HURDLE TECHNOLOGY

Hurdle technology is a concept that was developed to address the consumer demand for more natural and fresh foods. It is an intelligent combination of hurdles which secures the microbial safety and stability as well as retains the organoleptic, nutritional quality and economic viability of food products.

Some of the hurdles such as temperature (high or low), water activity (a_w), preservatives (nitrite, sorbet), competitive microorganisms (lactic acid bacteria) and acidity (pH) have been empirically used for years to stabilize meat, fish, milk and vegetables. Various novel hurdles that are being applied in various food products includes Nano-thermo- sonication, ultrahigh pressure, photodynamic inactivation, modified atmosphere packaging of both non-respiring and respiring products, edible coatings, ethanol, milliard reaction products.

The basic concept is to apply combinations of existing and novel preservation techniques ("hurdles") in order to eliminate the growth of micro-organisms. Hurdle technology has been developed to reduce the usage of preservatives in foods and consists of the combined effect of hurdles to establish an additional antimicrobial effect, thus improving the quality of the food.

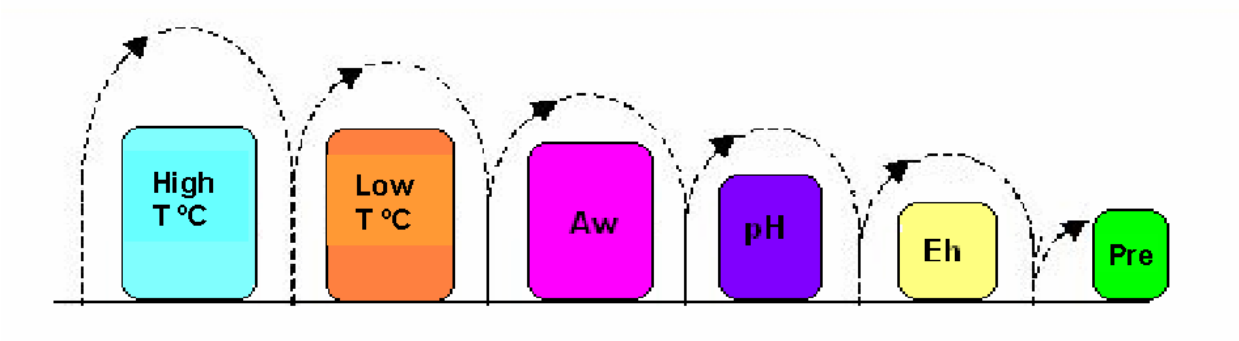


Figure 1 Hurdle Technology

OBJECTIVES OF PRESERVATION

Several objectives of preserving the foods are listed

- To ensure the safety of food from microbes
- To prevent the spoilage of food
- To enhance the keeping quality of food
- To control foodborne infections and intoxications

- To extend the shelf life of food
- To reduce economic losses

Aspects of hurdle technology

The hurdle technology affects the physiology and growth of microorganisms in food. There are mainly 4 major mechanisms by which hurdle technology affects the growth of microorganisms in foods:

- Homeostasis
- Metabolic exhaustion
- Stress relaxation
- Multi target preservation of food

Homeostasis

It is the process that maintains the stability of the living cell's internal environment in response to the changes in external environment. Some of the examples of homeostasis in the body are regulation of temperature and balance between acidity and alkalinity (pH). These factors are prerequisite feature of living cells and this applies to higher organisms as well as microorganisms. Disturbing the homeostasis of the microorganisms by various hurdles eventually results in the death of the spoilage causing microbes thereby protecting the food product from microbial spoilage.

Metabolic exhaustion

This aspect of hurdle technology deals with auto sterilization of food. It has been observed that the spore counts in hurdle technology treated food products actually decreases during storage especially at ambient temperature. The microbes in the hurdle treated stable products uses their energy for homeostasis thereby becoming metabolically exhausted. This leads to auto sterilization of food products. Thus, the microbiologically stable product becomes safer for storage at normal room temperatures.

