**INTRINSIC PARAMETERS**

The parameters of plant and animal tissues that are an inherent part of the tissues are referred to as *intrinsic parameter.* These parameters are as follows:

1. pH

2. Moisture content

3. Oxidation–reduction potential (Eh)

4. Nutrient content

5. Antimicrobial constituents

6. Biological structures

Each of these substrate-limiting factors is discussed below, with emphasis placed on their effects on microorganisms in foods.

**pH**

It has been well established that most microorganisms grow best at pH values around 7.0 (6.6–7.5), whereas few grow below 4.0.

Each bacterial species can survive within a range of pH values; within this range, it has a pH optimum. Despite the pH of the external environment, cells maintain a constant internal pH, typically near neutral.

Most bacteria can live and multiply within the range of pH 5 (acidic) to pH 8 (basic) and have a pH optimum near neutral (pH 7). These bacteria are called **neutrophils**.

**Acidophiles** grow optimally at a pH below 5.5.

**Alkalophiles** grow optimally at a pH above 8.5.

**Moisture Content**

It is now generally accepted that the water requirements of microorganisms should be described in terms of the *water activity* (*a*w) in the environment. This parameter is defined by the ratio of the water vapor pressure of food substrate to the vapor pressure of pure water at the same temperature: *a*w = *p/po*

**Oxidation–Reduction Potential**

It has been known for decades that microorganisms display varying degrees of sensitivity to the oxidation**–**reduction potential (O/R, Eh) of their growth medium.

**The groups of bacteria according to oxygen (O2) requirements:**

**Obligate aerobes** have an absolute or obligate requirement for oxygen (O2). They use it to transform energy in the process of aerobic respiration.

**Obligate anaerobes** cannot multiply if any O2 is present; in fact, they are often killed by traces of O2 because of its toxic derivatives.

**Facultative anaerobes** grow better if O2 is present, but can also grow without it. The term facultative means that the organism is flexible, in this case in its requirements for O2.

**Microaerophiles** require small amounts of O2 (2% to 10%) for aerobic respiration; higher concentrations are inhibitory.

**Aerotolerant anaerobes** they can grow in its presence, but they do not use it to transform energy.

**Osmotic Pressure**

Some organisms called extreme halophiles, have adapted so well to high salt concentrations that they actually require them for growth. In this case, they may be termed obligate halophiles. Although most microbes exist under hypotonic or isotonic conditions, a few, called **halophiles**.

Tonicity

1- Isotonic solution

2-hypertonic solution

3-hypotonic solution

**Nutrient Content**

In order to grow and function normally, the microorganisms of importance in foods require the following:

1. water

2. source of energy

3. source of nitrogen

4. vitamins and related growth factors

5. minerals

**Antimicrobial Constituents**

The stability of some foods against attack by microorganisms is due to the presence of certain naturally occurring substances that possess and express antimicrobial activity.

Cow’s milk contains several antimicrobial substances, including lactoferrin (see below), conglutinin, and the lactoperoxidase system (see below).

Eggs contain lysozyme, as does milk, and this enzyme, along with conalbumin, provides fresh eggs with a fairly efficient antimicrobial system.

**Biological Structures**

The natural covering of some foods provides excellent protection against the entry and subsequent damage by spoilage organisms. In this category are such structures as the testa of seeds, the outer covering of fruits, the shell of nuts, the hide of animals, and the shells of eggs.

**EXTRINSIC PARAMETERS**

The extrinsic parameters of foods are not substrate dependent. They are those properties of the storage environment that affect both the foods and their microorganisms. Those of greatest importance to the welfare of foodborne organisms are as follows:

1. temperature of storage

2. relative humidity of environment

3. presence and concentration of gases

4. presence and activities of other microorganisms

**Temperature of Storage**

Microorganisms, individually and as a group, grow over a very wide range of temperatures.

Those organisms that grow well at or below 7o C and have their optimum between 20o C and 30o C are referred to as *psychrotrophs*.Those that grow well between 20o C and 45o C with optima between 30o C and 40o C are referred to as *mesophiles*, whereas those that grow well at and above 45o C with optima between 55o C and 65o C are referred to as *thermophiles*.

**Presence and Concentration of Gases in the Environment**

Carbon dioxide (CO2) is the single most important atmospheric gas that is used to control microorganisms in foods. It along with O2 are the two most important gases in modified atmosphere packaged (MAP) foods. Ozone (O3) is the other atmospheric gas that has antimicrobial properties, and it has been tried over a number of decades as an agent to extend the shelf life of certain foods.