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Current activities in food irradiation as a sanitary and phytosanitary treatment in the Asia and the Pacific Region and a comparison with advanced countries

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ABSTRACT

Irradiation is an effective and safe method of food preservation, as it reduces spoilage, improves food hygiene, and extends shelf life. In October 2013, experts from Asia and Pacific Region gathered in Kuala Lumpur, Malaysia to share information on the application of food irradiation. The participants of the meeting discussed and analyzed the strengths and weaknesses of food irradiation with a view to sustainably continue the activity in the participating countries. The latest information in the Asia/Pacific Region regarding regulations, irradiation facilities and quantities irradiated is provided in this paper. The current status of food irradiation is reviewed and compared with the United States of America (USA) and European Union (EU). Activities on of food irradiation at commercial scale have increased significantly in these countries during last few years. Attention is also focused on the phytosanitary treatment of fruits and vegetables. Possible reasons for slow adoption of food irradiation and points to enhance the technology are also outlined.

1. Introduction

The Food and Agricultural Organization (FAO) estimated that 25–35% of world food production is lost through natural causes such as pests, microbes, and insects (Ihsanullah & Ahmad, 2003; Zaman et al, 2013). The raw agricultural products, grown and harvested by traditional methods are processed only by mild drying which does not help to reduce the level of microbes present in the food commodities. In the past, fumigation was used for disinfestations during storage, and quarantine treatment for commerce of various food commodities. It has been shown that most of these chemicals are carcinogenic or environmentally damaging and has serious adverse effects on human health. Because of the ban, many countries have had to either limit or stop the export of some agricultural commodities. This resulted in economic losses, further trade imbalances, trade deficits and curtailment of consumer food choices. These are areas where food irradiation has something significant to offer as an alternative method for reducing storage losses and/or meeting quarantine requirements. An important feature of irradiation is its ability to achieve different types of beneficial effects (sanitary, phytosanitary and shelf-life extension) in a wide range of food and non-food products.

Evolution of irradiation technology is a consequence of research activities of over 100 years that has resulted in understanding its safety and effectiveness as a food safety method. Thus making it the most researched area even over canning being used in the food industry today (Smith & Pillai, 2004). So far, sufficient evidences have been collected to prove and stablish the safety and efficacy of the technology. Significance of irradiation as phytosanitary treatment of horticultural products for international trade have been described in detail elsewhere (Bustos-Griffin, Hallman, & Griffin, 2012). Consequently, World Health Organisation (WHO), the Food and Agriculture Organisation (FAO), the International Atomic Energy Agency (IAEA) and Codex Alimentarius Commission (CAC) have been advocating and facilitating the use of irradiation as a food safety method throughout the world. So far, more than 50 countries have approved irradiation as a sanitary and phytosanitary method for over 60 foods and food products (IFSAT, 2013).

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1.1. Role of RCA

Cooperative agreements that promote science and development in key regions around the world strengthen the work of the IAEA to spread the benefits of the peaceful applications of nuclear technology. The first such cooperative agreement is the Regional Cooperative Agreement (RCA) for research, development and training related to nuclear science and technology for Asia and the Pacific. RCA was established on 12 June 1972 with six participating countries: India, Indonesia, Philippines, Singapore, Thailand and Vietnam. RCA has continuously grown and evolved over the years. In 2002, the RCA states (MSs) were 17 viz. Australia, Bangladesh, China, India, Indonesia, Japan, Malaysia, Mongolia, Myanmar, Nepal, New Zealand, Pakistan, Philippines, Republic of Korea, Sri Lanka, Thailand and Vietnam. Regional office of RCA was also established in Daejon, Republic of Korea in 2002. In 2012, with the inclusion of Cambodia, Fiji, Laos, Palau and Singapore the number of MSs became 22. The IAEA staying a non-party acts as a strategic partner and provides managerial, technical, administrative and financial support to the RCA member states. So far, over 100 projects have successfully been completed under RCA in different thematic areas. The RCA projects on food irradiation are listed in Table 1. To discuss, review and update a detailed regional work plan for implementation of the new RCA Project RAS 5057 on "Implementing Best Practices of Food Irradiation for Sanitary and Phytosanitary Purposes", the first proper meeting was held at Hanoi, Vietnam in March 2012 (Kume & Todoriki, 2013). The second Executive Management Meeting was arranged from 28 to 31 October 2013 at Kuala Lumpur, Malaysia. Senior policy/regulatory officials responsible for food safety and security together with the National Project Coordinators for this project participated in the meeting. The meeting aimed to promote awareness of irradiated foods and associated technologies amongst the food control authorities and those responsible for implementation of regulatory policy in this area. The meeting agenda included: policy and regulatory developments and technical aspects of food irradiation; current status, research initiatives and their applications; technology transfer and commercialization. It was recommended during the meeting that the status of food irradiation within RCA should be publicized and Pakistan was assigned to use the information provided by MSs in the review article for publication in a scientific journal (Anonymous, 2014). Although there are 22 MSs but the 5 new members have just started documentation and showed willingness to plan for establishment of food irradiation facilities. The paper includes the information which was either shared in the meeting by the 17 member states viz. Australia, Bangladesh, China, India, Indonesia, Japan, Malaysia, Mongolia, Myanmar, Nepal, New Zealand, Pakistan, Philippines, Republic of Korea, Sri Lanka, Thailand and Vietnam and other relevant sources.