Stress reactions

Some microbes acquire resistance or may become more virulent under stress conditions as they synthesize stress shock proteins. The synthesis of stress shock protein is affected by several factors like pH, water activity, ethanol, heat, etc. The different responses of microbes under stress conditions might hamper the food preservation. Exposure to multiple stresses simultaneously activates the energy

utilizing synthesis of several stress shock proteins, in turn making the microbes metabolically weak. Therefore, multi target preservation of foods could be an efficient approach towards reducing the synthesis of stress shock proteins and in food preservation.

Multi target preservation of food:

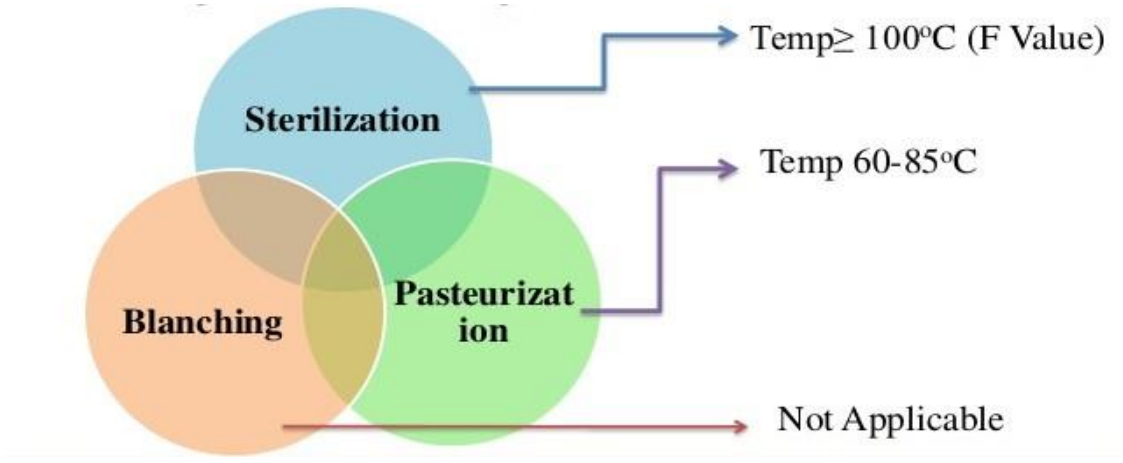
It is a very important aspect for efficient and effective preservation of targeted food material. Hurdles applied in the targeted food material might not just have effects on microbial stability but they could act synergistically. Synergistic effect could be achieved in the targeted food, if the hurdles affects different targets such as pH, aw, Eh, enzyme systems simultaneously within the microbial cell and thus disturb the homeostasis of the microbes rendering it difficult for the microbes to synthesize different stress shock proteins and to maintain their homeostasis. Therefore the application of several hurdles simultaneously would lead to an optimal microbial stability and effective food preservation.

Types of Hurdles

The types of hurdles, namely physical, physiochemical and microbial, which are used for the preservation of variety of foods, are briefly summarized.

Physical

Ionizing radiation, low temperature (chilling, freezing), aseptic packaging, high temperature (blanching, frying, baking, extrusion, evaporation, pasteurization, sterilization), modified atmosphere, ultraviolet radiation, electromagnetic energy (radio frequency, high electric fields, pulse magnetic fields, microwave), utrasonification, packaging films, ultra high pressures, photodynamic inactivation

