

# Application of Gamma Irradiation Technology in Preservation of Food: Prospects and Challenges

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**ABSTRACT** Since about over a quarter of the harvested food is lost due to different types of wastage and spoilage, preservation of food is no less important than production of food. Gamma irradiation technology is one of the most appropriate and prominent technologies that can be applied in preservation of food. Gamma area science, also restrict the spoilage and wastage of castrate various maintain security of benefits gamma irradiation high power of, effortlessly, less it is and economically absence awareness, education socialisation the utilisation of gamma irradiation, there are still several societies, which think that gamma irradiation technology is hazardous and its radiation damages the proteins and genes. In fact, preservation of food using nuclear irradiation has been tested, researched and inspected and presently marketable practice in different nations. Gamma irradiation technology is still required to be advanced and it is encouraged so that it can be applied extensively through the regulation that is decided by the administrations to enhance the information of peoples about the advantage of nuclear irradiation power. It is also be considered that irradiated food and foodstuffs and the research outputs of the technology must be socialised, advertised, and published in a variability of advertising mode both in public community and scientific society, so that irradiated food and foodstuffs can be documented and recognised by various communities.

## INTRODUCTION

Food and foodstuff are a foremost necessity for all of mankind. Food is a basic people requirement. Without food, human beings are incapable to develop and grow into a complete life. Security of food is one of the major challenges and serious concerns for all living life. An important hurdle in security of food is the storage of food for the long term. The food is most commonly soiled either by diseases causing microbes or unfavourable environmental conditions. Most common diseases causing bacteria that are found or observed in many foods and foodstuff are *Escherichia coli*, *Staphylococcus aureus*, *Vibrio* sp, and *Salmonella* sp. Food, which is damaged will adversely affect the food quality that will be consumed. The content of nutritional value, smell and taste will certainly decrease. The spoiled foods become poisonous to the body when consumed. Good quality of food will be favourable to understanding the quality of human resources, which will grip a major part in development of nations as mentioned in the legislation of food and foodstuff (Putri et al. 2015).

The food and foodstuffs preserving technology has been widely exploited and trained as with the application of artificial chemicals and fogging, evaporation, freezing and warm-up (Handayani and Permawati 2017). These technologies are well assessed but observe less effectiveness in preservation of food and foodstuffs because they are not able to destroy diseases causing microbes or pathogens and are inclined to residual product in spite of the small amount. Diseases causing microbes or pathogens have tolerance power when it is in a position of smoky, hot or frozen. Addition of synthetic preservatives for preservation of food and foodstuffs is another dangerous thing and its toxic effect is harmful to health. It is therefore necessary to find out the most suitable innovative technology that can preserve food, retain the nutritional value and preserve the quality of food and foodstuff.

Gamma irradiation technology was prominent technology that can be applied for preservation of food. It is reported the effect of antioxidant activity and irradiation against the preservation of Mede peanuts (Sajilata and Singhal 2005). He observed that 0.25 to 1.00 kGy dose of gamma ionising irradiation can decrease antioxidant activity with power save reaching half a year (Sajilata and Singhal 2005). Gamma irradiation technology is one of

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the inventions of radiation science that can be used in different areas like food science, health science, etc. Gamma irradiation technology in food science, apart from food preservation, can also sterilise various foodstuffs from pathogenic microorganism and enhance security of food. The benefits of gamma irradiation technology are high power of energy and materials, effortlessly controlled, with less residues and it is environmentally and economically friendly. However, due to the absence of awareness, education and socialisation about utilisation of gamma irradiation, there are still several societies, which think that gamma irradiation technology is hazardous and its radiation damages the proteins and genes. This has to be one of the reasons that caused the sluggish developments of nuclear technology in many countries and hence the trouble to take benefit of this state-of-the-art science and technology.

Gamma ionising irradiation breaks the hydrogen and phosphodiester bond, which is present in DNA of pathogens that will lead to hamper the growth and developments of pathogens. It is also well reported that some pathogens have the capacity to repair the strands of DNA, which ties cut off. Other actions such as frosting or fogging and use of synthetic chemicals are needed for the efficiency of gamma irradiation technology. For completely killing the microbes or to stop the spoilage of food, it is necessary to combine gamma irradiation technology with other treatments like fogging or freezing to reduce the growth and developments of pathogens. It is reported that low temperature can inhibit the activity of enzymes as well as degrading the colloidal systems protoplasm.

#### **Application of Gamma Irradiation on Food**

Ionising radiation is a radiation, which creates electrons bouncing off atoms forming converts, specifically that lose their. Alpha, beta. Generally, gamma ionising irradiation is applied in irradiation of food and foodstuffs because it contains very high-energy radiation. Radioactive cobalt-60 is used in generation of gamma rays, which has high penetrating power. Exploitation of gamma association cause chemical physical reaction, counting obstruct synthesis of tissues or breakdown the structure of DNA. Gamma irradiation will reduce the growth and development of diseases causing inhibit living food and foodstuffs continue to be.

