

# Irradiation and Trade in Food and Agricultural Products



International Consultative Group on Food  
Irradiation

# Irradiation and Trade in Food and Agricultural Products

**International Consultative Group on Food Irradiation  
(ICGFI)**

The ICGFI Secretariat  
Joint FAO/IAEA Division of Nuclear Techniques  
in Food and Agriculture,  
Wagramerstrasse 5,  
P.O.Box 100,  
A-1400 Vienna, Austria

# Contents

<b>Foreword</b> .....	<b>5</b>
<b>Executive Summary</b> .....	<b>6</b>
<b>Introduction</b> .....	<b>8</b>
<b>Problems in Trade in Food and Agricultural Commodities</b> .....	<b>9</b>
Food safety and foodborne illness issues .....	9
Presence of pests .....	9
Availability and seasonality issues .....	9
Market access .....	9
<b>Assessing Irradiation and Other Technologies Available to Resolve Trade Issues Concerning Food and Agricultural Products</b> .....	<b>10</b>
<b>The Place of Irradiation in the Food Distribution Chain</b> .....	<b>11</b>
<b>The Future for Trade in Irradiated Food</b> .....	<b>12</b>
<b>Regulations that Affect Trade in Food and Agricultural Products</b> .....	<b>13</b>
International .....	13
Regional .....	14
National .....	14
<b>Conclusions and Recommendations</b> .....	<b>15</b>
<b>Bibliography</b> .....	<b>16</b>



## Foreword

The International Consultative Group on Food Irradiation (ICGFI) was established on 9 May 1984 under the aegis of FAO, IAEA and WHO. ICGFI is composed of experts and other representatives designated by governments which have accepted the terms of the "Declaration" establishing ICGFI and have pledged to make voluntary contributions, in cash or in kind, to carry out the activities of ICGFI.

The functions of ICGFI are as follows:

- ❑ to evaluate global developments in the field of food irradiation;
- ❑ to provide a focal point of advice on the application of food irradiation to Member States and the Organizations; and
- ❑ to furnish information as required, through the Organizations, to the Joint FAO/IAEA/WHO Expert Committee on the Wholesomeness of Irradiated Food, and the Codex Alimentarius Commission.

As of May 1998, the following countries are members of ICGFI:

Argentina, Australia, Bangladesh, Belgium, Brazil, Bulgaria, Canada, Chile, Costa Rica, Côte d'Ivoire, Croatia, Cuba, Czech Republic, Ecuador, Egypt, France, Germany, Ghana, Greece, Hungary, India, Indonesia, Iraq, Israel, Italy, Republic of Korea, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Pakistan, People's Republic of China, Peru, Philippines, Poland, Portugal, South Africa, Syrian Arab Republic, Thailand, Tunisia, Turkey, Ukraine, United Kingdom, United States of America, Viet Nam, and Yugoslavia.

The 11th Annual Meeting of ICGFI held in Bali, Indonesia, November 1994 requested that a comprehensive Programme of Work and Budget of ICGFI for 1996-98 be developed to facilitate the consideration of ICGFI member governments on the extension of its mandate. A Working Group was therefore convened for this purpose in Vienna in April 1995 which recommended, among other things, that urgent consideration be given to the development of ICGFI documents which would clearly define the role that irradiation can play in achieving the general policy goals endorsed by Member States of various UN Organizations. Five such policy documents in the areas of Food Safety, Food Security, Trade Development, Environment, and Energy Conservation were recommended by the Working Group. However, in view of the financial constraints, the 12th ICGFI Annual Meeting held in Vienna, November 1995, decided to prepare only the first three such documents.

This document was prepared by Ms. Michelle Marcotte, a freelance consultant on food irradiation based in Ottawa, Canada, on behalf of ICGFI. It explains the comparative advantages of irradiation as a method to meet sanitary and phytosanitary requirements in international trade in food and agricultural commodities. After undergoing peer review and comments by national contact points of ICGFI and subsequent revisions by the author, this document was approved for publication as one of the information documents by the 14th ICGFI Meeting. The ICGFI Secretariat gratefully acknowledge the valuable contribution of Ms. Marcotte and those who were involved in reviewing this document. This document was professionally edited by Mr. R. Peniston-Bird, a former editor of IAEA.





## Executive Summary

Trade in food and agricultural products is important to all countries; the economies of many developing countries would be significantly improved if they were able to export more food and agricultural products.

Unfortunately, many products can not be traded because they are infested with, or hosts to, harmful pests, contaminated with microorganisms, or spoil quickly. As a result, many developing countries cannot build strong economies and consumers do not have access to the wealth of foods and products that could contribute to health and enjoyment of life. Foods contaminated with microorganisms cause economic losses, widespread illness and death.

