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 SO2 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.