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Research Article

IMPROVEMENT OF FOOD SAFETY ON EXPOSURE TO RADIATION PROCESSING

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ABSTRACT

Radiation dose is the quantity of radiation energy absorbed by the food as it passes through the radiation field during processing. It is measured using a unit called the Gray (Gy). In early work the unit was the rad (1 Gy = 100 rads; 1 kGy = 1000 Gy). International health and safety authorities have endorsed the safety of irradiation for all foods up to a dose level of 10,000 Gy (10 kGy). The incidence of food borne disease arising from the consumption of food contaminated with pathogenic microorganisms is increasing, and there is a heightened public awareness of the health threat posed by pathogens in or on food. In India efforts are being made to develop nutrition mixes for different health conditions and also as nutritional supplements. To improve the shelf life of these nutritional mixes gamma radiation process was employed. The acceptability of irradiated products is low, there is need to test the non-irradiated and irradiated health mixes for their nutritional quality, acceptability and shelf life. With this back ground an effort was made to study the Nutritional and Biochemical Investigation of Radiation Processed Foods.

INTRODUCTION

Preservation of food has been a major anxiety of man over the centuries. Contamination with microorganisms and pests causes considerable losses of foods during storage, transportation and marketing (15% for cereals, 20% for fish and dairy products and up to 40% for fruits and vegetables). Particularly, pathogenic bacteria are an important cause of human suffering and one of the most significant public health problems all over the world. The World Health Organization (WHO) stated, the infectious and parasitic diseases represented the most frequent cause of death worldwide (35%), the majority of which happened in developing countries in 1992 (Loaharanu, 1994). Numerous processing techniques have been developed to control food spoilage and raise safety. The traditional methods have been supplemented with pasteurization (by heat), canning, freezing, refrigeration and chemical preservatives (Ahari, 2010). Another technology that can be added to this list is irradiation.

Food irradiation is the process of exposing amount of energy in the form of speed particles or rays for improving food safety, eliminating and reducing organisms that destroy the food products. This is a very mild treatment, because a radiation dose of 1 k Gy represents the absorption of just enough energy to increase the temperature of the product by 0.36°C. It means that, heating, drying and cooking cause higher nutritional losses. Moreover, heterocyclic ring compounds and carcinogenic aromatic produced during thermal processing of food at high temperatures were not identified in irradiated foods (Tomlins, 2008). It has shown that irradiation used on alone or in combination with other methods could improve the microbiological safety and extend shelf life.

Irradiation is used to reduce or eliminate the risk of food borne illnesses, prevent or slow down spoilage, arrest maturation or sprouting and as a treatment against pests. Depending on the dose, some or all of the pathogenic organisms, microorganisms, bacteria and viruses present are destroyed, slowed down, or rendered incapable of reproduction. Irradiation cannot revert spoiled or over ripened food to a fresh state.

Ionizing radiation can change food quality but in general very high levels of radiation treatment (many thousands of gray) are necessary to adversely change nutritional content, as well as the sensory qualities (taste, appearance, and texture). Irradiations to the doses used commercially to treat food have very little negative impact on the sensory qualities and nutrient content in foods. When irradiation is used to maintain food quality for a longer period of time (improve the shelf stability of some sensory qualities and nutrients) the improvement means that more consumers have access to the original taste, texture,

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appearance, and nutrients (*Bahramikia and Yazdanparast (2010); Bhat et al., (2007); Ferreira and Isabel (2016).* The changes in quality and nutrition depend on the degree of treatment and may vary greatly from food to food Loaharanu *Paisan (1990).*

If the food still has living cells, they will be damaged or killed just as microbes are. This is a useful effect: it can be used to prolong the shelf life of fruits and vegetables because it inhibits sprouting and delays ripening (UW Food Irradiation Education Group, 2000).

In our current study we have used Food irradiation processing technique that exposes food to electron beams, X-rays or gamma rays. The process produces a similar effect to pasteurisation, cooking or other forms of heat treatment, but with less effect on look and texture. The energy absorbed by the food causes the formation of short-lived molecules known as free radicals, which kill bacteria that cause food poisoning. They can also delay fruit ripening and help stop vegetables, such as potatoes and onions, from sprouting (FSA UK 2012).

MATERIALS AND METHODS

Selection of Health Mixes

For the present study the ingredients selected includes Ragi (Eleusine Coracana), Wheat (Triticum Aestivum), Rice flakes (Oryzasativa), Bengal gram (Cicer Arietinum), Green gram whole (Phaseolus Aureus Roxb), Black gram (Phaseolus Mungo Roxb), Horse gram (Dolichos Biflorus), Cowpea (Vigna Catjang), Soya (Glycine Maxnerr), and Sesame seeds (Sesamum Indium) were procured from local market in Tirupati, Andhra Pradesh.

