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Preservation of food items by irradiation process

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Abstract

Two types of radiations are used for preservation. They are ionizing radiations such as cathode and gamma rays and non-ionizing radiation such as infrared and UV rays. The latter two have poor penetration and bactericidal properties. Ionizing radiations act by disrupting progeny cycles of pathogenic microorganisms by destroying DNA/RNA cycles. Thus, it enhances shelf-life of food and reduces microbial contamination. Food processing by irradiation process destroys most of the pathogenic microorganisms. But does not lead to sterilization of food. Consumers should also ensure proper storage of irradiated food materials under refrigeration followed by proper hygienic handling and cooking to reduce the risk of potentially harmful microorganisms. Irradiated foods maintain their wholesomeness and nutritive values. So, food irradiation increases the shelf life of food as well as its optimum quality is also maintained for longer durations. Even if some nutritional losses occur due to irradiation it is negligible.

Key words: Food, ionizing radiations, microorganisms, non-ionizing radiations, radiations, shelf-life.

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1. Introduction

Food is generally exposed to ionizing radiations for destroying microorganisms, bacteria, viruses, or insects which the food might contain. Further applications include delay of ripening, increase of juice yield, sprout inhibition and improvement of rehydration. In certain cases, food irradiation leads to substantial chemical changes [1]. Irradiation is effective not only on food items but also on non-food items, such as medical hardware, plastics, tubes for gas pipelines, houses for floor heating, shrink-foils for food packaging, automobile parts, wires and cables (isolation), tires, and even gemstones. Food irradiation is very promising as a new technique in enhancing food safety and quality standards by causing the destruction of pathogenic microorganisms such as *E. coli* O157:H7, *Campylobacter*, and *Salmonella* from foods.

Irradiation process also helps in reduction of spoilage bacteria, insects and parasites. It is gained its importance as a high quality food hygiene practice by causing the reduction and elimination of harmful and enteric microorganisms and bacterial population. The Food and Drug Administration has approved irradiation as an effective food quality technique for preservation and increasing storage life of meat, fresh fruits, vegetables and spices. Irradiation process is also used in certain fruits and vegetables for delaying and inhibiting sprouting and ripening processes. The effects of irradiation on the food and on animals and people eating irradiated food have been studied extensively for more than 40 years. These studies show clearly that irradiation process is approved for application on foods. Food irradiation is a very efficient mechanism in prevention of many food borne diseases and intoxications. Food preservation by irradiation technique provides consumers with wholesome and nutritious food items having improved hygiene and easy availability and quantity with increased storage life, convenience to transport. So, the process adds cost to fresh and preserved food items.

2. Effects

Irradiation leads to destruction and permanent damage to DNA of pathogenic organisms. As a result they loose their capability to multiply and proliferate. If insects are present in food items then they become sterile incapable of

reproduction and plants loose their natural ripening processes [1]. The process of food irradiation is given the term 'cold pasteurization'. The energy density per atomic transition of ionizing radiation is very high. It is capable of breaking apart molecules and induce ionization, which is not achieved by simple heating. Ionizing radiations impart the same effect as of during heat pasteurization of liquids, such as milk.

Food irradiation is regarded as cold process of preservation because this kind of treatment does not cause any significant rise in temperature. Temperature of irradiated food product poses influence on physical changes induced by exposure to radiation. Rise in temperature induces increase in migration free radicals whish affect the over all rate of radiolysis. Reduced temperature decreases the production of volatile substances in food products. These volatiles are known to adversely affect the sensory quality of irradiated foods. Refrigeration on the other hand causes minimum level of such changes [2].

3. Global acceptance

Nearly 40 countries all over the globe practice food irradiation and the process is permitted there. In an estimate, the volume of food treated is estimated to exceed 5,00,000 metric tons annually worldwide [3-5]. The effective irradiation of food depends on many factors such as, on the dose, some or all of the harmful bacteria and other pathogens present are killed [6]. Food irradiation also prolongs the shelf-life of food. In some foods such as herbs and spices food irradiation helps in reducing microbial count by several degree. In this way, spoilage causing microorganisms are permanently destroyed.

The U.S. Food and Drug Administration (FDA) has cleared among a number of other applications the treatment of hamburger patties to eliminate the residual risk of a contamination by a virulent *E. coli*. The United Nations Food and Agricultural Organization (FAO) have passed a motion to commit member states to implement irradiation technology for their national phyto-sanitary programs. Including India, many countries like Australia, New Zealand, Thailand and Mexico have adopted under provision irradiation of fresh fruits for eradication of fruit fly. Countries like Brazil and Pakistan have also adopted the Codex Alimentarius Standard on Irradiated Food without any reservation or restriction.

4. Radiation absorbed dose

The measurement unit of exposure is Radiation absorbed dose which is the unit of physical quantity which regulates the processing of food products related to its beneficial effect.

5. Irradiation dose measuring unit

The dose of radiation is measured in the SI unit known as the gray (Gy). One gray of radiation is equal to 1 joule of energy absorbed per kilogram of food material. In radiation processing of foods, the doses are generally measured in kilograys (kGy = 1,000 Gy). Irradiation process does not find its wide acceptability among manufacturers due to negative influence on consumer satisfaction and perception [7-8]. Many food producers also express their reluctance in this regard for the long term harmful effects [9-10]. Even environmentalist activists and consumers believe that consumption of irradiated food expose to serious long term health hazards [11-12]. Other approved methods to reduce several pathogens in food include ultra-high temperature processing, UV radiation, ozone, heat-pasteurization, or fumigation with ethylene oxide.

Insect pests can also be eliminated by fumigating with aluminum phosphate, vapor heat, hot water dipping, or cold treatment, methyl bromide or forced hot air. Other methods to extend shelf life of food items include freezing, flash freezing, modified atmosphere packaging, dehydration, carbon monoxide, vacuum packaging, including chemical additives.

6. Regulation of global food irradiation

The Food and Drug Administration (FDA) is the governing International agency for regulation of all aspects of food irradiation. It also emphasizes regarding use of radiations on suitable type of edible products, radiation dosing and proper labeling of radiated food products for consumers. The U.S. Department of Agriculture (USDA) is responsible for the inspection and monitoring of irradiated meat and poultry products and for the enforcement of FDA regulations concerning these irradiated food products. Since 1986, all irradiated products must carry the international symbol called a "Radura", which resembles a stylized flower. FDA envisage on the proper presence and visibility of approved logo and declaration statement to appear properly on packaged irradiated foods like bulk containers containing unpackaged foods and/or on cardboard curtains containing such type of irradiated food items at the point of purchase, on invoices for irradiated ingredients and products to be sold to food processors. Processors may add information explaining the need of irradiation for preventing spoilage or treated with irradiation instead of chemicals to control insect infestation.

7. Scientific recommendation

Currently over 40 countries have approved irradiation as a process for preservation and increasing shelf life of approximately 40 different foods. These include different fruits, vegetables, spices, grains, seafood, meat and poultry. More than half a million tones of food is now irradiated throughout the world on a yearly basis. The annual consumption of irradiated food items is constantly increasing. According to agricultural researchers and scientists, implementation of organic farming techniques can help in reducing microbial load in food products. HACCP suggest that radiation measures up to specific limit can reduce pathogenic germs up to a great extent thereby rendering food safe for consumption [13-15].

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