Several technologies and products have been developed to resolve problems in trading food and to improve food safety, but none can provide all the solutions. Some chemical fumigants currently in use are harmful to people and/or the environment. Other technologies, such as controlled atmospheres, may require special equipment or storage facilities and may be expensive. Regulatory approval is also an issue when controlled atmospheres are used for pest control. Heat treatments such as canning are commonly used to resolve problems such as bacterial contamination or short shelf-life. Canned foods are very different from the original product; some have excellent consumer acceptance, others may not be rated as highly as fresh products. Certain heat treatments sometimes damage fruit.

Irradiation is an effective technology to resolve technical problems in trade of many food and agricultural products, either as a stand-alone technology or in combination with others. As a disinfection treatment it allows different levels of quarantine security to

be targeted and it is one of few methods to control internal pests. As a disinfection treatment it offers good, broad spectrum control of many pathogenic and spoilage organisms with minimal change to the food.

The ability of irradiation virtually to eliminate key pathogenic organisms from meat, poultry and spices is an important public health advantage. The huge number of cases of illness and death from pathogenic bacteria in meats and poultry represents a terrible waste of human and economic potential, particularly when a technology that could prevent a large percentage of such cases is available. Irradiation also offers clear advantages over chemical and heat treatments for spices, in terms of bacterial control and maintenance of organoleptic properties. Since spices are so widely used in processed foods, this beneficial effect of irradiation is multiplied.

In addition to controlling pests and eliminating harmful bacteria, irradiation also extends the storage life of many foods; this effect makes irradiation particularly useful for tropical fruits, commonly infested and also requiring extended shelf-life to reach consumer markets in good quality. Although irradiation is often clearly a superior technology, there are constraints that restrict its use, including lack of regulatory approvals, labelling issues and lack of consumer information and understanding.

Harmonization of sanitary and phytosanitary measures was negotiated intensely under the Uruguay Round of the General Agreement on Tariffs and Trade (GATT), and detailed in two technical trade agreements: on the Application of Sanitary and Phytosanitary Measures (SPS), and on Technical Barriers to Trade (TBT). An important principle, that of equivalence, was agreed





to in these negotiations. Within the SPS Agreement, the principle of equivalency relates to recognizing the validity of alternatives for achieving an equivalent outcome. Equivalence will be key to moving regulatory agencies from prescriptive treatments towards standards and towards a focus on outcomes rather than specific processes. Governments will be obliged to accept any measures which can achieve the same results. This principle should result in greater acceptance of irradiated foods in international trade.

In summary, measures to handle technical or pest problems should not be more trade

restrictive than necessary to achieve a legitimate protection objective. To ensure national regulations can withstand the inevitable court challenges, efforts should be made to ensure that no discrimination against irradiated food, processed according to the principle of the Codex Standard, is introduced into national regulations.

Regulations on food irradiation vary widely - from broad acceptance of several food classes to limited acceptance of a few food items, and from prohibition to complete silence on the subject. Such disharmonious regulations are barriers to trade in irradiated foods.



## Introduction

While trade in manufactured goods is important to most developed and some developing economies, trade in food and agricultural products is important to all countries. Successful trade has built the largest world economies. The economies of many developing countries, and the health of their people, would be significantly improved if these countries were able to export or import more food and agricultural products. At the same time, consumers in importing countries would benefit from having access to new, nutritious and exotic foods and products.

Some commodities, such as grains and cereals, are of primary importance as the staple foods of many diets; others, such as fruits, are important sources of key nutrients or may simply be well liked for their exotic flavours. Agricultural commodities, such as animal feed, contribute to improved nutrition as well as economic health. Forestry, wood and fibre products contribute to the well-being of rural-living people and provide needed items to urban dwellers. All food and agricultural exports contribute to the well-being of both importing and exporting countries.

Unfortunately, many products cannot be traded because they are infested with, or hosts to, harmful pests, contaminated with microor-

ganisms, or spoil quickly. As a result, many developing countries cannot develop healthy economies and consumers do not have access to the wealth of world products, and their nutrients. Several technologies and products have been developed to resolve problems in trading food and to improve food safety, but none can provide all the solutions. Currently, trade in many products is either not allowed, or not profitable. In addition, some technologies currently in use (particularly chemical fumigants and dips) are harmful to people or the environment and their use is being phased out. Irradiation can often mitigate food trade problems, either as a stand-alone technology or in combination with others.

Since trade policies are governed by international agreements as well as domestic regulations, this publication reviews the pertinent regulatory situation that allows, or constrains, trade in irradiated foods and agricultural products. Trade policy and regulatory officials are already overburdened with reading material. Therefore, this publication is designed to provide easily accessible information: it will discuss trade problems, examine the technologies that can resolve the problems and show how irradiation can play an important role in improving trade in food and other agricultural products.





