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Minimal Food Processing Methods and its Effects on Nutritional Quality

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Introduction:

The decomposition of food products occurs due to physiological aging, biochemical changes, high respiration rate and high ethylene production which contribute considerably to discoloration, loss of firmness, development of off-flavours, acidification and microbial spoilage. 'Food processing' includes a broad field from simple boiling to the use of irradiation to know about changes in their nutritional value. The degree of stability of macro and micronutrients in food depends largely on the nature and structure of the food items and processing time to which products are subjected.

Due to change in life style patterns consumers have interest in minimally processed foods due to increase in their awareness to have fruits and vegetables with superior quality and natural integrity with fewer additives. At the same time, food processors are using emerging technologies to process perishable commodities, along with enhanced nutritional and sensorial quality.

Heavily processed products which areeventhough safe for human consumption but also associated with decreased nutritive value. In this view, approach to safe and nutritious food is regarded as a basic right of humans, as it is one of the ways to reduce various diseases by building better health and strengthen immunity. Increasing health awareness has guided the processors to opt for minimal processing of foods in recent years.

Ozonation:

It is moderately soluble in water, with decrease in temperature its solubility increases. Ozone can completely destroy microorganisms in the course of their cell membrane oxidation, organic matter deodorization, bleaching and putrefaction, and mycotoxin degradation. Unique property of ozone is auto-decomposition, without toxic residues accumulation. Oxidation potential of ozone is 1.5 times higher than chlorine.

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Ozone can be productive over a much wider continuity of microorganisms than chlorine and other sanitizers. Washing in ozonated water or ozone-micro bubbled solution is a main key for maintaining or even improving fresh produce of fruits and vegetables along with safety issues.

Shelf-life of potatoes can be extended up to 6 months at 6–14◦C and 93–97% relative humidity by means of 3 ppm of ozone without lowering the potato quality. Ozone slows down the fruit and vegetable ripening process in cold and is mainly effective against *E. coli.* It can be used in food industry for minimally processed fresh foods to enhance the antioxidant level of food products.

Photosensitization:

In this, interaction of two nontoxic factors, i.e., the photoactive compound and visible light, takes place which results in selective microbial cell destruction in the presence of oxygen. Right now, it is used for blood disinfection.

Main advantages of antimicrobial action of photosensitization consists of the following:

1. Treatment performance is free of the antibiotic resistance pattern of the strain.
2. Inactivation of pathogen population by up to six orders.
3. No negative effect on the environment.
4. No mutagen city or bacterial resistance to photosensitization.
5. Cost-effective, easy to maintain, and environmentally friendly source.

Various microorganisms such as multidrug-resistant bacteria, yeasts, microfungi, and viruses are at risk to this method. Therefore, photosensitization might open a new prospect for advancement of a no thermal, successful, economical, and environmentally friendly antimicrobial technology for application in safe food processing.

Edible Coatings

Defined as a thin layer of an edible substance as a film on the exterior of fruits and vegetables, which are applied on the food surface by different methods like spraying, dipping or brushing for creating a modified atmosphere.

Advantages include increased retention of colours, acids, sugars, and flavour compounds. Moreover, decreased weight loss results in the preservation of quality over shipping and transportation. These changes provide a route to enhance consumer appeal, together with an extension of shelf-life, also add to the value of the food produce and cut off

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the requirement of synthetic packaging. It comprises of polysaccharides, proteins, lipids, or a mix of all these compounds. In sliced mango chitosan is effective in shelf-life extension and quality maintenance. Edible coatings provide a great approach to control additives as they are known to carry on high concentrations of preservatives on the food surfaces, decreasing the effect of chemicals on overall consumer acceptability of fresh-cut fruit. Surface treatments consists immersing of fruit pieces into aqueous solutions having antimicrobial agents, antioxidants, calcium salts, or functional ingredients, e.g., minerals and vitamins are widely used for increasing the quality of fresh-cut fruits.

Modified Atmosphere Packaging

MAP is correlated to sealing actively respiring products in polymeric film packages to change O2 and CO_2 levels within the package atmosphere. It effects the metabolism of packed product or the activity of food spoilage-causing organisms by creating an atmosphere which low in O_2 and high in CO_2, which eventually results in increased storability and shelf-life. It inhibits spoilage mechanisms, as well as decreases respiration, slow down ripening, reduce ethylene production and sensitivity, delays textural softening, decreases chlorophyll degradation, and reduces physiological disorders by using different oxygen (O_2), nitrogen (N_2), and carbon dioxide(CO_2) concentrations.

Irradiation

Food irradiation (radio frequency, visible light, infrared light, microwave, and ultraviolet light) has damaging effects on DNA and cells become inactivated. Thus resulting in enhancing the shelf-life of the fresh produce by inhibiting reproduction of microbes and insect gametes. UV-B irradiation also came into view to be a useful nonchemical way of keep postharvest quality and improving antioxidant capacity in fruits and vegetables. The irradiation treatment of 1 kGy (100 krad) is allowed for fruits and vegetables by the Food and Drug Administration. Apart from pathogen destruction it also has other advantages which include increasing the shelf-life of fruits and vegetables provided an relevant replacement to chemical treatments, especially for fruits and vegetables. Moreover, it allow economic savings due to less food-borne illness frequency.

High-Pressure Processing

High-pressure processing (HPP) is an extremely favourable method for food industries as a substitution for thermal processing. HHP can provide with more opportunities

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for new product development with long shelf-life, high nutritional value, and extraordinary organoleptic characteristics. In HPP, in order to deactivate microorganisms and enzymes without degrading flavours and nutrients, products are subjected to high pressure in the range of 3000–8000 bars. Various food products such as jams, jellies, fruit dressings and sauces, toppings, yoghurt, and grapefruit, avocado and orange juice are subjected to HPP. In majority of cases, HHP decrease losses of beneficial components in fruit and vegetable commodities.

