the operation procedure & analysis
- Develop food product (R&D)
- Preparing quality control policies such as documentation for ISO 22000, GMP, HACCP



TOTAL QUALITY MANAGEMENT

TQM is an approach to improve the effectiveness and flexibility of the business. It is essentially a way of organizing and involving the whole organization, every department, every activity, and every single person at every level.

OBJECTIVES OF TQM

Meeting the customer's requirements is the primary objective and the key to organizational survival and growth.

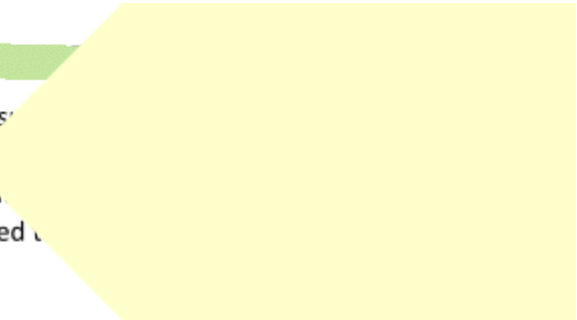
Continuous improvement of quality. The management should stimulate the employees to become increasingly competent and creative.

TQM aims at developing the relationship of openness and trust among the employees at all levels in the organization





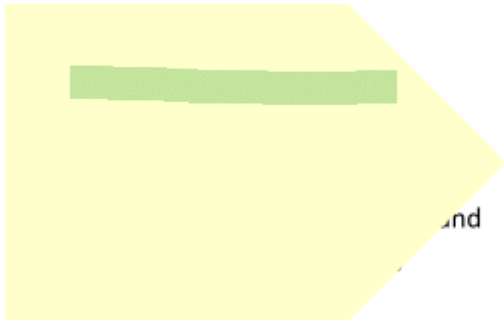
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DO IT RIGHT AT THE FIRST TIME

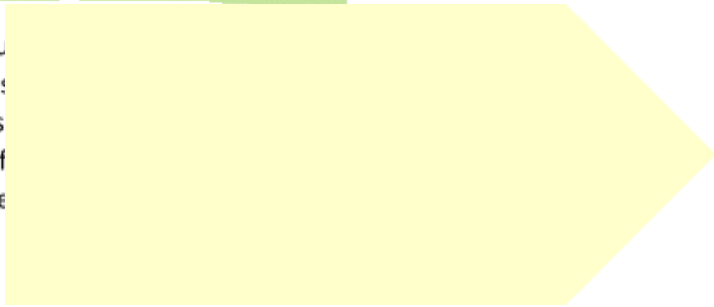
This means avoiding rework, i.e., cutting the amount of defective work



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ED

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skills
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staff
style



ers



involved,

the program

Tutorial 1

1. List **TWO (2)** importance of food quality control.
2. Explain **TWO (2)** elements of Total Quality Management.
3. FIFO is a system that is often used in the store at the food factory. Explain the FIFO system in food industry.
4. Warehouse is the most important place to be controlled to avoid a large amount of product failure. Mr. Zikri as a quality control officer was assigned to ensure that the warehouse is in good condition. Determine **THREE (3)** appropriate ways to make sure that the raw materials in that warehouse are in good condition.
5. Let's try to find hidden words based on the clue given below

C T E S J L Y V A N V L E L I E P H E W K P
V O W D I E W C Y S L V N J O O B P F P F C
Z T F Z Z R O Z A X T W O S B J W M T M R T
T A O L I R S H V S Z R L C V L K V J Z Q Q
S L R V Y T E L V A R P R C Y F Y B C G W U
Y Q D E A S U Y Z Y U R E W P L H V J D P H
H U L Y C Q M F V J N I F K M K G G U G U P
D A Z V F U C D A C W X Y C H E M I C A L P
M L V F I X E R B T B H D G K Z R F H Y M R
N I L R H E X Z W Y Z R G U R K O X J Y E V
X T C P L U A D Q E F I F O U T S S B V I G
E Y S R C V J S R G P C P I U Z W R I D E Y
Q M Z B O D Q O G I W B Q P H L W M B K G I
Y A E O A B T V E E K S V C N J Y C A J X V
Q N P B A S I I G F K I Z D L Z Q D C A Q J
K A A R T C B O J W P E V L W B B P Q T Q O
R G R E T N I L L G C Q J Z E O H G N I P B
O E W T R E K O F O H W Q U N W C M L B Z N
Z M P V B C P B N G G A Z O K D D E S A N N
B E V S M W V P K U G Y L C D N R S O I C P
L N F G C A U F Z V E H P Y V O C K W N G F
G T E L L H B F Q L X W O Y B S G K D I H H

- A system used in a warehouse
- One types of test in analysis food/product
- One of the process to treat effluent
- A system that improve effectiveness of a business

02

QUALITY SPECIFICATION



THE KEY TO **SUCCESS** IS
TO FOCUS ON **GOALS**
NOT **OBSTACLES**



Quality specification is needed in any condition from raw materials, processing, finished goods, storage and for some product microbes count also can be a part of the quality specification.

Specification needs to be comprehensive details of product attributes such as grade, weight, nutritional values, and microbe count. The objective for establishment of quality specification is to ensure wholesome, hygienic, sincerely packed, and labelled product 'Wholesome': good in ecstatic value (taste), nutritious and safe to consume. If the specification checklist is followed by the person in charge at every time of production, the quality of product produce should have constant quality.

Importance of quality specification:

Suppliers

Provide uniform and high-quality goods for manufacturer and retail market

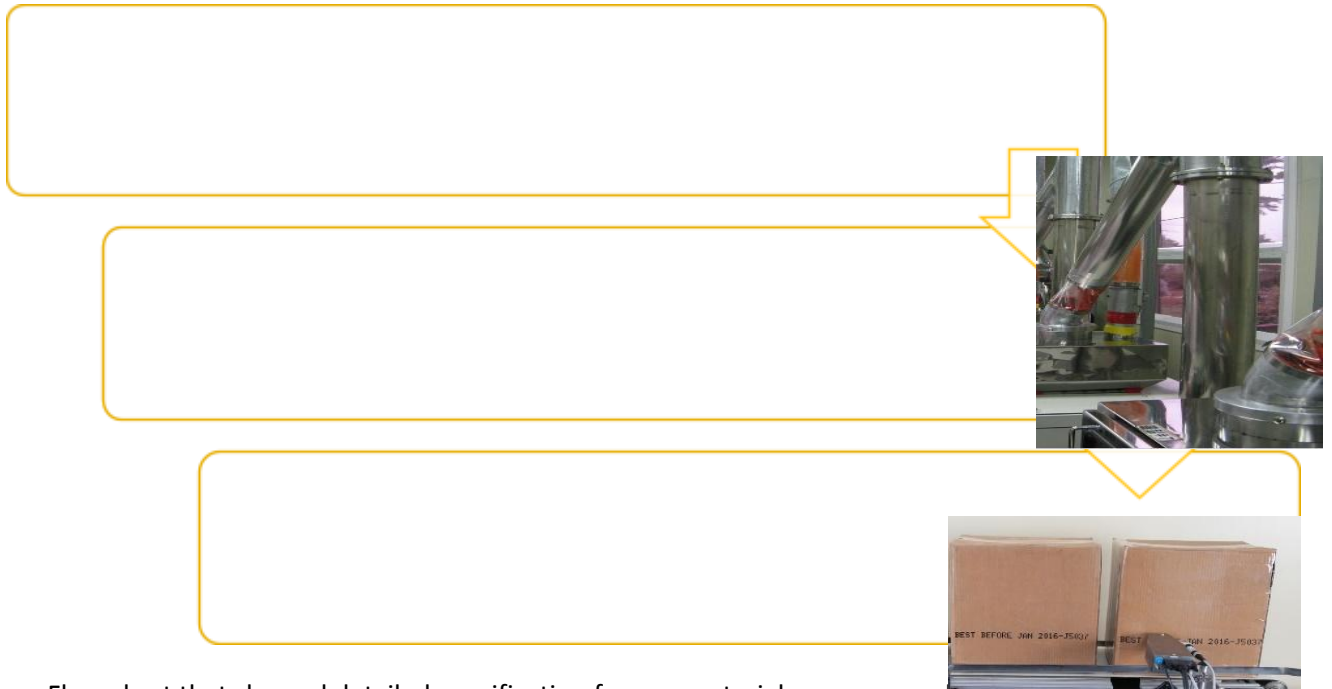
Reducing costs because all raw materials follow the quality specification and no rework done.