# Problems in Trade in Food and Agricultural Commodities

## Food safety and foodborne illness issues

Bacterial contamination can and frequently does cause human illness. According to the World Health Organization (WHO), illness due to contaminated food is perhaps the most widespread health problem in the contemporary world and an important cause of reduced economic productivity. Trade in many food products, usually meat, poultry and marine foods, is sometimes constrained because of microbial contamination. These foods can be contaminated, even when processed using good manufacturing practices. Rapid spoilage caused by microbial contaminants, enzyme and other chemical reactions is also an issue.

## Presence of pests

Insects and other pests can be present on and in many horticultural foods and agricultural products. Pests of perishable foods may entail quarantine, since these foods have a short shelf-life. Pests of stored foods or agricultural products are usually a cause for economic concern since they can cause serious storage losses as well as damage to the importing country. If pests are not already known or not established in the importing country, the host product may be prohibited, or may have to be disinfested before being allowed entry.

The agricultural fumigant most used for this purpose, methyl bromide (MB), has been listed as an ozone depleting substance under the United Nations Montreal Protocol and its production must be phased out. Other chemical treatments applied as dips or sprays are increasingly being viewed as not in the best interests of human or environmental health. In

some cases, governments are phasing out these products, in other cases, consumers are demanding that chemical treatments be replaced. The trend is towards the elimination of many chemical treatments.

## Availability and seasonality issues

Unlike manufactured products, agricultural commodities are often only available seasonally and harvest quantities may vary from year to year. These factors make trade more risky and often more expensive. On the other hand, continuing demand for some products encourages their trade between growing regions. Often though, significant losses and quality downgrading of seasonal products occur because of their short shelf-life, the need to use inexpensive transport systems and the long distances the product must travel.

## Market access

Several regulatory and technical barriers to trade exist for various reasons. Treatment regimens required or allowed by one country may not be available or allowed in another country. This is often the problem with irradiation since regulations governing the use of irradiation vary widely. Many trade barriers are not sufficiently well grounded and may have been devised to protect local growers from competition. Political influences commonly make trade difficult, slowing or preventing trade possibilities. Under the General Agreement on Tariffs and Trade (GATT) these differences must be overcome and national regulations adapted accordingly.







## Assessing Irradiation and Other Technologies Available to Resolve Trade Issues Concerning Food and Agricultural Products

Irradiation is an effective technology for resolving technical trade issues for many food and agricultural products. As a disinfection treatment it allows the possibility of targeting different levels of quarantine security and it is one of few methods to control internal pests. As a disinfection treatment it offers good broad spectrum control of many pathogenic and spoilage organisms with minimal change to the food. Although it is often clearly a superior technology, there are constraints that restrict its use.

One important constraint is lack of regulatory approval in importing countries, even though the same countries may allow the irradiation of the same product for export. Many countries, particularly major importers, continue to require extensive and food-specific approval petitions that are then reviewed at length, with often no approvals resulting. This process, frequently based on bureaucratic interpretation of regulatory requirements, represents a key constraint to the implementation of irradiation, and a key discouragement to the food industry.

Whilst labelling can assist consumers who are interested in irradiation for the benefits it offers in helping them find the foods they want, labelling requirements for irradiated foods are seen by the food industry in some countries as a handicap because it assumes that consumers hold negative opinions concerning irradiation. Since labelling is not required for many competitive treatments, such as chemical fumigation, the imposition of such requirements for irradiated food may be seen as an unfair technical trade barrier. Given the unfair marketing position and additional expense of mandatory labelling of irradiated foods when competitive chemical treatments do not require it, labelling of irradiated foods should be voluntary.

Consumer attitudes, real or perceived, also constrain the use of irradiation. Often perceptions of consumer attitudes are based on personal observations, or a political analysis, as opposed to consumer research or market testing. This perception then affects decisions at regulatory and industry levels, sometimes to the detriment of overall health and economic goals.

For irradiation to be useful in resolving a food trade or technical problem, a country must have a sufficiently developed infrastructure. Food transport and distribution mechanisms must be in place as well as good storage, and sometimes refrigeration storage. Although available in many countries, irradiation equipment is sometimes not accessible for research or commercial treatments for food products.

Often the capital costs of irradiation equipment are seen as prohibitive, even though low operating costs make per unit costs for most commodities very competitive with other treatments. Fortunately, however, commercial contract multipurpose irradiators operate in many countries offering irradiation services at reasonable cost. Since irradiation gives the added economic benefit of prolonged fresh market life for many foods, decreased waste and increased market potential of the food should be considered in a cost-benefit analysis.

