Use of Hurdle Technology in Food Preservation

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Abstract:-

Today’s concern is toward minimal damage food product with maximum protection of food to microorganisms. Consumers demand fresher and more natural products. This prompts food manufacturers to use milder preservation techniques and could be stimulating the current trend to hurdle technology. Hurdle technology is used in food industry for the gentle but effective preservation of foods. Hurdle technology is used in developing countries for the gentle but effective preservation of foods. Hurdle, a new concept for the production of safe, stable, nutritious, tasty and economical foods. The intelligent application of hurdle technology has become more prevalent now, because the principles of major preservative factors for foods (e.g., temperature, pH, aw, Eh, competitive flora), and their interactions, became better known. The influence of food preservation methods on the physiology and behaviour of microorganisms in foods, i.e. their homeostasis, metabolic exhaustion, stress reactions, are taken into account, and the novel concept of multitarget food preservation emerged. The Hurdle Technology makes minimal sensory and nutritional changes in the product and is valuable and acceptable than traditional methods of preservation. The paper contributes the aspects of this technology, and the prospects of the future goal of a multitarget preservation of foods with effective applications of this technology in the food industry.

KEYWORDS:

Hurdle technology; Hurdles; Food preservation; Homeostasis; Stress reactions

Introduction:-

Food preservation involves preventing the growth of micro-organisms as well as retarding the oxidation of fats that cause rancidity. Food preservation has been necessary to supply food between harvest peaks and in times of need. Several preservation methods, such as heating, chilling, freezing, drying, salting, sugar addition, acidification, fermentation, removal of oxygen, and addition of preservatives have emerged over the centuries from empirical observation. Stability of the food product, its safety without affecting its sensory and nutritional quality is the main demanding feature of most preserved foods, combination of several applied preservative factors (hurdles), and more recently on knowingly employed hurdle technology, first highlighted by Leistner (1978). The critical limits are
being used by the industry when each hurdle such as heat treatment, water content, pH and storage temperature is applied alone.

Hurdle technology is used worldwide industry of countries for the gentle but effective preservation of foods. Hurdle technology was developed several years ago as a new concept for the production of safe, stable, nutritious, tasty and economical foods. Previously hurdle technology, i.e., a combination of preservation methods, was used empirically without much knowledge of the governing principles. More than 60 hurdles may involve in food preservation (Leistner 2000a). The details of the important hurdles used in establishing food stability are discussed in the IFT/FDA Report (2003) and Leistner (2007)

**Fig No.1 Types of Hurdles for food preservation**
The Principles of traditional methods used for the preservation of food have been defined and effective limits of these factors for microbial growth, survival and death were established. (Ohlsson and Bengtsson, 2002) These hurdles includes physical, physiochemical and microbial hurdles as discussed in figure no.1

**Principle of Hurdle Technology:**

In Hurdle Technology, hurdles are deliberately combined to improve the microbial stability and the sensory quality of foods as well as their nutritional quality of foods and economic properties. Thus, hurdle technology aims to improve the total quality of foods by application of an intelligent mix of hurdles (Leistner, 2000).

![Mechanisms of Hurdle Technology](image)

**Fig No.2: Mechanisms of Hurdle Technology**

Hurdle Technology involves four major mechanisms to preserve the food as shown in fig no.2. These include Homeostasis, Metabolic Exhaustion, Stress Reaction and Multitarget Preservation. An important phenomenon that is crucial to hurdle technology is homeostasis of microorganisms. Homeostasis is the process which maintains stability of the living cell internal environment in response to changes in the external environment. Preservative factors functioning as hurdles can disturb one or more of the homeostasis mechanisms, thereby preventing microorganisms from multiplying and causing them to remain inactive or even die. 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 i.e auto sterilization was observed out on liver sausages inoculated with *Clostridium Sporogenes* and stored at 37°C (Leistner et al. 1970). Later this behaviour of stored under refrigeration (Leistner, 1995a). It has been observed that 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 and thus it becomes safer for storage at room temperature.
Stress Reaction:- Most of the stress reactions of microorganisms are active processes and involves expenditure of energy. The synthesis of stress proteins is induced by heat, pH \( a_w \), ethanol etc. The various response of microorganisms under stress may hamper food preservation and thus hurdle technology application becomes problematic and also simultaneously exposure to different stress will require energy consuming synthesis of several proteins. Therefore, multitarget preservation of foods is the key to avoid the synthesis of stress shock proteins (Leistner, 2000)

Multitarget Preservation: Synergistic effect could be achieved in the targeted food, if the hurdles affects the different targets such that pH, \( a_w \), enzyme system simultaneously within microbial cell and thus disturbing the homeostasis of the microbes making difficult to synthesis shock proteins and thus applying several hurdles simultaneously will lead to optimal microbial stability and effectiveness (Leistner, 1994a)

Need for the Hurdle Technology

Need for the hour is to develop the new methods so as to produce stable and safe food as demanded by the consumers. The concept of hurdle technology addresses this need. Hurdle technology deliberately combines existing and new preservation techniques to establish a series of preservative factors (hurdles) that the microorganisms in question are unable to overcome (jump over). These hurdles may be temperature, water activity, acidity, redox potential, preservatives, and others. A crucial phenomenon in hurdle technology is known as the homeostasis of microorganisms. This multi-targeted approach is the essence of hurdle technology. It is more effective than single targeting and allows hurdles of lower intensity, improving product quality. There is the further possibility that different hurdles in a food not only have an added effect on stability, but can act synergistically.