Manufacturers -Produce high quality products since following specification, reducing controlling cost if follow specification, use enough quantity of raw materials (based on target quantity), no waste on cost and materials and most importantly cost can be controlled.

Consumers -Have many choices of products to choose from the market. However, if a product produced high in quality, many consumers would buy, high demand, high production and many choices of product will be produced. The quality of product value for the money and the impact high purchase from the consumer since the product so valuable and high in quality.

Purpose of a product having quality specification

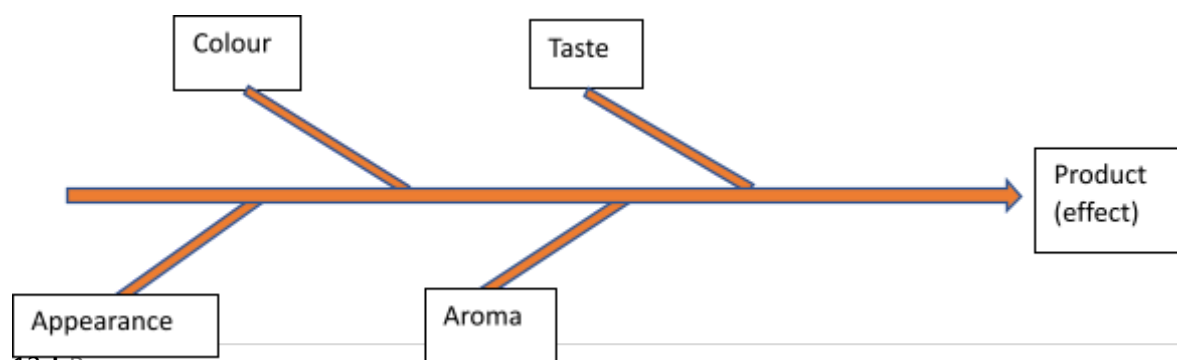
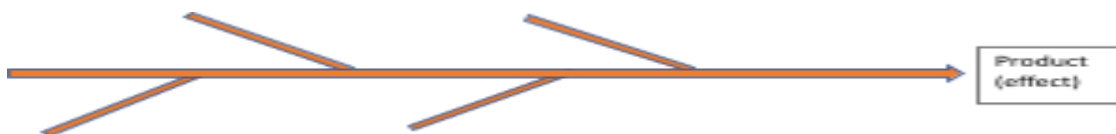
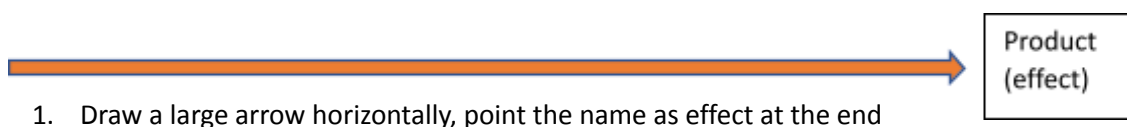
- ✓ As a legal requirement which easy to be marketed
- ✓ To show the level of product quality
- ✓ To satisfy the custome



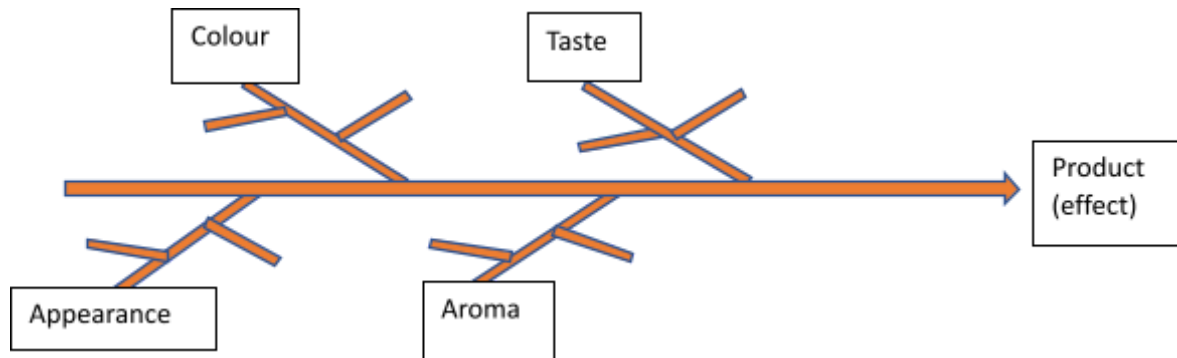
Flow chart that showed detailed specification for raw materials, process and finished good for soybean beverage in sachet.

Quality specification is usually done by quality control/assurance department backed with production & sales personnel. There are tools used in the establishment of quality specifications such as Ishikawa diagram and PDCA cycle.

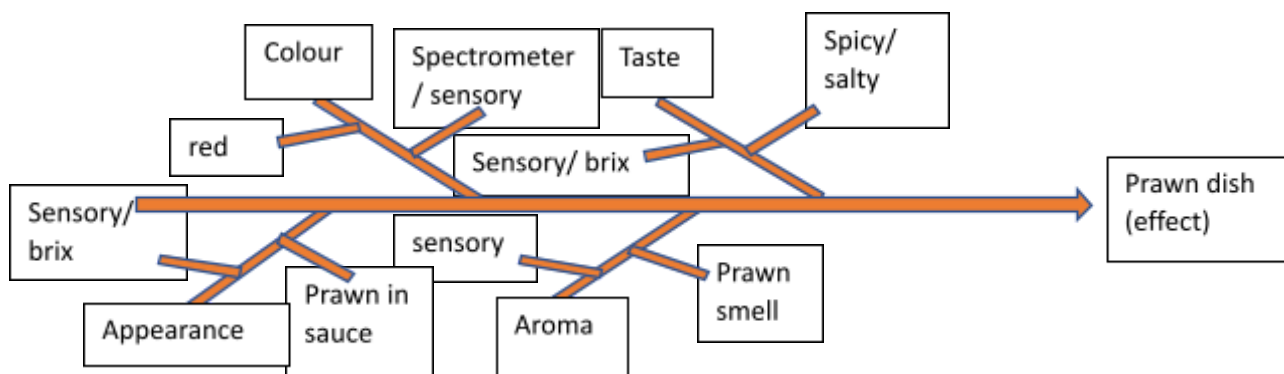
Four basic step of drawing Ishikawa diagram:



3. Tertiary causes can be listed on branches off the category branches.



4. Additional causes can be branched off the tertiary causes.



Tutorial 2

1. Develop **ONE (1)** new product using Ishikawa Method Should include:

Potential causes -basic quality attribute - the factor that led to the quality attribute -test method to evaluate the causes and -scales/grades/specification

03

QUALITY CONTROL PROCEDURE



**DON'T BE BUSY, BE
PRODUCTIVE**





Quality control procedures including raw materials control, process control and finished product control. One of the systems that can be applied during processing is Just in Time (JIT) system. These controls were closely related with the QC jobs.