Gamma irradiation technology is power irradiation the procedures of method. Irradiation of food and foodstuffs are exploiting areas applied food and inhibit diseases causing pathogens retain the nutritional value, freshness of. Gamma technology applied preservation food and since irradiation are destroying materials of diseases causing pathogenic microbes.

Fineness in the irradiation of food procedure is non-thermal, permissible technology can inhibit or destroy the pathogenic microorganism, holding the quality, nutritional value, freshness, less residue left, harmless food and foodstuffs consumed and treated using the correct method. In general, the gamma irradiation technology is the finest technology as compared to present prevailing technologies in terms of efficacy, cost, and the subsequent harmful effect.

In the food industry, irradiation doses were grouped in three categories such as high, medium and low dose. A low dose, which ranges from 0.4-2.5 kGy is called radurization, and it is used to inhibit the living pathogenic microorganism present in the food and foodstuffs and delay maturity period. A medium dose, which is ranged from 1-10 kGy is called radicidation, and it is used to kill the living pathogenic microorganism as well as its spore present in the food and foodstuffs. A high dose, which is ranged from 30-50 kGy is called radappertization, and it is used to kill the entire living microorganism as well as its spore present in the food and foodstuffs and this quantity is applied to increase the life span of food and foodstuffs.

#### **Gamma Irradiation Technology Mechanism in Preventing and Killing Pathogenic Microorganisms**

Gamma irradiated food will deliver indirect and direct material gamma diseases causing microbes pests damage texture structure. Gamma may presence, dissociation, ionisation (Ahn and Lee 2013). The instant impacts of the subsequent progression of gamma irradiation are the hydrolysis of hydrogen as well as phosphodiester bonds, which are present in the double strands of pathogens insect pests disturb capacity grow, persist, reproduce. However, subsequent procedure of gamma are that key factor happen molecules creation of reactive oxygen species.

Gamma treatment presence and physical pathogens and insect pests. Breaking hydrogen

bonding between and causes, the phosphodiester bond resulting loss of sugar molecules from polynucleotide of DNA and single strand breaks, the termination of double strand break of polynucleotide of DNA by the breaking of the polynucleotide intermolecular.

It is well reported that every microorganism contains different resistance and sensitivity against gamma irradiation, which determines the amount of dose and success rate of gamma irradiation. Some microbial pathogens are too tough to kill or inhibit, but most microbial pathogens are very sensitive and simple to kill or inhibit. The level of damage of cell of microbial pathogens and insect pests related with tolerance to irradiation dose is exposed with D10. D10 is an irradiation dose, which is required to kill pathogens by ten times or kill ninety percent of the whole population of microbial pathogens and insect pests. The higher the value of D10 reflects its resistance pathogenic microorganism and insect pest against gamma irradiation. The resistance of microbial pathogens and insect pest against gamma irradiation depends on several factors such as the composition and size of the pathogenic microorganism DNA, oxygen, DNA, water, temperature, media and post irradiation (Harsojo and Andini 2010).

#### **Safety Issues of Gamma Irradiation Technology on Food and Foodstuffs**

The Organisation clearly said gamma irradiation is a harmless method to prolong the capacity to save food and foodstuff. The WHO also said that the approved dose of gamma irradiation does not hinder the quality, content of nutrient and toxicity problems. A maximum of 5MeV is the recommended source of ionising radiation of gamma irradiation. These restrictions are built effect, which will be suffered from irradiation energy applied beats irradiation. moment ionising radiation of power surpassed approved reason a hazardous.

Any materials, which have potential of larger radioactive materials, are capable of changing inherited stability forever. Gamma irradiation technology leaves less deposited effectively a capsule, which is coated with metal. At the time of the process of gamma irradiation of food, which became a target of the rays just does not fix. Gamma is based on ionising definite enter hampering and killing

microbial pathogens, microbial spores, insect pest and parasites. Gamma irradiation does not leave any radioactive does hinder nutritional gamma is environmentally friendly, totally safe. Assessment of the food quality and content of nutrient of food and foodstuffs and chemistry, gamma irradiation technology consequences major alterations. composition content are calculated by the doses ionising irradiation. The higher alter remarkably. This is observed research with gamma rays little observed on any alteration in chemical composition and nutritional content. It is reported that vitamin losses occur when materials are irradiated with 1-10 kGy dose of irradiation. Several vitamins such as vitamins A, B, B1, E and K are easily altered by gamma irradiation, while some vitamins such as niacin, riboflavin, and vitamin D are not easily changed by gamma irradiation, gamma in a not suitable suggested dose (high) will cause proteins denaturation, altering the fatty acid and carbohydrate composition changes chemical structure due to gamma inhibits no light low temperatures (Harris 1989).