Microwave and Ohmic Heating

Ohmic heating can be defined as electrical resistance heating, and is a method of heat treatment in which an electric current is passed through the food for attaining food sterilization and required cooking level. In certain areas of food processing (blanching, evaporation, dehydration, fermentation, and extraction), ohmic heating applications have excellent potential of avoiding microbial load and maintaining the quality characteristics of minimally processed fresh fruits and vegetables. It is regarded as a cost-effective treatment as its operational costs is found to be comparable to those for freezing and retorting treatments of low-acid products. Flow rate, temperature, heating rate, and holding time are few factors that can affect the application of ohmic heating to industrial scale, and the size, shape, orientation, specific heat capacity, density, thermal and electrical conductivity, and specific heat capacity of the carrier medium are those factors that can influence heat transfer in the food.

Pulsed electric field

Pulsed electric field (PEF) processing technology is a no thermal method of food preservation that uses short bursts of electricity for microbial inactivation used for processing liquid and semi-liquid products. PEF, a favourable preservation technology, preserves volatile flavour compounds and thermo labile nutrients as compared with conventional heat pasteurization. Hybrid drying technologies normally result in shorter drying time to achieve the desired product moisture content resulting in a beneficial improvement in the energy required per unit of water removed.

Hurdle Technology

Hurdle technology is a new concept for producing safe, stable, nutritious, tasty, and economical foods. It put together the intellectual blend of various preservation techniques for sterilization of fruits and vegetables. It can also be named as integrate processes, combined

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methods, combination preservation, combination techniques, or barrier technology. Microbes are exposed to a hostile environment for inhibiting their proliferation and growth or shortening their existence or causing their death in hurdle technology. The possible responses of microorganisms to this hostile environment are homeostasis, metabolic exhaustion, and stress reactions. The microorganisms' homeostasis interruption is the main phenomenon of food preservation. Microbial stress reactions may lower food preservation, whereas the metabolic exhaustion of microorganisms during stable hurdle technology of foods could promote food preservation.

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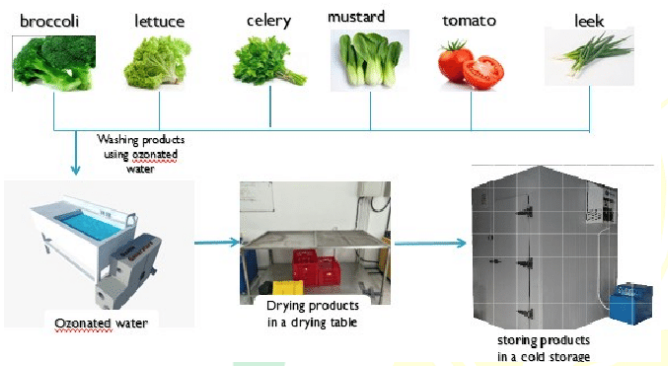
<td> 
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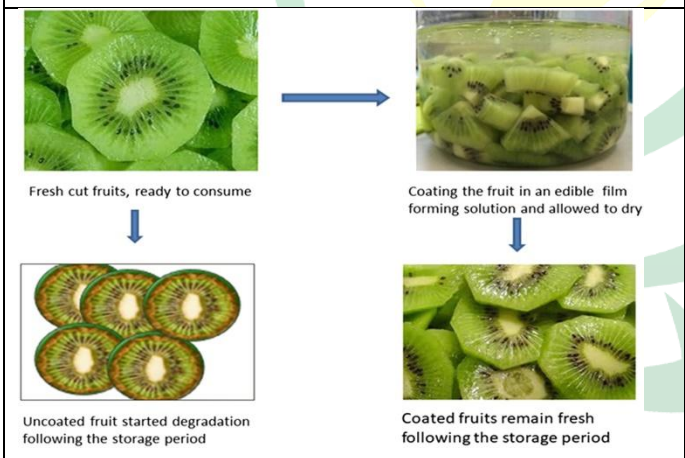
<td> 
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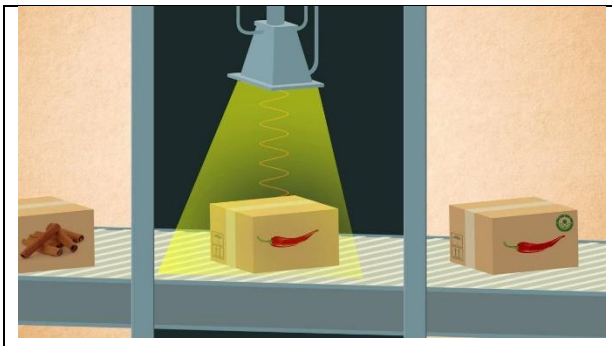	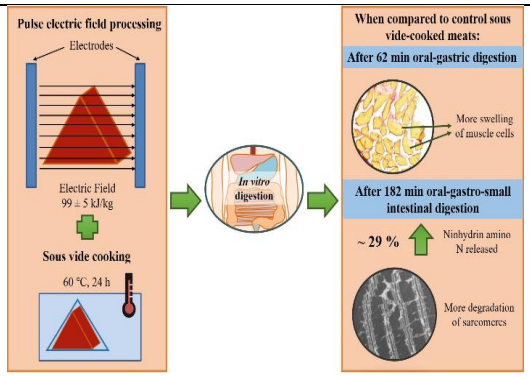
Irradiation	**Pulsed electric field (PEF)**