JUST IN TIME SYSTEM

Minimize the cost by reducing the inventory, reject source, repeat work, wastage, to the

All the documents used while processing must be keep documented. This documentation is also important for the application of any food industry certification. The impact of verbal communication not documented:

- ✓ the verbal instructions can cause misunderstanding and wastage

- ✓ the verbal instructions cannot be used as evidence if something happens at processing department
- ✓ All instructions must be in documentation because all staff can refer to the procedure without a supervisor
- ✓ Must have written instructions for evidence to support the test if any matters arising

Raw materials control means all the receive material whether it been used directly in processing (exp: food ingredients and water) or it been used indirectly (exp: cleaner, food packaging a)

Usually in the food industry, receiving the new raw materials must be inspected first. Raw materials must be hold while waiting for the analysis and result from the lab. That result will determine the future action either accept or reject.

MICROBIOLOGY, CHEMICAL AND PHYSICAL CONTROL OF RAW MATERIALS

Food safety parameters or tolerances for raw materials could include biological, chemical, or physical characteristics. However, the test apply will depends on the types of raw materials. As for example, the dry raw materials commonly do not relate with the microbiological test.

Biological – Microbiological limits for pathogens, such as *Salmonella* and *Listeria monocytogenes*. Microbiological limits for spoilage organisms or indicators of poor sanitation, including total plate count, yeast, mold, and coliform.

Chemical – Fortification levels, sulfite levels, heavy metal content, etc. Characteristics such as concentration levels or purity.

Physical – Size and foreign material (rocks, glass, metal, bones, etc.) Characteristics such

The objective in raw material control can be achieve if the attention is given to the following matters:

1. List all the raw materials, food additives and packaging materials.
2. Determine the role of each raw material, food additives and packaging material.
3. Identify all materials that considered most critical to produce quality product and indicate the characteristic and attribute to be analyze.
4. Determine the specifications of each material.
5. Determine the sampling plan, testing method and accept or reject the raw material that have been provided

as viscosity, color, granulation size, insect parts, crush strength, physical measurements, etc.

Checking of raw materials usually involved the Quality Control officer too. During the inspection, if the raw materials do not meet the specification, first get all the documentation regarding the rejected raw materials such as delivery information and inspection of acceptance. Next label it clearly so that everyone in the production area aware of rejected raw materials. Moreover, that rejected raw materials must be placed away from the good materials to avoid other workers used it. Lastly the items should be destroyed or return to the supplier.

Process control - The control that performed during processing to know whether the ingredients follow the specifications in food Act 1983 and food regulation 1985

The effort of quality control is more focused on processing flow and processing ability studies whether

The process can fulfill the specification of the products

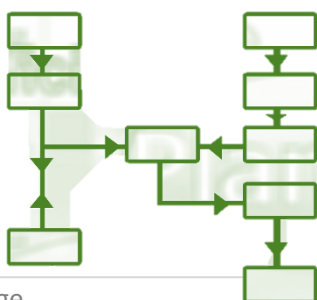
Sampling point. Choose the best place to do sampling. As for example, sampling the weight of biscuit before baking and after baking



The important thing in processing control is to prepare the flow chart. Flow chart must be understood by the workers while producing product.

IMPORTANCE OF FLOW CHART

- The flow that shows the procedure from raw material until finish product can be follow clearly
- Identified the critical control step since processing. (The critical control step must be control closely to make the product follow the specification given)



Sampling frequency. As for example, one sampling within an hour. The higher the frequency better for the quality control process.



Rapid Test Example

The control must be able to give immediate response. The tests must be brief and fast. While conducting the test, if any defect detected, the production needs to stop immediately, so that reduce rework or wastage of the product.

FINISH PRODUCT CONTROL

Involve production evaluation. This process can be run after production or after duration of the product have been stored. However, controlling in this stage cannot improve the quality of the product after the processing activity. As for example controlling since storing, handling, and transporting

The purpose of finished product control:

- To make sure that the production follows the formulation.
- Identified the cause of contamination might be happen in finish product although the product has been controlled since raw material.
- Give information about the product status either follow the specification or not.
- Determine whether the good control has been carrying out in raw material and processing

Viscometer - viscosity examples: sauce, cream, chocolate

α – amylase test - *Salmonella* present example: egg

Refractometer - soluble solid content: determination of concentration of sugar in fruit product. examples: pickle, jelly, puree

EXAMPLES OF FINISH PRODUCT CHECKING

Weight and volume checking

Storage effectiveness

Determine color, moisture, taste, fat contain, soluble solid contain.

Storage and packaging control.



PRODUCT RECALL

Rather than raw materials control, process control and finished product control, the

product produced always has the probability of defect detected. A company should also

have the procedure of accepting complaints from the consumers. Hence, this is when all the product with the same batch number needs to be recalled back to the factory.

Product recall

Recalling a food product is often the worst-case scenario for a company in the food industry

The cost of notifying the public, transporting the recalled stock, and subsequently destroying the product can quickly amount to millions.

Worst still is the irreversible damage that a product recall can do to a brand's reputation whenever public health care is involved.

Impact of product recall

- These are just the direct costs, which typically include notification
- Affect regulatory bodies, supply chain and consumers
- Product retrieval (reverse logistics)
- Storage and destruction issue
- Unsalable product problem
- Additional labor costs associated with these activities as well as the investigation of the root cause.

Tutorial 3

1. State the definition of 'Just In Time' system.
2. Explain **THREE (3)** importance of documentation in the food industry.
3. Your company is planning to produce chocolate biscuits. Your team is required to come up with suitable quality specifications for the products
 - i. Show how the specifications are set by applying **FOUR (4)** steps in developing Ishikawa Diagram
 - ii. Suggest **TWO (2)** raw materials for biscuit
 - iii. Based on your answer in question 3(ii), write **TWO (2)** suitable quality specifications for each raw material that you stated.

04

SAMPLING



JUST KEEP GOING



Sampling is a process of selecting a suitable representative part of a population for the purpose of determining characteristics of the whole population. The aim of sampling is to ensure that the sample taken for analysis is accurate and precise to define the whole population. The **population** refers to the total quantity from which a sample is obtained. Normally, the food samples obtained from a sampling will be subjected to a further analysis or inspection. **Food analysis** is important to determine the quality, safety, or compositional compliance of a particular food products. Whereas **inspection** is required to measure, examine, or test a sample of ingredients or products units to determine if the items are acceptable and meet specifications.

Most sampling is done for a specific purpose, and the purpose may dictate the nature of the sampling approach. Apart from that, sampling

approach might may also vary according to the nature of the food samples. The food samples may exist in various form such as powder, semi-solid, liquid and emulsion thus might need an appropriate sampling technique.

Besides that, sampling need to be planned carefully to ensure it effectiveness. A **sampling plan** will require a person to define the sample size, sampling frequency, location of sample collection, method used to collect the sample, and method used to transport and preserve before analysis. By defining the sampling plan, it will make the sampling process easier and workable.

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sampler which is an in-line sampling systems for collecting “composite samples” from a uniform flow of liquids, powders, or particulates. There is another tool known as rifle or divider, which a vibrating, subdividing sampling system with numerous sample pockets for use with a free-flowing particulate powder.

Where does sampling occur?

- In supplier’s warehouse
- Upon receiving
- During processing activity
- From storage area

- In truck / container
- In market

Benefits of sampling:

- Low production cost (analysis on certain part of product only)
- Low labour cost (less checking activity needed)
- Prompt feedback and represent whole product
- Provides strong motivation for supplier to improve their quality



Statistical considerations during sampling

Probability sampling prescribes the selection of sample from a population based on chance. It provides a statistically sound method for obtaining representative samples with elimination of human bias.

For examples blenders are effective in grinding soft/flexible foods and suspensions. Meanwhile, mortars and pestles and mills are best for dry food samples.