#### **Socialisation of Application of Gamma Irradiation Technology**

The first difficulty that underlies the problem of distributing the use of gamma irradiation technology accessibility socialisation of gamma irradiation technology in actual life. So, the deleterious evidence about applications of gamma irradiation technology tends to be leading holding the brain, particularly group. There has been low active participation of the government in presenting to the public that gamma irradiation technology can be applied for constructive stuff in various segments of life, like food, health, agriculture, industry, and energy, which is definitely beneficial to improvement desires. Gamma irradiation technology has been applied commercially or has been on the take-off step in many developed and developing nations, but the quantity of gamma irradiation of food manufactured low as. This may be application not being stretched information societies, food or manufacturers or industries, gamma irradiation obstacles to certifying. Several practical obstacles are still prerequisites gamma irradiation to be used more economically, proficiently, and effectively.

Enhance knowledge of recognised and the of gamma irradiation can be established in the

widespread community could include a blowout of knowledge through radio TV seminars, cassettes, exhibition, video films, and sharing or sale of irradiated of cost. Positive impact of correct food gamma is still sensed still to be low because of the quantity and passion of the broadcasting of knowledge narrow. Modified are essential subsequently enhanced and lengthened its area. Outcomes of irradiated broader societies, society of scientists gamma irradiated recognised by community. Significance revolutionise of public technology of gamma deliver an improved gratefulness towards gamma irradiation technology related to its role in the inhibition of food damage. The progress of additional directions about gamma irradiation technology can also activate a healthier reply from the community. Approval by the community is a difficulty of training astounded by allowing the truths that exist destructive observation deviation societies of gamma irradiation societies progressively smart and intelligent mind-set of communities that reflects all that occurs of radioactive and nuclear materials injurious to changed community can admit the gamma irradiation valuable. An optimistic community observation towards gamma irradiation technology will make the growth and expansion of the gamma irradiation technology in countries become more advanced.

#### **Approval by Food Producers, Consumers, and Retailers**

Remarkable commercialisation, which is irradiated with gamma irradiation, to essential manufacturers to accept advanced shop normally assumed key hurdle gamma unwillingness admit, which is irradiated with gamma irradiation. The proof for this was mainly based on surveys of consumer (Eustice and Bruhn 2013) various researchers advised undervalue clients buy gamma accessible assess (Bruhn 1995; Satin 1996; Eustice and Bruhn 2013). Roberts and Henon (2015) said proof awesome buyers purchase gamma, as buyers recurrence procurements gamma labelled numerous nations (Roberts and Henon 2015). While an important buyers escape purchasing gamma, the fact.

The maximum better gamma technology insistent opinion manufacturers traders buyers purchase produce. Forthcoming progress gamma of food on quantity representing manufacturers

dealers advantageous, but also procured buyers. Supported harmonisation assessment of cataloguing foods. Respects cataloguing as an additional charge and maybe more significantly, as an emphasis of the lasting disagreement and buyer doubts gamma irradiation.

#### **Regulations on Gamma Irradiated Food for Human Health**

Almost more than 60 nations have permitted the use of gamma irradiated food in their regulation of food or health for at least one, and typically more, food or foodstuffs. Though, compulsion an appeal authorisations suspicious totally of the guidelines built. Though, regulation label exact and foodstuffs gamma. Almost with gamma rays permitted nations guideline, permits gamma and foodstuffs acquiescence examples of illustration, purpose, dose' guideline foodstuffs bear the gamma. Many nations choose agreements an identified foodstuffs designated the basis of. Nations Canada, New Zealand, authorisation alter the prevailing guideline. The applicable organisation can start sanction.

Guidelines nations approve classification and tagging. Though, enforcement and interpretation of tagging provisions is flexible, Australia, New Zealand and EU need all entire foods and foodstuffs to be tagged with a script representing with gamma rays of food, specific thing adjacent closeness components tagged lesser amount boundary d components tag cookery trades restaurant. Tagging symbol New Zealand and Australia, recommended obligatory.

Many nations agree with reason or supportable advantage. In several nations guideline is quiet on an announcement of benefit or purpose. For entire food USA guidelines need that the tag stands the Radura sign "treated with gamma irradiation" or "treated by gamma irradiation." Though, gamma components supplementary and foodstuffs with gamma rays, distinct tagging compulsory trade. Canada and specify tagging compulsory component lower ten percent and five percent mass entire.

#### **CONCLUSION**

Gamma irradiation technology is an appropriately applicable technology useful to the visions preservation. These technologies are economically

and effortlessly controlled, and does not leave residue. Technology of suggested lengthen the save of making safety food products without altering the quality of the components like the nutritional and chemical composition. Gamma irradiation technology also still needs to be established like the essential of the mixture of technology of gamma irradiation with existing science and technologies to enhance the efficacy and effectiveness in stretching the save power, kill and inhibit pathogens without the slightest alter the food quality.

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