2. Regulations

The potential use of irradiation for sanitary and phytosanitary purposes has been known since early 1920's. United States of America was the leading country in the development of food irradiation on commercial scale for the domestic exports from Hawaii and was the first country to establish a generic dose for fruit fly disinfestation. However, the international export of irradiated fruit didn't occur until in 2004 when Australia and New Zealand established a protocol for Australian mangoes under Food Standards Australia New Zealand (FSANZ Standard 1.5.3); a human health-based standard that permits the irradiation of 12 fruits, herbs, spices and herbal infusions for a phytosanitary purpose. In 2003, FSANZ granted approval for irradiation of 9 tropical fruit (breadfruit, carambola, custard apple, longan, litchi (lychee), mango, mangosteen, papaya and rambutan) and later revised the standard in 2010 and 2013 to include persimmon, tomato and capsicum. Formulation of standards under the Australia New Zealand Food Authority was discussed earlier (Roberts, 2000).

In New Zealand, irradiated food imports are regulated under FSANZ Standard 1.5.3 and Import Health Standards to ensure biosecurity (quarantine pest). So far, the Import Health Standard has been issued for the import of Hawaiian papaya in 2006, Vietnamese mango in 2012 and for mango, papaya, litchi, tomatoes and capsicums from Australia. The use of irradiation as phytosanitary treatment is approved for both domestic use and for international trade in Australia. However, irradiation can only be applied for fruit and vegetable commodities with the approval of FSANZ. Australia does not have any class-wise approval system for fruit and vegetables. Therefore, research must be undertaken if new crops are to be included for approval under existing regulations. In this context, The Queensland Government has proposed amendments in food standard code to include apple, apricot, cherry, honeydew melon, nectarine, peach, plum, rockmelon, strawberry, table grape and zucchini for irradiation treatment. Likewise, New South Wales Government is also expected to propose some amendments in food standard code based on R&D on blueberry and citrus. In Australia, the radiation doses used are: (i) 150 Gy generic treatment for all fruit fly species, (ii) 300 Gy for mango seed weevil, and (iii) 400 Gy Generic treatment for all arthropod pests except for Lepidopteron that pupate internally.

Bangladesh government gave conditional/unconditional clearance for irradiation of 18 food items in 1983, with specification of dose limits based on the item and purpose of irradiation (Table 2). Market trials of irradiated potatoes, onions and dry fish were carried out during 1984–1988 and the Bangladesh Standard providing specifications for irradiated foods was approved in 1988. Later, Bangladesh Standards and Testing Institution (BSTI) adopted the "Revised Codex General Standard for Irradiated Foods, Codex Stan 106, 1983, Rev.1-2003" for irradiation specifications based on groups or classes of foods in June 2005. The parliament of Bangladesh passed the Plant Quarantine Act in 2011 and the relevant operational rules are under preparation. Over the years, Bangladesh has developed some commercial protocols of irradiated food for domestic use and for export. However, the use of irradiation technology for phytosanitary purposes is yet very limited.

Table 1
Regional projects on food irradiation have so far been launched.

S. no.	Code	Title	Period
1	RAS/5/020	Food Irradiation Process Control and Acceptance	1989–1996
2	RAS/0/022	Public Acceptance and Trade in Irradiated Food	1995–1998
3	RAS/5/034	Irradiation as Sanitary & Phytosanitary Food Treatment	1999–2001
4	RAS/5/042	Application of Food Irradiation for Food Security, Safety, and Trade	2001–2004
5	RAS/5/046	Novel Applications of Food Irradiation Technology for Improving Socioeconomic Development	2007–2010
6	RAS/5/050	Enhancing Sanitary and Phytosanitary Treatment of Regional Products for Export by Irradiation	2009–2011
7	RAS/5/057	Implementing Best Practices of Food Irradiation for Sanitary and Phytosanitary Purposes	2012–2014