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THE ECONOMIC IMPORTANCE OF MICROORGANISM IN FOOD PROCESSING

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1.0 PREAMBLE:

This paper attempts to highlight the Economic Importance of microorganisms in food processing and manufacturing; it goes further to differentiate between the desirable and the undesirable Importance of these organisms, and concludes by looking at the activities of the local, national and international law enforcement authorities towards these organisms.

2.0 OVERVIEW

Microorganisms, despite their small size, play an Important role in the assessment and maintenance of food quality and safety in food processing and manufacturing industries. These microscopic form of life has been recognised by enforcement authorities at the local, national and international levels.

The phrase "Economic Importance" is a double edged sword, it has it's advantages and disadvantages at the various area of applications. Putting into consideration the diverse areas of which includes organisms display their economic importance which includes pharmaceutical, clinical, environmental etc, this paper will be restricted to food processing and manufacturing.

Economic Importance of microorganism in food processing and manufacturing is directly proportional to microbiological specifications, standards or control. In the light of the above, it's objectives could be summarized as follows:-

i) To ensure a safe product for the consumer.
ii) To ensure an adequate keeping quality.
iii) To pin-point faults in processing/manufacturing.
iv) To improve the quality of the product.
v) To educate the employees in hygiene and other aspects of their work.

3.0 ECONOMIC IMPORTANCE

This could be divided into two groups: desirable and undesirable importance. Desirable importance are those cost saving and revenue generating activities exhibited by microorganism under controlled conditions. These include:

3.1 FERMENTATION:

This is a biochemical process which involves the conversion of simple sugar to acid, ethanol and Carbon dioxide through the metabolic pathways, e.g the conversion of lactose to lactic acid by *Lactobacillus bulgaricus* and *Strep. thermophillus* during yoghurt production. And also the decomposition of glucose to ethanol and Carbon dioxide by yeast (*S. calbergeneis* and *S. cerevisea*) during alcoholic beverages production (beer, cider, wine, spirit etc.)

By the above processes, microorganisms have been found to play important roles in saving cost and revenue generation. Processing of foods such as Gari, Cheese, Yoghurt etc; is successfully done by the activities of these organisms.

These organisms also assist man in ensuring the safety of these products for consumption and the keeping quality of such products, e.g the production of lactic by *Lactobacillus bulgaricus* and *Strep. theremphillus* during yoghurt production. This lactic acid does not only improve the keeping quality of such products but also eliminates the growth of pathogenic organism which is of primary importance to the consumer. This same process could be applicable to quite a number of consumable food items.

Xanthan Gum called Ticaxan - is a naturally fermented product derived from pure culture of an improve strain of *Xanthomonas camperstris.* This microorganism ferments aerobically in a primarily carbohydrate medium which contains micronutrient. Xanthan gum exhibits high viscosity at low concentration, it is a significant additive in many food industries; it may be used to provide body in relishes; add smoothness to cream cheese; control ice crystal growths and improve freeze/thaw properties in frozen foods; helps retain moisture in baked goods; inhibits syneresis in fruit blends; and acts as a stabilizer in beverages. All these are possible with microorganism as the principal actor.

Micrococcus lysodeikticus produces liquid enzyme called Microcatalase through a controlled fermentation process. This enzyme catalyzes the decomposition of hydrogen peroxide to water and molecular oxygen (used in treatment of raw milk).

Microbial rennet used for cheese making is produced from controlled pure culture fermentation of *Mucor pusillus linddt*; "Emporase" microbial rennet is suitable as an economical alternative to animal rennet.

