

FACTORS AFFECTING GROWTH OF MICROORGANISMS

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In most cases, micro-organism utilizes food supply as a source of nutrient for their growth. This course can result in deterioration (decay) of food. The organism not only deteriorates the food but may also pose risks of disease to the human being on consumption of such contaminated food. However, the growth of microorganisms in food may be affected by several factors like physical, chemical and biological.

These factors can broadly divide into two categories i.e.

Intrinsic parameters or intrinsic factors

Extrinsic parameters or extrinsic factors

INTRINSIC FACTORS

Intrinsic parameters are natural or inherent properties of food. These parameters greatly affect the number and types of microorganism that will colonize the food and food product. Intrinsic parameters affect only microorganisms, not to the food itself. Intrinsic parameters of food include:-

1. pH Value
2. Moisture content or water activity(a_w)
3. Nutrients Contained
4. Anti-microbial Constituents
5. Biological Structure

1. **pH Value-** Every organism has a minimal, maximal and optimal pH for growth. Some organism can grow better at low pH or acidic pH, some can grow in alkaline pH and while other grow at somewhat neutral pH. pH influence both the growth rate and types of organism that will predominant the food. In general yeast and mould are more acid tolerant than bacteria.

2. **Moisture content or water activity(*aw*)**- Micro-organism has an absolute demand for water, however, the exact amount of water needed for growth of microorganisms varies. This parameter helps us to understand the movement of water from the environment to the cytoplasm or from cytoplasm to the environment. The water requirement of microorganisms is expressed in physical form, called water activity(*aw*). Water activity is the ratio of the vapour pressure of water present in food substrate(solution) to the vapour pressure of pure water at the same temperature.

$aw = P / P_0$, P =vapour pressure of water present in food and P_0 =Vapour pressure of pure water at some temperature.

3. **Nutrients Contained**- The kinds and proportional of nutrient in food are all important in determining which microorganism(microorganisms) is most likely to grow. In general, the simple compound is utilized first by the measuring microorganisms. The carbohydrate (simple sugar) is most commonly utilized as an energy source. Protein-rich food like meat, egg, fish etc. are always spoiled by protolytic organism because they can utilize protein as a source of energy if sugar is not available. In fact, protein-rich food promotes more growth of bacteria than yeast and mould. Similarly, in the general mould can grow in the higher concentration of sugar, yeast in fairly high concentration but most bacteria grow best in the low concentration of sugar.
4. **Anti-microbial Constituents**- Some foods possess naturally occurring substances which influence the activity of invading microorganisms, for example:-

In Plant

Clove:- Essential oil

Eugenol Garlic:- Allicin

Mustard oil:- Allyl isothiocyanate

In Animal

cows milk:- Lactoferrin, conglutinin, lactoperoxidase system.

Egg:- Lysozyme, Ovatransferrin (inhibit *Salmonella enteritidis*)

5. **Biological Structure-** The natural covering of some foods provides excellent protection against the entry of microorganism and spoilage of food by such microorganisms.

Natural covering of food like,

Testa of seed

Shell of egg/nuts

peel of fruits/vegetable

Hide of animal may limit the entry of microorganisms

EXTRINSIC FACTORS

Extrinsic parameters are environmental factors, in which food and food products are kept.

Extrinsic parameters substrate independent and affect both micro-organism (mos) as well as food. Unlike intrinsic parameters, extrinsic parameters can be maintained and regulated well.

The extrinsic parameters include:-

- 1) Temperature of storage
- 2) Relative humidity of the environment
- 3) Presence and concentration of gases
- 4) Presence and activities of micro-organism

1. **Temperature of storage-** It is highly important parameters that affect the spoilage of highly perishable food. Micro-Organisms are reported to grow between -34°C to 100°C and each organism exhibit a minimum, optimum and maximum temperature for growth and these are known as cardinal temperature. Yeast and mould can grow at the temperature range of 20 to 30°C . Most bacteria can grow well at ordinary temperature (37°C), however, some (thermophiles) grow at high temperature and other (psychrophilic) grow at low temperature.

Thermophiles can be found growing in environments such as the inside of a geyser, while psychrophiles can be found growing at the North and South Poles. Mesophiles include all

of the human pathogens, such as the bacteria *E. coli*, *Staphylococcus aureus*, and *Streptococcus pyogenes*, and the protozoans *Naegleria fowleri* and *Plasmodium falciparum*. Many psychrophilic microbes are found in Antarctic soil and surrounding waters; there have been species from every group of microbes found on this continent. Most thermophiles are prokaryotic (Archaea and Bacteria). An example of a thermophile is the bacteria *Synechococcus*, which is found in the hot springs of Yellowstone National Park, where temperatures range between 54°C and 75°C.

2. Relative humidity- Humidity is the concentration of water vapour in the atmosphere. Relative humidity is the ratio expressed as the percentage of moisture in the air to the moisture present in food under the saturation condition at temperature and pressure. Relative humidity and water activity are interrelated i.e. when food with low water activity are stored in the environment of high humidity, water will transfer from gas phase (air) to the food and thus increased water activity of the food, leading to spoilage by viable micro-organisms.

3. Presence and concentration of gases- Presence of different gases and its varying concentration may significantly affect the colonizing mos on the food i.e. surface spoilage is prevented by altering the gaseous composition. Oxygen is one of the most important gases which affects both food products as well as Mos. Oxygen gas when comes in contact with food, influence redox potential of food and finally the microbial growth. Ozone added to food as a preservative action on certain food. Ozone has GRAS (generally recognized as safe) status in the US, effective range is 1-5 ppm. However, it has some demerits like strong oxidizing agents, causes the rancidity of high lipid-containing food.

4. Presence and activity of micro-organism- Inhibition or destruction of one population of micro-organism by the presence of other population of mos present in the same habitat is the microbial interference. Some Micro-organisms produced substances/metabolites (like secondary metabolites), that are either lethal or inhibitory to others.

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