Randomization is always desired. However, it is not always feasible, or even practical, to take samples based on probability methods. Therefore, **nonprobability sampling** may be more economical and practical than probability sampling.

Preparation of samples

General size reduction

When the particle size of the sample is too large for the analysis, it must be reduced in bulk. Reduction of the particle sizes can be obtained via grinding process. Various mills are available for reducing particle size to

Enzymatic inactivation

Food materials often contain enzymes that may degrade the food components being analysed. Therefore, the enzyme activity must be eliminated and controlled. Heat denaturation is the common methods used to inactivate the enzymes. Besides that, some enzymes are more effectively controlled by changing the pH. Meanwhile, oxidative enzyme may be controlled by adding reducing agents.

Lipid oxidation protection

Unsaturated lipids are sensitive to oxidative degradation and should be protected by storing under nitrogen and vacuum. Antioxidants may also be used to stabilize the lipids if the antioxidant do not interfere with the analysis.

Microbial growth and contamination

Microorganisms are present in almost all foods and can alter the sample composition

prior to analysis. Therefore, the most effective technique to control microbial growth are by freezing, drying and chemical preservatives. However, the used of preservation methods need to consider its probability of contamination which may influence the results of analysis.



Sampling Principles

i) Sample population

finite: sampling provides an estimate of lot quality

infinite: sampling determines characteristics about the process

ii). The number of samples must be sufficient, the larger the sample size, better to get an accurate result

iii). Sampling point can be done upon receiving raw materials, during processing or for the finished product (before / after distributing)

iv) Sampling frequency, higher frequency much better. For instance, one sampling/hour.

v) Sampling area must be suitable and clean.

vi) Sampling application should be important to give ideas about the quality of the products. For example, the brown color shown the sufficient timing of cooking

Homogeneous or Heterogeneous populations

The ideal population would be the same at every location

Homogeneous: can select a portion from any location and obtain results that are representative of the whole

Heterogeneous: results obtained will depend on the location of sampling

Manual and Continuous sampling

Manual sampling

The unit being sampled as homogeneous as possible prior to sampling

Example:

- liquids – shaking or aeration
- grain - taken from several points at random, then composite

Continuous sampling using mechanical sampling devices. Automatic sampling devices for liquids, or dry materials

Sampling Defect Classification

Defects detected during visual inspection are usually classified within 3 categories:

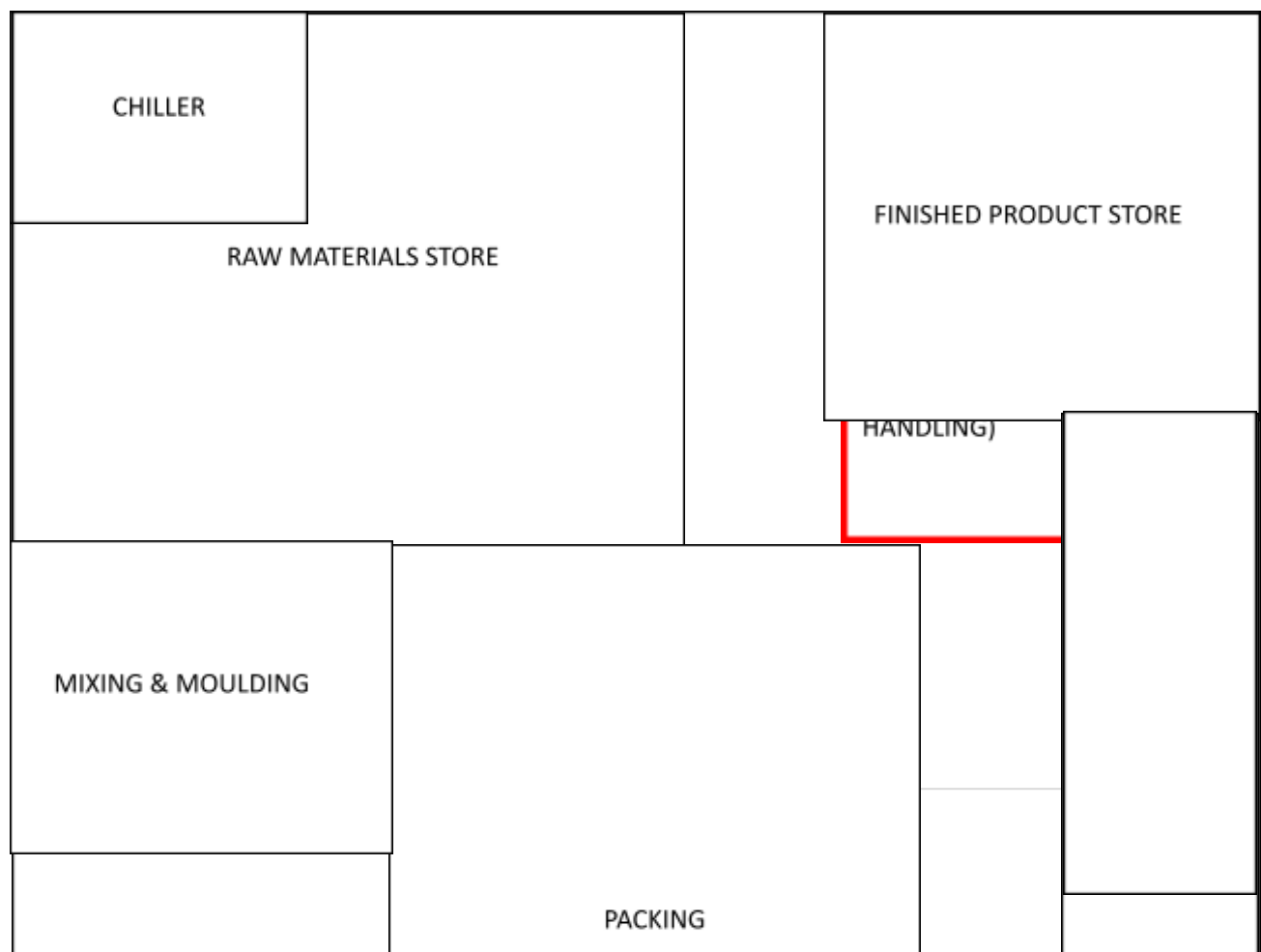
Critical: likely to result in unsafe condition or contravene mandatory regulation or reject by import customs

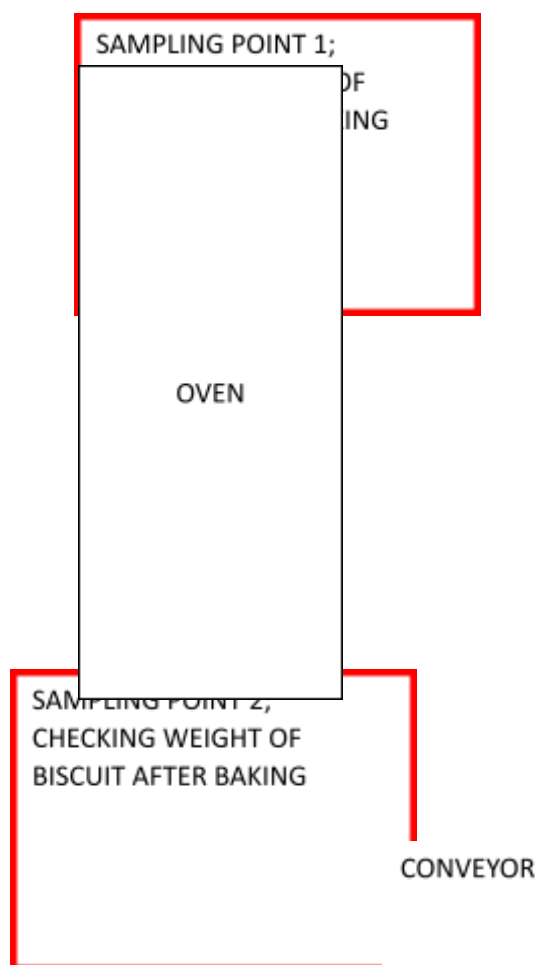
Major: reduces the usability/function and/or sale of the product or is an obvious appearance defect.