Applications:-

Many promising hurdles have been identified so far, although application of the idea in the food industry has been largely restricted to the meat sector. Recent studies, however, emphasize a much wider potential application, e.g., in bakery products, fish, and dairy products. More specifically, the concept was introduced into mild processing of fruits and vegetables. The design of new hurdles such as gas packaging, bioconservation, bacteriocins, ultrahigh pressure treatment, and edible coatings aided.

Using hurdle technology, fermented sausages are produced that are stable at ambient temperature for extended periods. A sequence of hurdles is important at different stages of the ripening process. The first hurdles used are the preservatives, salt and nitrite, which inhibit many of the bacteria present in the batter. Other bacteria multiply, use up oxygen and thereby cause a drop in redox potential, which inhibits aerobic organisms and favors the selection of lactic-acid bacteria. These bacteria then proliferate, causing product acidification and an increase of the pH hurdle. During the long ripening process of salami, the initial hurdles gradually become weaker: nitrite is depleted, the number of lactic-acid bacteria decreases, redox potential and pH increase. However, since water activity decreases with time it becomes the main hurdle.
About 50 different hurdles have been identified in food preservation. Apart from the most important and commonly used hurdles such as temperature, pH, and water activity, there are many others of potential value. Other hurdles include: ultrahigh pressure, mano-thermo-sonication, photodynamic inactivation, modified atmosphere packaging of both non respiring and respiring products, edible coatings, ethanol, maillard reaction products and bacteriocins. Examples of foods preserved by combined processes are fruit juices and heat-processed, cured meat products.

Paneer is a highly perishable product. It was reported that the freshness of paneer remains intact only for 3 days at refrigeration temperature (Bhattacharyet al.1971) at room temperature paneer does not keep good for more than one day. In order to increase the shelf life of paneer additives, modification in paneer manufacturing process, surface treatments and packaging materials have been recommended by various workers.

Gasasase (poppy seeds) payasum is product prepared from poppy seeds and rice and by application of retort processing (f0 value 6 at steam pressure of 1.04 bar) to this product, there was a marginal change in its pH, acidity and HMF content and viscosity take place during storage leads to extension of shelf life at 37°C temperature (Geetha, 2005).

This technology has been applied in many dairy products to enhance the shelf life. Shelf life of panner can be enhanced on applying various hurdles such as pH, MAP, the quality and shelf life of panner extended to 12 days at refrigeration temperature without affecting is physiochemical and sensory properties (Thippeswamy et al,2011)

Panjagari studied the effect of conventional cardboard boxes modified atmosphere and vacuum packaging techniques on the sensory, physico-chemical, textural, biochemical and microbiological quality of brown pea during storage for 40 days at 30°C. (Panjagari et al, 2007)

Curd rice is another traditional dairy product popular in South India. Normally shelf-life of curd rice is 24 h at 30°C, but attempts were made to increase self-life of curd rice by incorporating fresh ginger along with other spices (for seasoning) in milk and boiled for 2-3 min and it is then used for curd preparation of rice as per standard method and it was found that ginger added curd rice has shelf-life of 7 days at 37°C storage and 12 days at refrigerated storage (4 to 6°C). The acidity and water activity of fresh curd rice were 0.54 % and 0.994 respectively. The culture pH and natural preservative like ginger has been identified as probable hurdle for improved shelf-life of curd rice (Balasubramanyam et al., 2004)

Hurdle technology applied in the preservation of high moisture fruit products such as peach, pineapple, papaya, mango This was based on combination of heat treatment and addition of anti microbial (Alzamora et al., 1993)

Sugarcane juice was preserved using hurdle technology like heat treatment, irradiation, packaging and it enhances the product safety (Sankhla et al., 2012)Use of osmotic dehyradation, infrared drying, gamma radiations reduces the microbes of pineapple slices and increases shelf life upto 40 days (Saxena et al., 2009).Implementation of Hurdle technology to sausages helped to store them for longer duration (Thomas et al., 2010)

Use of hurdles like pH,FFa,TBP value,nitrite content increases shelf life of ready to eat picle of buffalo meat (Malik and Sharma,2014).The Hurdle technology is a novel concept and it is being applied in food preservation of Meat products, Dairy industry, Fruits ,Vegetables (Pundhir and Murtaza ,2015)
Conclusion:-

Hurdle technology is used in industrialized as well as in developing countries for the gentle but effective preservation of foods. It is the best way to improve the product without disturbing its physiological characteristics. It is widely applicable in fruits, vegetables, dairy and meat industry and holds good for future with an aim of multitarget preservation of foods.

References:-


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