Irradiation of Health Mixes I and II

It was reported that at low doses of radiation levels there were no changes in Nutritional quality of foods occurs, hence it was proposed to study two levels of low dose radiation (0.25kGy and0.75KGy for the developed Health Mixes I and II.

Two samples of each health mix (500g) was weighed and packed in Polythene pouches and sealed, all the samples were labeled appropriately and were stored at room temperature until the time of irradiation. The irradiation process was carried out in Gamma (ϒ) radiation chamber in irradiation unit at PJSR Agricultural University, Hyderabad, India. For the irradiation of samples, Cobalt-60 was used as a radioactive compound.

The labeled samples were irradiated at 0.25kGy and 0.75kGy in cobalt 60 gamma cell 220. The control samples were not exposed. After irradiation Trail –I samples were kept at room temperature. The trail –II sample along with control were kept at refrigerator to preserve the changes if any that may occur due to irradiation and to minimize the external environmental influences. Trail –I samples were used for Nutrient analysis and trail –II stored in refrigeration was used for sensory evaluation.

AOAC (2005) methods of Food Analysis
Moisture Analysis by Oven Drying

An accurate assessment of moisture content in feed ingredients is important because moisture influences the nutritional evaluation of Health Mixes .The oven-drying method for moisture determination has been widely used; this method measures the weight loss following heating of a sample. Although the oven method has been commonly used for estimating the loss on drying (LOD), this procedure has several limitations because the results of the LOD vary depending on the drying temperature and time.

Ash Analysis

When organic contents of a material are burnt down, the left behind is ash. It is the inorganic content present in any material. If any material is heated to its burning point in presence of oxidizing agents, only ash is left behind. To assess the quality of a material, it is very important to assess the presence of inorganic components. There are different processes defined to measure the ash content in the food products, to perform the ash test, preparing the sample is a crucial part. The food sample has to be in powdered form. Any moisture content present is dried first and it would lead to sprinkling during heating. Fatty food samples leave moisture when dried which prevents spattering. Another major problem is contamination of sample due to surroundings or due to the container used for holding the sample.

Carbohydrate Analysis by Difference method

Total carbohydrate by difference = total solids – protein – fat – ash. For high solids distilled spirits the total solids may include added sugar, citric acid, extracts, colors, and other Carbon/Hydrogen/Oxygen compounds. For most products under the scope of this method, fat and protein are not expected. However, cream liqueurs may contain milk and/or egg products, and so might contain fat and protein. (OFFICIAL METHOD-SSD:TM: 407) Official Methods of Analysis, 17th Edition, 2002; Horowitz; AOAC International, Maryland.

Protein Analysis of Health Mix by Kjeldhal method

The Kjeldhal method of nitrogen analysis is the worldwide standard for calculating the protein content in a wide variety of materials ranging from human and animal food, fertilizer, waste water and fossil fuels.

A three step procedure The Kjeldahl method consists of three steps, which have to be carefully carried out in sequence:

1. The sample is first digested in strong sulfuric acid in the presence of a catalyst, which helps in the conversion of the amine nitrogen to ammonium ions, the ammonium ions are then converted into ammonia gas, heated and distilled.
2. The ammonia gas is led into a trapping solution where it dissolves and becomes an ammonium ion once again,
3. Finally the amount of the ammonia that has been trapped is determined by titration with a standard solution, and a calculation made.

Fat analysis by Soxhlet Fat extraction method

Fat plays an important role in many foods. Fat contribute to the flavour of food as well as it gives texture and also mouth feel to the food. It is an important component which gives us maximum energy. Approximately 9 Kcal energy per gram. Extra intake of fat mostly leads to obesity and below the level lead to malnutrition. It nourishes the body with all the essential fatty acid that body cannot synthesise and also help in building the body.

Iron Estimation by Wong's method

Iron is an absolute requirement for most forms of life, including humans and most bacterial species, Plants and animals as all use iron, and it can be found in a wide variety of food sources.

Calcium Estimation by Titrimetric method

One of the factors that establish the quality of a water supply is its degree of hardness. The hardness of water is defined in terms of its content of calcium and magnesium ions. Since an analysis does not distinguish between Ca2+ and Mg2+, and since most hardness is caused by carbonate deposits in the earth, hardness is usually reported as total parts per million calcium carbonate by weight.