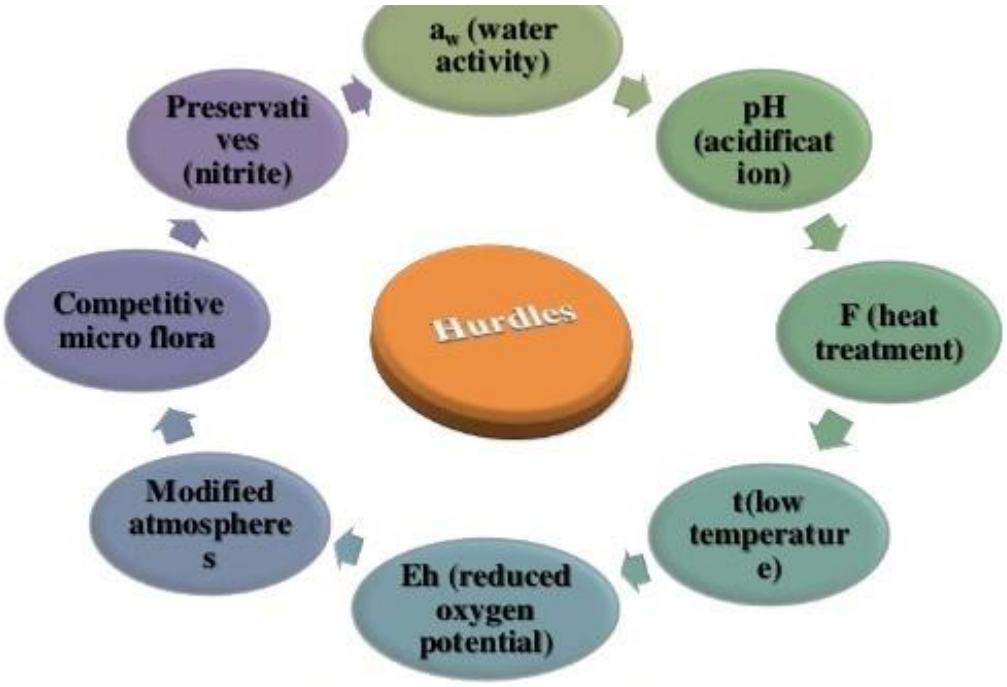


Physio-chemical

Sodium nitrate, Sodium sulphite, sodium nitrite, potassium sulphite, phosphates, salt, spices and herbs, carbon dioxide, ozone, oxygen, organic acids, surface treatment agents, phenols, ethanol, lactic acid, low redox potential, low pH, low water activity, lactoperoxidase, smoking, Maillard reaction products

Microbial

Bacteriocins, protective cultures, competitive flora, antibiotics



Applications of Hurdle Technology in different products

Hurdle Technology is a novel concept which has several applications in the preservation of various food products such as:

Dairy products

- Hurdle technology has been applied in many dairy products to enhance their shelf life.
- Shelf stable paneer can be prepared by applying various hurdles such as pH, aw, preservatives and Modified Atmosphere Packaging.
- Another product brown peda, a traditional Indian heat desiccated milk khoa based product have also been prepared and preserved through hurdle technology.

Fruits & Vegetables

- Several hurdles are considered to be important in the preservation of various vegetables and fruits like carrot, pineapple, coconut & papaya to enhance their stability and shelf life.
- Hurdle technology can also be applied to develop shelf stable RTE (Ready-To-Eat) intermediate moisture pineapple with increased shelf life.
- Osmotic dehydration, infrared drying and gamma radiation can successfully reduce the microbial load in pineapple slices increasing its shelf life up to 40 days.
- Hurdle technology in the preservation of fresh scrapped coconut. Additives such as humectants, acidulants and preservatives were used.
- Minimally processed shelf stable high moisture grated papaya is also prepared by hurdle technology using different hurdles like mild heat treatment, aw, pH reduction, and the addition of preservatives.

Fruit derived products

- Several conventional hurdle strategies are effectively used along with the novel ones for the preservation of various fruit products.
- Some of the hurdles applied in fruit processing includes UV light, pulsed light (PL), ultrasound (US), and high hydrostatic pressure (HHP).
- Hurdle or combined technology is also applied in the preservation of high moisture fruit products such as peach, pineapple, papaya, mango and banana. The technology is based on the combination of heat treatment, aw and addition of antimicrobials.

In Meat & Meat products

- Hurdle technology has been applied to a number of meat products. The effect of different hurdles such as (pH, aw, vacuum packaging and post package treatment) in pork sausages at refrigerated temperature.
- Shelf stable ready to eat pickle type spiced buffalo meat products was also prepared and preserved by controlling different hurdles like pH, water activity, proximate composition, FFA, Soluble hydroxyl proline, TBA values, nitrite content, protein solubility.