Importance of microbiological risk management in the stabilization of food processing co-products

- Microbiological stabilization is essential to avoid the growth of micro-organisms, which would have two major implications.
- Firstly, the micro-organisms may utilize or convert some of the co-products and hence diminish yields or corrupt the process (essentially act as spoilage organisms).
- Secondly, the organisms may be capable of causing illness to workers involved in the process, or cause illness in consumers for whom the co-product is intended.

- Accordingly, eradication of micro-organisms or control of their growth should be an integral part of co-product processing.

- Micro-organisms may cause spoilage of the co-products or waste streams. Or that the micro-organisms are hazard to health and may cause disease.

- A **hazard** can be defined as a biological agent with the potential to cause an adverse health effect.

- **A risk** can be defined as a function of the probability of an adverse effect derived from the hazard.

Micro-organisms can be controlled by one or more of three methods:

1. Good Hygienic Practices
2. Hazard analysis and critical control points
3. Risk analysis

Good Hygienic Practices

- It involves ensuring that the product remains "microbiologically clean" throughout and that no additional microbiological contamination occurs during the processing.
- However, it does not quantify the initial numbers of contaminating micro-organisms, does not determine the risk presented by them, and not does it introduce procedure capable of controlling their growth or eradication.
- It is a good first step and should be applied irrespective of the use of HACCP or Risk Analysis approach.
- In the context of co-products, the application of good hygience practices would begin with the segregation of separate waste streams.

HACCP

- This is the practical, yet systematic approach to the identification, evaluation and control of hazards.
- It designs methods into the process by which the survival and growth of micro-organisms can be controlled.

HACCP is based on seven principles:

1. Conduct a hazard analysis.
2. Determine the critical control points.
3. Establish critical limits.
4. Establish monitoring procedures.

5. Establish corrective actions.
6. Establish verification procedures.
7. Establish record-keeping and documentation procedures.

Quantitative Microbiological Risk Assessment

- It is a broad and overarching framework that is primarily for governmental safety management.
- The broad application of QMRA to co-products or end-products necessitates an understanding of the types of micro-organisms in the co-product, their numbers and fate, and the consumption or use pattern of that co-product or end-product.

The component stages of QMRA are

1. Hazard identification
2. Hazard characterization
3. Exposure assessment
4. Risk characterization

1. Hazard identification

- This can be either reactive or proactive.
- Reactive hazard identification is our response to a microbiological hazard that has been identified or a consequence either of an outbreak of disease or of spoilage.
- It is a response to a problem and to cases where the micro-organisms have been identified and confirmed as the causal agent.
- Proactive hazard identification is preferable. It arises where the presence of a microbiological hazard in a particular product may be suspected, but where a link between the product and disease or spoilage has not definitely been established.
- The raw materials may thus be used to inform the hazard identification because they might classically be associated with particular spoilage or food-borne pathogenic micro-organisms.
- The micro-organisms can then be prioritized: some pathogens or spoilage organisms will be more important than others and therefor require urgent control.

2. Hazard Characterization

- This is the evaluation of the nature of the adverse effects resulting from the presence of micro-organisms in the co-product.
- It may be qualitative or quantitative.
- The hazard characterization can be influenced by the composition of the co-product stream.

3. Exposure assessment

- It is an assessment of the likely intake by a consumer, by the hazard in the co-product.
- Equally, it could assess the likely presence of micro-organisms able to cause spoilage within that co-product.
- It includes the potential for the survival or growth of those organisms, or contamination and growth after the co-products have been processed, but prior to the consumption by a consumer.

4. Risk Characterization

- It is an estimate of the probability of an occurrence and the severity of the potential adverse effects derived from processing of the co-product or form consumption of the co-product.

- Therefore, risk characterization combines the identification of the micro-organims concerned and its virulence, either in terms of the risk to the consumer or its ability to cause spoilage.

Strategies for Controlling Micro-organisms

1. Preservatives

a. Organic acid

- Preservatives used in food matrix are predominantly weak acids, such as acetic, lactic, citric or sorbic acids.
- Their preservative action is a combination of their effect on pH and the antimicrobial properties of the un-dissociated form of molecules.

b. Inorganic preservatives

- The well known inorganic preservatives are probably sulphur dioxide and nitrites, which are used widely.
- Both SO_2 and nitrite are inhibitors of the growth of micro-organisms and of certain sensory changes, particularly those due to oxidation or enzymatic deterioration.

c. Natural preservatives

- Natural preservatives can include inhibitory compounds found in plant tissues.
- Many herbs and spices have antimicrobial properties.
- The active components vary in types considerably and include thiocyanates, sulphoxides, cinnamates, and a range of acids and phenolic compounds.

d. Microbial antagonism

- The growth of certain micro-organisms can be inhibitory to the growth of others.
- The most closely studies are the lactic acid bacteria which can be inhibitory to a range of food poisoning and food spoilage bacteria.

2. Low temperature

- Storage at refrigeration temperature can be fundamental to the stability of co-products and end products.
- The effect of a decrease in temperature is retardation of chemical deterioration and of growth rate of micro-organisms, thereby prolonging the period of microbiological stability.

3. Applied processing

- Common treatments or processes that can be applied to kill micro-organisms or retard their growth include chilling, freezing, heating, dehydration or a combination of these processes.