Minor: doesn't reduce the usability/function of the product but is a defect beyond the defined quality standard reduces the sale of the products. Example the product dirty.

Tutorial 4:

1. Based on your understandings, discuss three purposes of sampling.
2. Explain **TWO (2)** type of probability sampling.
3. Differentiate between homogenous and heterogenous sampling.





Example of sampling

point in biscuit production factory

05

TESTING METHOD



GREAT THING NEVER COME
FROM THE COMFORT ZONES



Food products should be tested according to the specification. The test applied depends on the types of food products produced. There are three main characteristics of quality testing methods which is **physical characteristics testing, chemical characteristics testing** and the quality of taste bud (organoleptic). However, in this subtopic only physical and chemical characteristic testing will be covered. Physical characteristic testing such as color, solubility, density, shape, and size. While chemical characteristic testing such as pH, food additive and heavy metal in food. The test usually done by the quality control officer that directly involved at the production. The test conducted should accurate and precise as well as producing no error while testing.

PRECISION

Ability to produce same value each time measurement is done by an equipment/method of similar material

ACCURACY

The ability of a measurement to match the actual value of the quantity being measured

ERROR

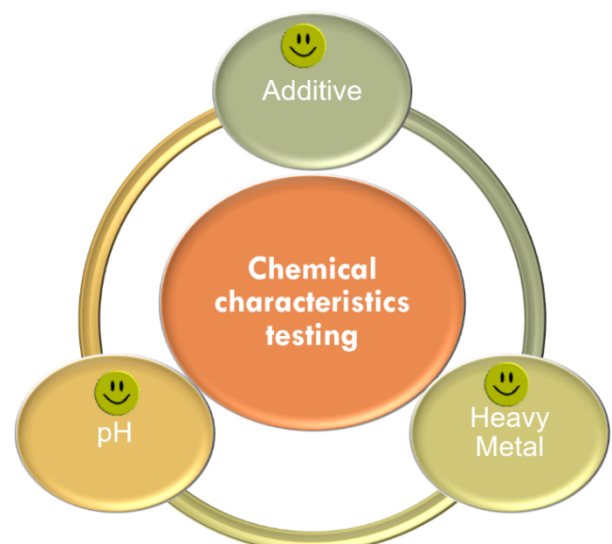
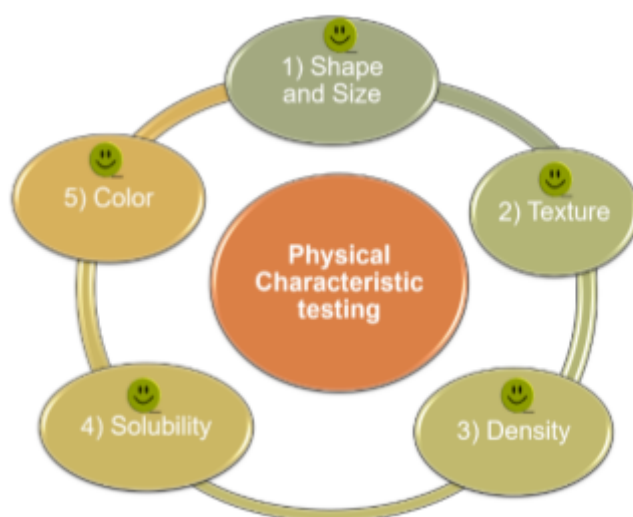
Difference between the actual value of the quantity and the value obtained by a measurement

Food texture is the group of physical properties derived from the structure of the food that can be sensed by touch. This touch is usually by the elements of the oral/pharyngeal cavities but may be sensed by other parts of the body, such as by the hands.

Solubility of a substance can be expressed as the amount of materials that will dissolve in the solvent with a given volume at a specified temperature and pressure. If not specified the solvent is considered as water.

Food additives are substances or mixtures of materials that can be inserted directly into the food or indirectly during production, storage, or packaging. According to Food Protection Committee food additive group can be classified as:

- Acid, alkali, buffer, neutral substances
- preservative
- Color material
- Flavor and sweetness without nutrients
- Additional nutrients
- Emulsifier, stabilizer, or thickeners.



PHYSICAL CHARACTERISTIC TESTING

1) SHAPE AND SIZE

- Obtaining a uniform grading for cutting, peeling, and filling in the former.
- Get uniform size and shape as customer

METHOD/EQUIPMENT

- Manual-hand /visual
- Mechanical. example: drum conveyor, conveyor belt and screen

4) DENSITY

- Indicator of total solid content.
- One of the physical characteristics of raw material or product
- Can evaluate the oil content by measuring its density extractions . (oleometer)

Quality characteristics of purity:

- Fruit texture
- Maturity
- Drying indicator

METHOD/EQUIPMENT

By inserting the hydrometer into solution (floating principle)

- Example:
- oil - oleometer
- milk – lactometer
- sugar – saccharometer
- salt – salanometer
- alcohol-alcoholometer

5) COLOR

i. Raw material

- As maturity index
- As spoilage index

ii. Product

- End point index
example : frying potatoes
- oxygen point index during processing
example : high oxygen – the colour of the product become darker.
- humidity index
example : tomato powder- the colour become darker if high humidity

METHOD/EQUIPMENT

- Subjective– visual
- Objective – example: Hunterlab

CHEMICAL CHARACTERISTIC TESTING

pH

- Food storage – indicate the acid effect as inhibitors of the growth of microorganism and enzymes
- Hydrogen ions affect the degree of heat use in canning process for commercial sterilization.

Example: vegetables and meats require high temperature, long time while processing compare fresh fruits with high acid content.

- Varies of food physical characteristics are affected by pH value.

Example: texture properties and the ability of freezing for toughening the gelatin gel and sugar acid pectin for jam.

METHOD/EQUIPMENT

- Universal indicator
- Litmus paper
- pH meter

ADDITIVES

- Maintain food quality
- Improve storage quality
- To ease the processing.
- Increase the acceptable

METHOD/EQUIPMENT

- The equipment that can be use:
- Spectrophotometer
- High Performance Liquid Chromatography (HPLC)
- Gas Chromatography (GC)

HEAVY METAL

- Determining the food taste uniformity
- Determining the oxidation reaction in foods
- Determining the losses of vitamin during reaction
- Detection the heavy metal which is not required to present in food (always found in imported food)

