



Hurdle Technology: Principle and Application in Food Industry

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Abstract

In the modern era , people demand that type of food which contain minimum changes in sensor and nutritional level, this led to the development of hurdle technology in the field of food technology .Hurdle technology is a new concept in the preservation of foods of plant as well as animal origin. The factors used for food preservation are known as hurdles. Hurdles is applied to inhibit or eliminate the growth of microbes, which can either cause spoilage. It is imperative to use at least two or three hurdles in the system to control organisms. Each hurdle puts the microorganisms in a hostile environment so that no multiplication can occur in the food, and thereby, extend the shelf life of the food products. Hurdle technology is also known as combine method technology.

Key Word: Hurdle, Microbes, Technology

Introduction

Hurdle technology is a concept that was developed to address the consumer demand for more natural and fresh foods. (Leistner, 2000) defined hurdle technology as 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. Since the time immemorial, man is dependent on food for survival. The microbial stability and safety of most foods is based on a combination of several factors (hurdles), which should not be overcome by the microorganisms' present (Leistner, 1994). A variety of food from plant and animal origin including poultry, egg, fish and sea-foods are consumed by humans for growth, health, pleasure and satisfaction besides satisfying nutritional needs (Pal, 2014). Statistics shows that 95% of the investment for agriculture resources has been allocated for production while only 5% for the



preservation of food. In the majority of the cases microorganisms are responsible for the spoilage or poisoning. Hence, the preservation of food is very important in order to avoid the huge financial losses occurring due to deteriorative changes brought by microbial, chemical, and physical process (Pal, 2014). The main principle of preservation is to create unfavourable conditions for the growth of microorganisms in food (Pal,2014). The conventional preservation methods are based on single parameter that makes changes in sensory and nutritional quality of the food.

History Origin of preservation

Since the beginning of time, man has searched for ways to preserve the life length of food materials. Before the concept of food processing preservation developed, humans were forced to travel from one place to another place in order to locate fresh foods. Food had to be eaten almost immediately after it was either killed in instances of animal meat or not long after harvesting for fruits and vegetables. Discovering a method to save food was vital to the expansion and development of mankind as it is today, (Anurag et al.,2013). Origin of hurdle technology for centuries, combined methods were applied empirically in food preservation. For example, combination treatment includes heat, reduced moisture content and antimicrobial chemicals deposited from the smoke onto the surface of the food. Some smoked foods may also be dipped or soaked in brine or rubbed with salt before smoking, to infuse the flesh with salt and thus add a further preservative mechanism. In jam and other fruit preserves, the combined factors are heat, high solids content (reduced water activity) and high acidity. In vegetable fermentation, the desired product quality and microbial stability are achieved by a combination of factors such as salt, acidification, and so forth (Leistner, L.,2000). After the factors (F, t, aw, pH, Eh, competitive flora, etc.) governing the traditional methods of food preservation were better understood, their interaction was studied. The preservation factors were called hurdles and their interactions the hurdle effect. The logical next step was to modify and optimize the hurdles in foods. This approach was called intelligent hurdle technology. (Karthikeyan, J. et al. 2000).

Need for hurdle technology

The right combination of hurdles can ensure the total freedom from microbes and therefore, secure microbial safety, stability, organoleptic, and nutritive quality of the food. Hurdle technology can deliver the stable and ready to eat meat products to the mountaineers, and space scientists. The multi-targeted preservation of foods could be an efficient approach in food processing industries. Attempts should be made to develop more hurdles, which can be safely and effectively used to enhance the quality and safety of various foods. It is recommended that hurdle technology may be an important key to food. According to FAO, one third of the total gathered foodstuff, in the globe is missing before it is used up. Consumer wants to use natural & fresh food



which is a stressful condition for the food companies to launch a new technique for preservation. The main concern regarding the food is their shelf life and shelf stability. To have the wholesome foods accompanied and avoid undesirable changes attributed to non-effective methods (destructive methods), multi-hurdle approaches is considered as an appropriate alternative prior to increasing the intensity of a single hurdle factor i.e. Combination of hurdles can emerge more synergistic affections, more reduction of pathogens along with more keeping nutrients. In few recent decades, almost all of food products preserve by hurdle method.

Principal of hurdle technology

The most important hurdles commonly used in food preservation are temperature (high or low), water activity (a_w) (see Colligative Properties), acidity (pH), redox potential (Eh), preservatives (nitrite, sorbate, sulphite, etc.), and competitive micro-organisms (e.g., lactic acid bacteria). More than 60 potential hurdles for foods of animal or plant origin, which improve the microbial stability and/or the sensory quality of these products, have been already described, and the list of possible hurdles for food preservation is by no means complete (Leistner, 2011). Preservative factors hurdle is correlated to each other, they both disturb the homeostasis of microorganisms, hurdle related to multiple preservative technique, microorganism cannot able to jump all the hurdles present in the food product. Preservative factors prevent microorganisms from multiplying and causing them to remain inactive or even die. The hurdle concept illustrates that complex interaction of temperature, water activity, Ph etc and these are significant to the microbial stability. If several hurdles are used simultaneously a gentle preservation could be applied, which nevertheless secures stable and safe foods of high sensory and nutritional properties. The physiological responses of microorganisms during food preservation such as homeostasis, metabolic exhaustion, and stress reaction are the basis for the application of hurdle technology.