Thiamine Estimation

The determination of thiamine in widely different products has become a necessary as a result of the enrichment program, providing for a minimum and maximum vitamin content. However, the development of a completely suitable and accurate method for the determination of thiamine has proved a difficult task.

Determination of Riboflavin

Riboflavin is an essential micronutrient in the human diet. Because riboflavin is water soluble and not stored in appreciable amounts in the body, sources of riboflavin must be constantly consumed. In the United States many cereal grains are being fortified with riboflavin. In this review we briefly discuss the chemistry of riboflavin, the role of riboflavin in nutrition and health, effects of food processing and storage and means of measuring riboflavin in food and animal feeds.(AOAC 992.16)

Dietary Fibre Analysis

The dietary fibre is edible parts of plants' carbohydrates that are resistant to digestion in human small intestine. Diets naturally rich in dietary fibre support to prevent constipation, improve gastrointestinal health, glucose tolerance and the insulin response, and reduce the risk of colon cancer, hyperlipidemia, hypertension and other coronary heart disease risk factors. About 45% of the dietary fibre intake comes from grains and grain mixtures. (AOAC 992.16)

Statistical Analysis

All statistical analysis was done in triplicate and average values are calculated. Data were presented as mean ± Standard Deviation. The results were statistically analysed by one way analysis of variance and means were compared using bonferroni post hoc test with least significant differences procedure at 0.05 levels were used to describe the significance of differences between control and irradiated samples. Graph pad prism 3.1 version was used as statistical analysis software.

RESULTS AND DISCUSSION

Impact of Radiation on Nutritional Quality

Nutritional quality of irradiated and non-irradiated Health Mix I & II

Gamma irradiation has emerged as an efficient and remarkable technique for the prevention of growth of microorganisms, insects and mites in order to have safe food as well as smooth trading across the borders. Irradiation can contribute to ensure food safety to healthy and compromised consumers (pregnant mothers, immune-compromised patients, people on medication and ageing persons), satisfying quarantine requirements and controlling severe losses during transportation and commercialization. This technology also has the advantage that it can be applied to fresh, frozen or cooked products to enhance their shelf life. It is a physical, safe, environmentally clean and efficient technology (Bhasir and Aggarwal, 2016).

When foods are exposed to ionizing radiation under conditions envisioned for commercial application, no significant impairment in the nutritional quality of protein, lipid and carbohydrate constituents was observed. Irradiation was no more destructive to vitamins than other food preservation methods. Protection of nutrients is improved by holding the food at low temperature during irradiation and by reducing or excluding free oxygen from the radiation milieu. (Joseph son, 1978).

The impact of low dose of Radiation. The statistical difference among the samples namely ;non irradiated, irradiated at 0.25kGy and irradiated at 0.75kGy of Health Mix-I and II were studied separately using one way ANOVA and Bonferroni Post hoc test. For the three samples of each Health Mix and each nutrient included in the study, the difference between sample and within sample were studied. The results of statistical analysis done using Bonferroni Post hoc test were shown in figure-1

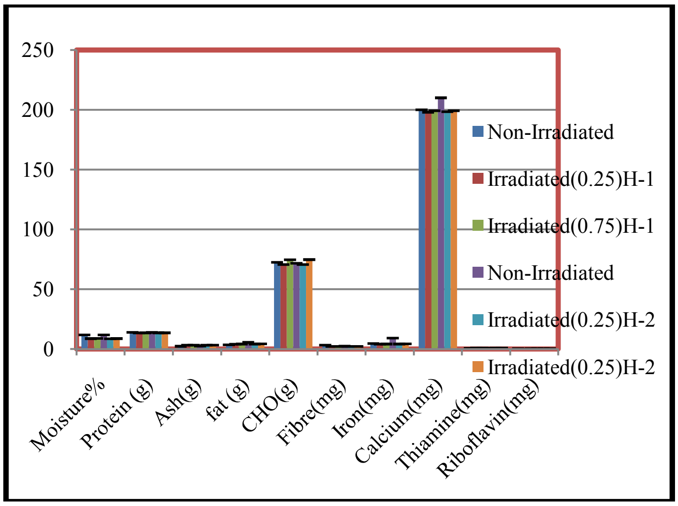

Figure 1 Nutrient composition of Health Mix-I and II before radiation

The Health mixes I and II did not differ in their nutritional quality before and after irradiation at two low doses (0.25 kGy and 0.75kGy) ,that is there is not much difference in non irradiated and irradiated health mixes I and II except for slight variation in nutrient values ; **;** protein, carbohydrates, iron and calcium. Hence the null Hypotheses $H0_3$ "The Health Mix I after irradiation do not differ in nutritional quality" and the null Hypothesis $H0_4$ "The Health Mix II after irradiation do not differ in nutritional quality" were partially accepted.