METHOD/EQUIPMENT

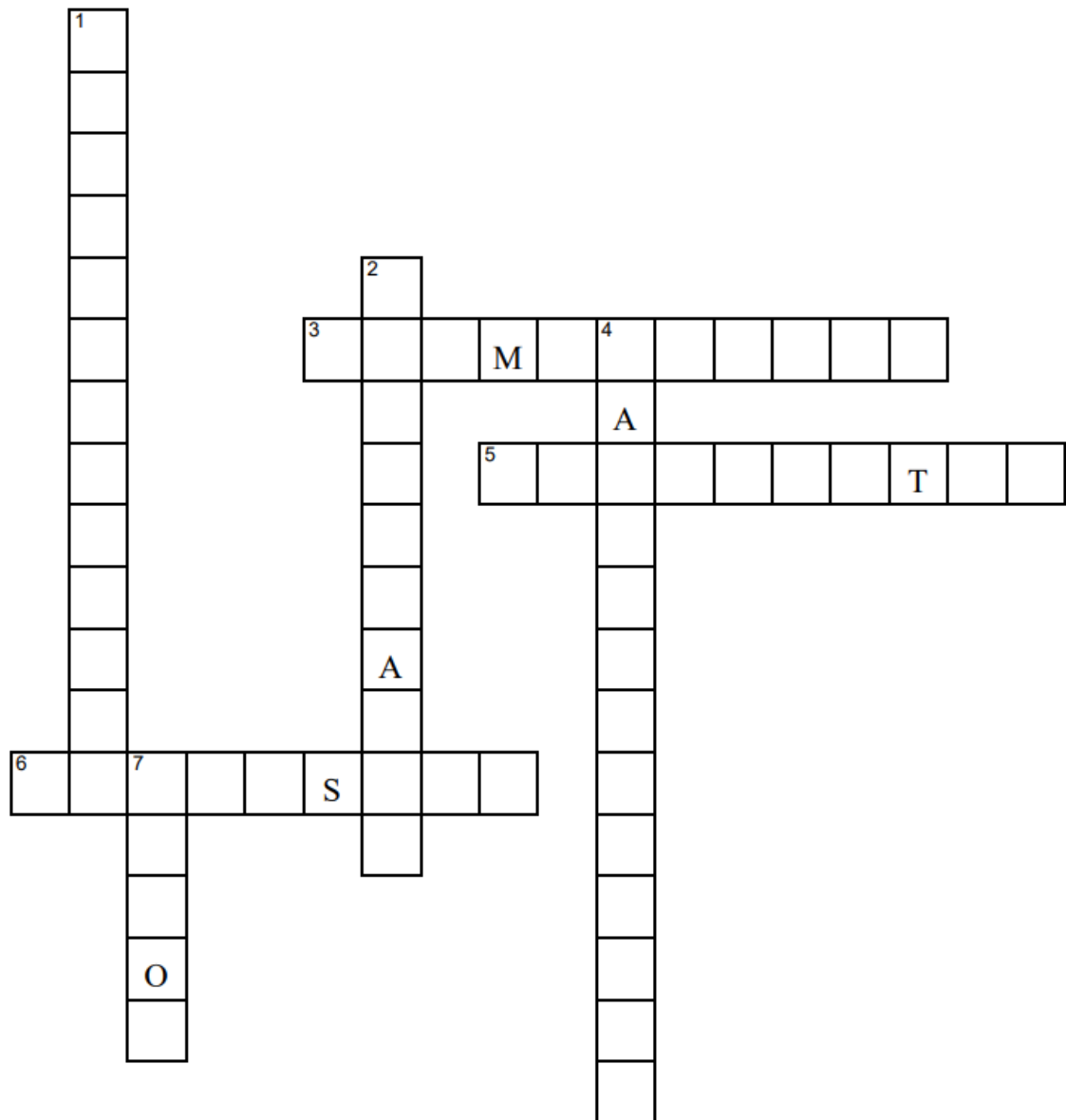
- The method used:
- AAS (Atomic Absorption Spectrophotometer)

Essential heavy metal: Copper, Zinc, Iron

Non-essential heavy metal: Aluminium, Boron, Arsenic, Plumbum

Tutorial 5

1. What is the purpose of determining the size and shape of a product?
2. Colour is one of the parameters that can be used to determine food products quality. Explain how colour can indicate product quality.
3. State **THREE (3)** non-essential metal.
4. Let's try the puzzle below!



Across:

- | | |
|--|---|
| 3. A method to measure pH | 6. Ability to produce same value at every time of measurement |
| 5. An equipment to measure density of milk | |

Down:

- | | |
|--|--|
| 1. An equipment to measure solubility | 4. An equipment to measure density of sugar |
| 2. Touching method for the texture of food | 7. Difference between the actual value of the quantity and the value obtained by a measurement |

06

RECORDING AND REPORTING

“

IF YOUR DREAM
DON'T SCARE YOU,
THEY ARE TOO SMALL

”

During production days, QC recorded many data from all the processes. The data is then will be kept and analyze and reported by the management usually by the quality assurance officer.

Recording to record all the data in inspection form

Reporting to make report from the control chart analysis

Importance of recording and reporting:

- Ensure specification is met (every single process eg: list down/ record all criteria from raw materials, process, product -follow specification.)
- Increase quality of products. (if specification is met, the quality of product assured).
- Reduce product un uniformities through most economical means. (Through R&R –continuously process, so early detection of ununiformed product can be controlled.
- Increase productivity



Things to be considered in drafting a form:

- ✓ Does the form contain all information needed?
- ✓ Does every item include in the form is important?
- ✓ Does it have enough space to write down all information required?
- ✓ Does it item in the form are arranged for ease of inspection?
- ✓ Use of different form for different inspection (raw material inspection form, process inspection form)
- ✓ Copy is sent to related departments/parties

Variable's chart is a way of presenting data that collect daily by a quality control officer which used in quantitative measurements, extremely useful, easy to prepare, simple to understand. Measurements are expressed in discrete number, such as in mililiter (ml), gram (g), % solids, °C, inches and pH unit. Example variable chart X bar chart and R bar chart. Both of this chart was correlate each other and data can be calculated together prior plotting the graph.

Importance of variable chart:

- Used for controlling every step of production
- Acceptance / Rejection
- Product improvement
- early detection of equipment or process failure

Attribute chart used in qualitative measurements/pass-fail features good or bad/heavy or light. An example of attribute chart is P chart.

X BAR CHART

To check the efficiency of a filler machine, periodic headspace inspection is done by randomly drawing 5 cans for each sampling.

Experience shows that can headspace between 3/32 - 4/32 inches(2-3mm) is acceptable.
Data from 15 working days is shown as follows

Day	Sampling number (cans)							
	1	2	3	4	5	Σx	Average $\sum \bar{x}$	Range, R
1	7	10	8	2	8	7+10+8+2+8 =35	$\frac{(7+10+8+2+8)}{5}$ = 35 / 5 7	(↑ - ↓) (10 - 2) 8
2	6	9	3	4	3	25	5	6
3	6	7	2	6	4	25	5	5
4	4	8	5	8	7	32	6.4	4
5	10	3	5	7	4	29	5.8	7
6	8	11	9	7	6	41	8.2	5
7	5	7	5	5	7	29	5.8	2
8	9	5	8	0	6	28	5.6	9
9	6	5	4	5	5	25	5	2
10	1	3	1	3	3	11	2.2	2
11	3	4	6	9	4	26	5.2	6
12	5	3	6	7	3	24	4.8	4
13	5	6	8	7	9	35	7	4
14	7	7	8	6	7	35	7	2
15	7	7	6	7	8	35	7	2
					Σ	435	87	68
							$\sum \bar{x} = 87/15 = 5.8$	$\bar{R} = 68/15 = 4.5$

Steps:

1. Find Σx , $\Sigma \bar{x}$, $\Sigma \bar{x}$, ΣR and $\bar{R}$

$$\Sigma x = 435$$

$$\Sigma \bar{x} = 87$$

$$\Sigma \bar{x} = \Sigma \bar{x} / \text{day} = 87/15 = 5.8$$

R = the highest value – the lowest value

$$\Sigma R = 68$$

$$\bar{R} = \Sigma R / \text{day} = 68/15 = 4.5$$

2. Refer to factors for computing control chart limits table to get A_2 , D_3 , and D_4 values.

Table of Control Chart Constants							
	X-bar Chart Constants		for sigma estimate	R Chart Constants		S Chart Constants	
Sample Size = m	A_2	A_3	d_2	D_3	D_4	B_3	B_4
2	1.880	2.659	1.128	0	3.267	0	3.267
3	1.023	1.954	1.693	0	2.574	0	2.568
4	0.729	1.628	2.059	0	2.282	0	2.266
5							
6	0.483	1.287	2.534	0	2.004	0.030	1.970
7	0.419	1.182	2.704	0.076	1.924	0.118	1.882
8	0.373	1.099	2.847	0.136	1.864	0.185	1.815
9	0.337	1.032	2.970	0.184	1.816	0.239	1.761
10	0.308	0.975	3.078	0.223	1.777	0.284	1.716
11	0.285	0.927	3.173	0.256	1.744	0.321	1.679
12	0.266	0.886	3.258	0.283	1.717	0.354	1.646
13	0.249	0.850	3.336	0.307	1.693	0.382	1.618
14	0.235	0.817	3.407	0.328	1.672	0.406	1.594
15	0.223	0.789	3.472	0.347	1.653	0.428	1.572
16	0.212	0.763	3.532	0.363	1.637	0.448	1.552
17	0.203	0.739	3.588	0.378	1.622	0.466	1.534
18	0.194	0.718	3.640	0.391	1.608	0.482	1.518
19	0.187	0.698	3.689	0.403	1.597	0.497	1.503
20	0.180	0.680	3.735	0.415	1.585	0.510	1.490
21	0.173	0.663	3.778	0.425	1.575	0.523	1.477
22	0.167	0.647	3.819	0.434	1.566	0.534	1.466
23	0.162	0.633	3.858	0.443	1.557	0.545	1.455
24	0.157	0.619	3.895	0.451	1.548	0.555	1.445
25	0.153	0.606	3.931	0.459	1.541	0.565	1.435

Control chart constants for X-bar, R, S, Individuals (called "X" or "I" charts), and MR (Moving Range) Charts.

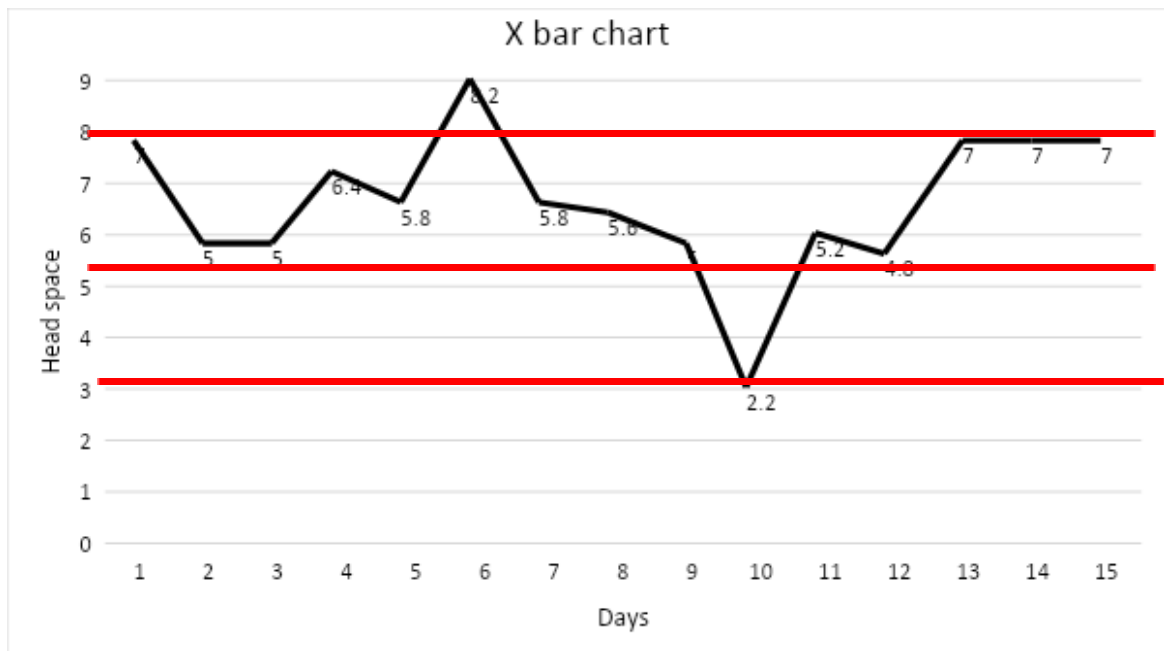
3. Calculate UCL and LCL for both charts

UCL = Upper Control Limit

LCL = Lower Control Limit

$$UCLX = \bar{\bar{x}} + A_{2R} = 87 + 0.577 (4.5) = 8.3965 \approx 8.4$$

$$LCLX = \bar{\bar{x}} - A_{2R} = 87 - 0.577 (4.5) = 3.2035 \approx 3.2$$



4. Make a conclusion:

- The chart was not under controlled because one of the head spaces was below LCLx
- Not a normal graph
- Not follow the specification
- Need corrective action such as calibration

Based on the conclusion, one of the measurements of the head space was out of range at day 10. Corrective action needed to ensure all the measurement of head space within the range of specification.

Example of corrective actions:

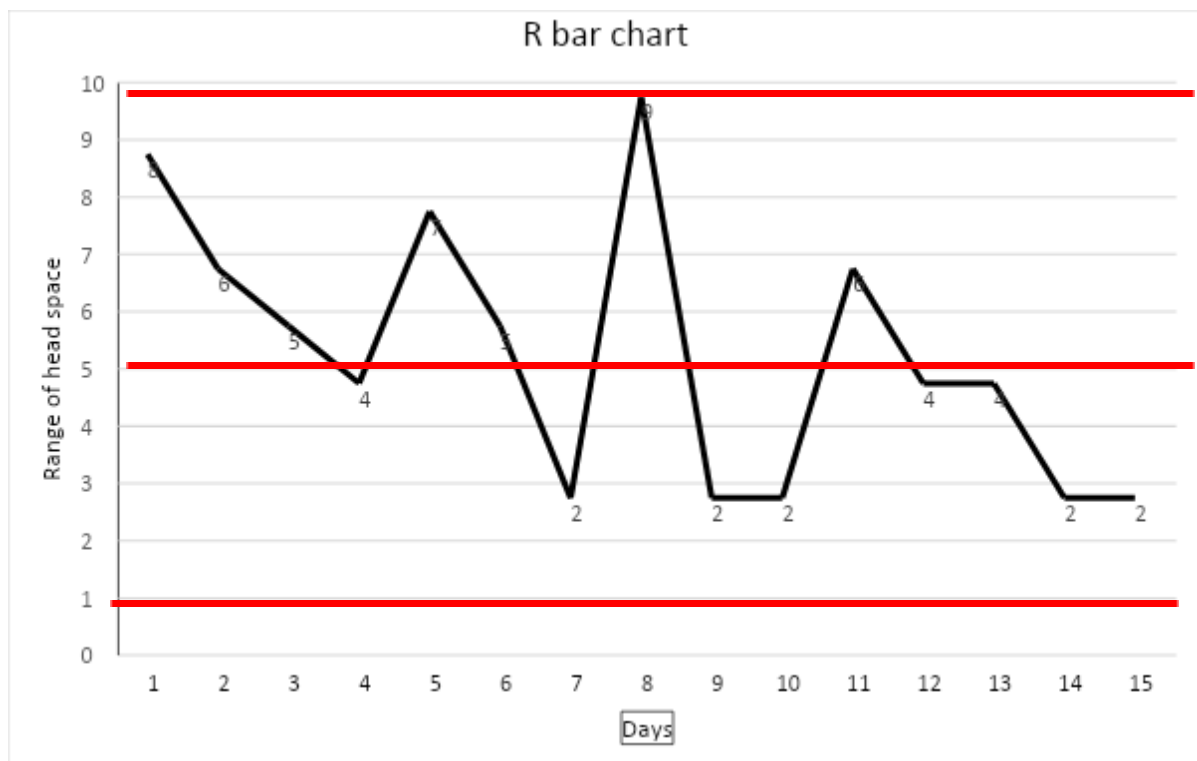
- ✓ Manpower skill-not doing job properly such as wrong formulation and materials, need to have training on the job scope
- ✓ Equipment failure-wrong setup, quality control officer ensuring the correct set up
- ✓ Power supply-electricity down, stop the production immediately
- ✓ Environmental conditions-temperature and humidity, record of the data can be verified periodically

R BAR CHART

With the same data that calculated previously in plotting X bar chart and using the same table of control chart constant, calculated the UCL_R and LCL_R . Then plot the R bar chart using the same steps and data.

$$UCL_R = D_{4R} = 2.114 \times 4.5 = 9.513 \approx 9.5$$

$$LCL_R = D_{3R} = 0 \times 4.5 = 0$$



Conclusion:

- The chart was under controlled because none of the average head spaces was below the UCL_R or more than LCL_R
- Normal graph
- Follow the specification
- No need any corrective action

Based on the conclusion the range of the head space was within the range of specification since all the data within the UCL_R and LCL_R .