Types of Hurdles

At present, physical non-thermal processes (eg. Pulse electric field) received considerable attention. Another group of hurdles of special interest in industrialized and developing countries at present would be “natural preservatives (spices and their extracts, lysozyme, chitosan, pectin hydrolysate etc.), they are not synthetic chemicals, but in some developing countries, they given preference, since spices are readily available and cheaper than imported chemicals.

1. Physical Hurdles.

Most hurdles under this heading are processes used in food manufacturing. When using processes intended to kill microorganisms, it is necessary to protect the food



product against (microbial) recontamination after processing, this includes: heat processing, manipulation of storage temperatures, irradiation, electromagnetic energy, photodynamic inactivation, ultrahigh pressure processing, ultrasonication and packaging. (Leif, 1994).

2. Physicochemical Hurdles

Hurdles categorised under this heading include water activity (aw), pH, redox potential (Eh), salt (NaCl), nitrite (NaNO₂), carbon dioxide (CO₂), oxygen (O₂), ozone (O₃), organic acids, spices and herbs, sulphite or SO₂, smoking, ethanol, maillard reaction products (MRPs) and lysozyme. (Leif, 1994).

3. Microbiologically Derived Hurdles

Hurdles under this class are; competitive flora, starter cultures, bacteriocins and antibiotics (Leif, 1994).

Applications and Effects on Food

Hurdle technology can be applied to wide categories of food which include; dairy products, fresh fruits and vegetables, fruits derived products, animal product. The technology have a broad application in production Ready-to-Eat foods and production of edible coating. Some preservatives at high concentrations represent chemical hazards; a combination of chemical preservatives with other preservation methods is useful. Proper application of combined methods gives stable products, prevents the undesired side-effects of each individual treatment, saves energy and lowers the required concentration of added preservatives. 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 (MAP). The quality and shelf life of hurdle treated paneer extended from one to twelve days at ambient temperature and six to twenty days at refrigeration temperature without affecting its physicochemical and sensory properties (Thippeswamy et al., 2011). Panjagri and co-investigators (2007) reported that hurdle treated brown peda, a traditional Indian heat desiccated milk khoa product, can be preserved up to 40 days at room temperature without any loss in quality. In smoked products, for example, combination treatment includes heat, reduced moisture content and anti-microbial chemicals deposited from the smoke onto the surface of the food. Some smoked foods may also be dipped or soaked in brine or rubbed with salt before smoke. Anurag et al., (2013) reported that application of radiation to intermediate moisture products dried by infra-red, and use of 400-gauge polythene bag will provide effective retention to nutrient up to six months under ambient storage. Santos et al. (2001) studied the formulation and processing condition for production of a sausage stable at room temperature using hurdle technology. Raw material were used to obtained a fine paste with small meat piece in artificial impermeable casing



with a guaranteed water activity of 0.95. Sausages were heated to 75 or 80 °C at the centre of the product and then store at room temperature for up to 3 months. Fresh and stored sausages were analyzed for physiochemical and sensory properties and microbiology quality. Thermal treatment to a core temp of 80°C in combination with use of the artificial casing guaranteed a shelf stable product, apart from colour remained unchanged throughout storage.

The efficacy on the use of hurdles such as antimicrobials, partial dehydration, and packaging in polymeric bags to develop grated carrots fresh and microbiologically safe for more than 6 months at ambient temperature was investigated by Vibhakara and others (2016). Karthikeyan and others (2000) applied hurdle technology for the production of shelf stable caprine keema using hurdles such as aw, pH vacuum packaging, heat treatment, and preservatives. The hurdle treated keema was shelf stable, and accepted up to the fifth day unlike the conventionally prepared keema that is highly perishable and was found acceptable only for one day.

Hurdle technology has been used in a wide variety of foods, such as milk and dairy products, meat and meat products.

Principal Hurdles used in Food Preservation

PARAMETER	SYMBOL	APPLICATION
Low temperature	T	Chilling, freezing
High temperature	F	Freezing
Reduce water activity	aW	Drying, curing, conserving.
Increased acidity	pH	Addition or formation
Reduced redox potential	Eh	Removal of oxygen or addition of ascorbate
Bio preservatives		Competitive flora or Microbial fermentation
Other preservatives		Sorbates, sulfites, nitrates

Source: Leistner (1995)

Conclusion

Food plays a key role in our life, as it is the major source of energy to perform various activities. Hurdle technology was developed to address the consumer demand for more natural and fresh foods. Hurdle technology is an important approach that can be used to improve quality parameters during processing and storage of food. More than 60 hurdles reported to be available, these can be use in different combinations and concentrations in wide range of foods.

The importance and potential of this technology in better food preservations been recognized in developed as well as in developing nations of the world. There are several hurdles



such as reduced water activity, reduced redox potential, high and low temperature, preservatives, and competitive flora. A combination of selected hurdles can keep microbiological hazards under control in order to obtain and retain the end product safety and suitability. It is emphasized that this technology must be widely used in order to get high quality of safe and stable food for the consumers.

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