Radiation processing involving the exposure of food to a controlled source of ionizing radiations can be used for reducing the microbial load by destruction of pathogens, and therefore improving the product shelf-life. The results of the current study on irradiation of health mixes at low dose 0.25 kGy and 0.75 kGy does not result in any predominant changes in the nutrient composition and does not affect the sensory qualities of Health Mixes.

CONCLUSION

Application of gamma irradiation has shown promising results in extending the shelf life of Health mix-I and II by disinfestation and preventing microbial growth. Irradiation has also resulted in increased antioxidant properties besides decreasing the anti-nutritional content of the health mixes. Food irradiation has been approved by the CODEX, Food Safety and Standards Authority of India (FSSAI), Food Standards Australia New Zealand, American Medical Association, the Institute of Food Technologists, International Atomic Energy Agency (IAEA), Food and Agriculture Organisation (FAO), World Health Organisation (WHO). In spite of the importance of communicating information about food irradiation to consumers, it is also important for regulators and producers to know the consumers general attitude to the technology. However, more research is needed to evaluate the mechanism of action of different doses of gamma irradiation on the most important pathogens found in different foods and to optimize the doses. Gamma irradiation seems to be one of the promising techniques of future to be used to meet the ever growing consumer demands for safe food, food security and enhanced food shelf life so as to feed the huge population and to approach the distant markets while maintaining high quality of the food.

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References

Ahari, M. H; Mirmajlessi, S. M; Fathollahi, H.; Minasyan, V. & Mirjalil S. M. (2011). Evaluation of gamma irradiation effect and Pseudomonas flourescens against Penicillium expansum, *African J. Biotech*., Vol. 10, no. 54, pp. 11290-11293.

AOAC, 2005. Official Methods of Analysis (18th edn.). Association of Official Analytical Chemists. Washington. DC.

AOAC 992.16, Total Dietary Fiber, Enzymatic Method and AOAC 994.13, Total Dietary Fiber (Determined as Neutral Sugar Residues, Uronic Acid Residues, and Klason Lignin)-Gas Chromatographic–Colometric–Gravimetric Method (Uppsala Method), (Andrews, 1998).

AOAC Official Method 970.65, Riboflavin (vitamin B2) in foods and vitamin preparations. Fluorimetric method, Final Action 1971 (Ref: Official *Journal of the European Communities* N° L 344/36 of 26.11.92, Determination of crude fibre/ AOAC, 2005, 962.09).

Bhat,R., Alothman, M., and Karim, A.A. 2009. Effects of radiation processing on phytochemicals and antioxidants in plant produce. Trends in Food Science Technology 20: 201-212.

Eliana Pereira a,b , Lillian Barros a , João C.M. Barreira a,d , Ana Maria Carvalho a , Amilcar L. Antonio a,c , Isabel C.F.R. Ferreira a. Electron beam and gamma irradiation as feasible conservation technologies for wild Arenaria montana L.: Effects on chemical and antioxidant parameters. Innovative Food Science and Emerging Technologies. 36 (2016) 269–276.

E. S. Josephson ·M. H. Thomas · W. K. Calhoun. Nutritional aspects of food irradiation: An overview. *Journal of Food Processing and Preservation* 2(4):299 - 313 · May 2007.

Khalid Bashir and Manjeet Aggarwal . Effects of gamma irradiation on cereals and pulses- a review. *International Journal of Recent Scientific Research Research* Vol. 7, Issue, 12, pp. 14680-14686, December, 2016.

Loaharanu, P. (1994). Food irradiation in developing countries: a practical alternative, IAEA Bull., Vol. 1, pp. 30-35.

Paisan Loaharanu and Mainuddin Ahmed.(2000) Advantages and disadvantages of the use of irradiation for food preservation. Journal of Agricultural and Environmental Ethics (J AGR ENVIRON ETHIC). 4(1):14-30 ·

Seifollah Bahramikia, Amin Ardestani and Razieh Yazdanparast. (2010).Protective effects of four Iranian medicinal plants against free radical-mediated protein oxidation. *Journal of Food Chemistry*.Volume-115;37-42.

Tomlins, K. (2008). Food safety and quality management, Food Africa. http://foodafrica.nri.org/safety/safety discussions1.html.

WHO (1994). Safety and Nutritional Adequacy of Irradiated Food. World Health Organization, Geneva.

WHO. Wholesomeness of Irradiated Foods. Technical report Series 659, Geneva, 1981.

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