Next is the attribute chart which is commonly used in accepting or rejecting products. There are four commonly used charts, and each has a specific use.

- **p Chart (constant lot size)** used to determine control of percent defective units
- **p Chart (variable lot size)** used to control percent defective units where the number of units varies from sample to sample
- **np or m Chart** (constant lot size) used to control the number of defective products in each lot
- **c chart** used to determine if the number of defects in a single product is within control limits.

Percent Defectives Chart: p Chart with Constant Lot Size

A beverage company receives its bottle supply from Supplier A. An acceptance sampling is done by taking 50 bottles randomly for every in-coming batch to determine any presence of defect. Data below is gathered from 15 batches of bottles supplied.

Batch	Sample size (n)	Defective (m)	Fraction defective (p) $p=m/n$
1	50	4	0.08
2	50	1	0.02
3	50	7	0.14
4	50	11	0.22
5	50	3	0.06
6	50	6	0.12
7	50	8	0.16
8	50	1	0.02
9	50	7	0.14
10	50	5	0.10
11	50	3	0.06
12	50	1	0.02
13	50	2	0.04
14	50	3	0.06
15	50	2	0.04
	$\sum \bar{n} = 750/50 = 50$	$\sum m = 64$	$\sum p = 1.28$ or $\sum m / \sum \bar{n} = 64/50 = 1.28$
			Average fraction defective = $\sum m / \sum n = 64/750 = 0.085$

Steps:

1. Sum the sample size(n) and defective (m)
2. Calculate fraction defective (p)
3. Average sample size (n)
4. Average fraction defective
5. Calculate UCL_p and LCL_p

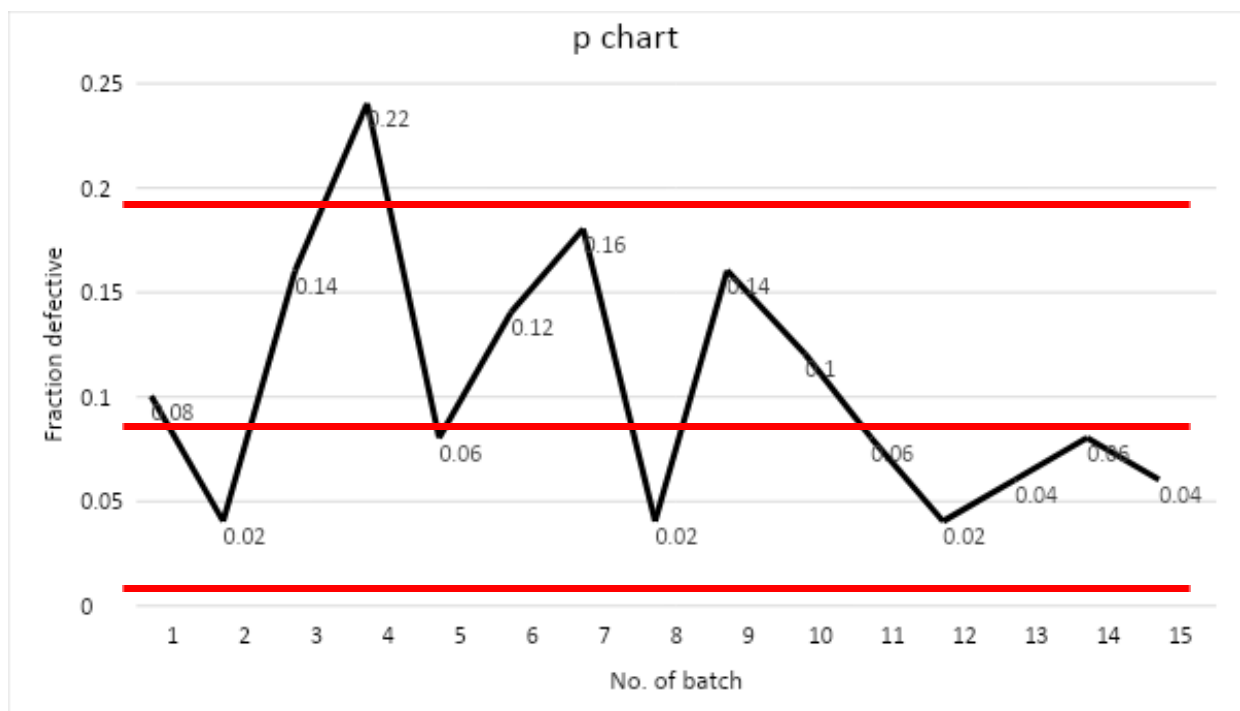
$$\frac{p \pm 3(\sqrt{p(1-p)})}{n}$$

$$UCL_p = 0.085 + \left(\frac{3 \cdot (\sqrt{0.085(1-0.085)})}{50} \right)$$

$$= 0.203 \approx 0.2$$

$$LCL_p = 0.085 - \left(\frac{3 \cdot (\sqrt{0.085(1-0.085)})}{50} \right)$$

= -0.033 @ 0 (this value cannot be negative, automatically converted to 0 if gain any negative value)



Conclusions:

- The chart was not under controlled because one of the batches was more than UCL_p (batch number 4)
- Not a normal graph
- Not follow the specification
- Need corrective action

The corrective action will depend on the company policy in accepting or rejecting any batches from that bottle supplier. For instance, one batch had been rejected means the other batches also will be rejected.

Tutorial 6

To check the efficiency of a filler machine, periodic headspace inspection is done by randomly drawing 5 cans for each sampling.

Experience shows that can headspace between 3/32 - 4/32 inches(2-3MM) is acceptable.

Data from 15 working days is shown as follows:

Day	Sampling number of cans					Σx	Average, $\bar{x}$	Range,R
	1	2	3	4	5			
1	7	9	8	3	6			
2	5	8	2	3	3			
3	5	6	2	5	4			
4	4	8	5	8	7			
5	8	3	5	7	4			
6	8	11	9	7	9			
7	5	8	5	5	8			
8	10	5	8	2	2			
9	9	5	6	5	5			
10	2	3	2	3	3			
11	5	4	6	8	4			
12	4	4	6	7	3			
13	5	6	7	7	7			
14	9	9	8	6	7			
15	4	5	6	7	8			

Based on Table above,

- I. Calculate the total sum of sample size ($\sum x$), sum of average sample size ($\sum \bar{x}$), grand average / central limit ($\bar{\bar{x}}$), total range ($\sum R$), average range ($\sum \bar{R}$), Upper Control Limit (UCL_x) and Lower Control Limit (LCL_x) for the final product.
- II. Sketch an X Bar Chart and determine the Upper Control Limit (UCL_x) and Lower Control Limit (LCL_x) in the chart. Then do conclusion for the chart.

PHOTO CREDITS

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