3.2 RIPENING PROCESS:

This is the process of making a particular product ready for eating. Microorganism play a role in ripening process of foods such as Cheese, Fruits, Cream etc. In cheese the characteristic organisms involved include *Brevi-bacterium linens, Penicillium roqueforti; P. camemberti* etc. *B. linens* produces a brownish red surface growth on Cheese (during surface ripening) and breaks down part of the Cheese protein to amino nitrogen thereby releasing a subtle, pleasing flavour into the Cheese. *P. roqueforti* is also added to semi-hard Cheese (Sitilton, Roquefort etc.) to make them ready for eating. And by this singular act, enormous funds are conserved and revenue is generated from this organism. In similar manner, a culture containing *lactococcus lactic subsp. cremoris, lactic leuconostoc mesenteroides subsp. cremoris* is added to cream to make it ripened for Butter production.

Concentrated Banana juice is extracted from ripened banana imparts a natural banana flavour to foods without adding insoluble solids. Suitable for use in ice cream, candy, clarified beverages, and a variety of refrigerated or frozen dairy beverages and bakery products.

3.3 AROMA AND FLAVOUR DEVELOPMENT

Aroma and flavour development is an important aspect of food processing involving microorganism. These, in addition to revealing the natural characteristic of a particular product, primarily assist in organoleptic assessment of such product. These could be grouped in to four (4) categories:-

- Non-volatile acids e.g. lactic, pyruvic. oxalic or succinic.
- Volatile acids e.g. formic, acetic, propionic or butyric.
- Carbonyl compounds e.g. acetone acetaldehyde, diacetyl etc.
- Miscellaneous compound, e.g. constituents formed by thermal degradation of protein, fat or lactose.

The aroma and flavour of yoghurt are basically due to the production of lactic acid and carbonyl compounds. Again funds are conserved through this act. Tamari soy sauce - a naturally fermented product made from soybeans, used in a variety of oriented and non-oriented foods including frozen entrees, prepared meats and sea foods, baked goods, dairy products, salad dressing, sauces, soups and snacks.

Tamari soy sauce is a versatile flavour enhancer which can bring out subtle qualities in food as well as provide a rich aroma and full bodied flavour. This is successfully achieved with the help of microorganisms.

3.4 BREAD, CAKE AND BAKERY GOODS

Microorganism (yeast) play very useful role in the Bakery industries. Not only that they decompose carbohydrate to produce ethanol and Carbon dioxide which is responsible for rising the dough, aldehydes and aromatic compounds are also produced by these organisms and these accounts for the organoleptic and keeping quality of such products.

3.5 In the processed meat factory, species of *Lactobacilli, Micrococci, Pediococcus* and *S. cerevisae* are used for summer sausage production, and salami (polish sausage) production.

3.6 The fruit juice industries are no exception. Species of yeast are often used for various purposes such as volatile acid productions, ethanol and carbonyl compounds.

Find below a highlight of few of these organism and the product for which they are used for:

TABLE 1

ORGANISM	PRODUCT USED FOR
Streptococcus thermophillus	Yoghurt
Strep. lactic	Butter (culture cream)
Strep. cremoris	Butter (culture cream)
Strep. diacetilactis	Yoghurt/Butter cream
Leuconostoc citrovorum	Cheese/Butter cream
Lactobacillus casei	Cheese
Lactobacillus lactic	Cheese
Lactobacillus helveticus	Cheese (emmenthal cheese
Lactobacillus bulgricus	Yoghurt
Geotrichum candidum	Gari
Corynebacterium manihorti	Gari
Acetobacter Sp.	Vinegar
Aspergillus oryzae	Soy Cheese
Mucor rasmusen	Norway Cheese
Penicillin rogueforti	Roquefort Cheese
P. camembert Var Thom	Camembert Cheese
P. Candidium	Camembert Cheese
P. glaucum	Blue Cheese
Penicillin caseincolor	Cheddar Cheese (France)
Bacillus linens	Brie Cheese (East paris)
S. calbergensis	Beer production
S. cerevisae, Lactobtobacillus Spp	Processed Meat product
Pediococcus Sp. & micrococcus	Polish sausage (salami) - Summer
Lactococcus lactic sub. cremoris	sausage
Lactococcus lactic sub. lactic	Gouda Cheese/ripen cream butter
Leuconostoc mesenteroides sub.	Gouda Cheese/ripen cream butter
cremoris.	Gouda Cheese/ripen Cream butter
Xanthomonas campestris	Xanthan Gum

4.0 UNDESIRABLE ACTIVITIES

These are activities that result in loss of revenue, ill-health, fall in profit margin etc, as it may be viewed from different perspectives.

Below is a highlight of few of these activities.

4.1 In the dairy industry, a well-define microbiological fault are characterized by high count of the causative organism eg. *Bacillus cereus* for "bitty cream" in pasteurized milk.

4.2 *Bacillus sp.* for defects in sterilized and evaporated milk, Proteus for bitterness in canned cream ("leakers") *Clostridium sp.* for "stinker" or blown cheese; moulds for colour defect in butter, and yeast for blown tins of sweetened condensed milk.

4.3 *Bacillus ciralans* for phenolic or carbolic taint, Coliaerogenes group for sourness; *Bacillus sp.* for sweet clotting and gassiness in milk. *Streptococcus lactic var. maltigene* for maltytaints. Yeast for blowing in fruit yoghurt and Carbon dioxide production.

4.4 In fruit industries, bottled fruit juices and squashes which may contain preservatives and have been pasteurized may contain cells of acetic acid bacteria which can cause off flavours and organoleptic failures. Citrus fruit are greatly destroyed by activities of *Penicillium spp.* especially *P. italicum, P. digitatum.*

4.5 Some species of fungi are responsible for fruit spoilage e.g Blue and Green mould rot which is caused by penicillin, while the fluffy grey mould growth is caused by *Botrytis cinerea* and is typical of pome fruit.

4.6 In the bakery factory, Ropiness in bread, cake and other bakery products, is caused by *Bacillus spp.*

4.7 Vegetables which are prepacked in an insufficiently ventilated water impermeable wraps can be affected by bacterial soft rots caused by particularly gram negative organism of the genera Erwinia and Pseudomonas.

4.8 The meat industry is not an exception; meat-spoilage by mould in refrigeration or frozen at temperature down to about -5°C can occur without spore production giving rise to a white fluffy appearance caused by mucor. Some obvious spoilage could include; white spot caused by Sporotriclium. Black spot caused by Clasdoporuim and green patches caused by Penicillium. In addition, surface slime on meat is caused by Pseudomonas and Acinetobacter but Streptococcus and lactobacillus could also be responsible.

Several losses are being incurred as a result of the above undesirable activities.

5.0 CONCLUSION

As already noted in the opening parts of this paper; law enforcement authorities have a special recognition attached to these group of organisms and as such regulatory standards are being enforced to restrict usage and to limit it's abuse.

Apart from a broad requirement that a consumable food item should not contain pathogenic microorganism or toxins produced by microorganism or any other chemical substance found to be hazardous or injurious to health, the usual practise is for regulatory bodies to issue guidelines for microbiological quality control which it expects processors, exporters and importers to follow.

Products produced or processed by addition of microorganism have special attraction for this enforcement authorities since microbial behaviours and activities could only be predicted under standardized conditions, these enforcement authorities find it very necessary to regulate by specification, the number of live microorganism that should be present in a particular product at the end of shelf-life.

Codex alimentarious commission in conjunction with international commission on microbiological specification for food, and international association of microbiological societies are presently reviewing important organisms with a view to declaring the

maximum application level at various areas of needs at any particular time and also, the maximum level that could be permitted in any consumable food item at any point in time.

REFERENCES

1) Journal of food science and IFT information. Volume 59, No. 3, 5 and 6 1994

2) Herschoerfer, S.M. 1986 - Quality Control in the food industry Volume 2 Academic Press London.

3) Food Technology, A publication of the INSTITUTE OF FOOD SCIENCE AND TECHNOLOGY DEC, 1993 VOL. 47 No. 12.

4) Society of Dairy Technology (1972) "Quality Control of Milk products" Author, Huntingdom.