Tables I-IV provide a quick reference to the main food and agricultural products traded. Each table refers to a commodity group, the trade problems often associated with the commodities, some current or potential technologies to resolve the trade issues as well as the constraints, effectiveness and relative costs associated with the technologies.





## The Place of Irradiation in the Food Distribution Chain

The purpose irradiation fulfils in the processing or handling of a food will dictate where irradiation fits in the food distribution chain. Fortunately, irradiation is reasonably versatile and could fit in several, but not all, links of the chain.

Irradiation is most often viewed as being the last process after packaging. In this way, foods such as meat, poultry and shellfish can be irradiated to control pathogenic and spoilage organisms with a reasonable assurance that the product will not be further contaminated before purchase by the consumer or food service operator. Where these foods are to be further processed in a Hazard Analysis Critical Control Points (HACCP) environment, and where control of specific pathogenic bacteria is required, there is also an argument for irradiation at the bulk product stage, for example irradiation of carcasses of beef before ground beef patties are made.

In other instances, irradiation is a pest disinfection method. Where irradiation facilities exist, and where a sufficient level of assurance can be given to the importing country about the exclusion of pests during shipping and handling, irradiation disinfection can be done at the port of exit. In other instances, some country inspection services may require the assurance that irradiation for pest control be carried out at the port of import. The product can either be packaged in wholesale boxes, such as those commonly used for fruit, or the product may be in bulk, such as grain or dry ingredients. In the case of packaged foods, the packaging must exclude the re-entry of pests. In bulk products, the transport or storage container must be free of pests, and it would be advisable to ensure that any pests that re-enter

the product do not survive. In these instances, the use of an effective diatomaceous earth to disinfest the transport or storage mechanism before the grain is added, or applying a very small amount of diatomaceous earth to the top of the carrier might be a good combination practice. Where storage facilities are sufficiently airtight, storage under carbon dioxide may also be a potential combination treatment. For some products, lower storage temperature might also work to exclude pests.

Spices are commonly irradiated, mainly to reduce bacterial and mold counts, although sometimes pests are an issue. Usually spices are irradiated in bulk bags or barrels before further processing by the spice blender, or before use as ingredients in food products. In other instances, small spice packets, included in packaged food mixes, are irradiated to ensure the consumer receives clean spices.

Irradiator ownership scenarios vary. Usually irradiators are owned by contract irradiation companies, but they could also be owned and operated by food processors, grower marketing co-operatives, port authorities or governments. Contract irradiator companies already own facilities in many countries and specialize in the cost effective, safe operation of irradiators, selling irradiation services to a wide range of companies for many product types.

It is commonly asked whether irradiators could be built to process individual items such as hamburgers in a restaurant, or packages of food in a home kitchen, similar to microwave ovens. These scenarios are not possible with current technology, and not ever likely.





## The Future for Trade in Irradiated Food

Irradiation will be increasingly used, provided the trend towards increased regulatory approval of irradiation continues. Recent trade agreements will reduce the ability of importing countries arbitrarily to decide that irradiation may not be used. The 1996 US Department of Agriculture/Animal Plant Health Inspection Service quarantine policy statement is a positive step towards greater use of this technology.

As the economies of developing countries improve, and as their infrastructure elements are further developed, their ability to export foods will increase. The desire to increase food trade will promote the necessity for effective technologies to resolve problems such as pest infestation, microbial contamination and food spoilage. On the other hand, the desire to export food for the foreign currency value should not come at the expense of meeting the domestic food needs of developing countries. Food irradiation should also be seen as a technology to improve the quantity and quality of food available for domestic consumption.

The international phasing out of MB as an ozone-depleting substance will most critically affect the need for alternative technologies for pest control. Production was frozen at 1995 levels and in some countries reductions in use have begun. Quarantine and pre-shipment uses of MB are currently exempt internationally, although there is no exemption for these uses under the Clean Air Act in the USA. Developing countries are on a delayed time schedule for the phase-out of MB. There are many foods and agricultural commodities that will require new treatments and approval for the use of new treatments.

Irradiation is one of the most ready and effective pest control treatments. If regulatory approvals by leading importing countries such

as the USA continue, irradiation has the potential to become a very important alternative to MB. On the other hand, the poor level of official regulatory acceptance of irradiation by other major importing nations such as Australia, Canada and Japan negatively affects its use for many exports.

It is important to ensure harmful bacteria are eliminated from meat, poultry and marine products. Irradiation is already used as a means to eliminate harmful bacteria in these foods, enhancing trade and reducing economic risk with these commodities. However, there is an urgent need for many countries to acknowledge that irradiation is either needed or already used for these foods and to improve their regulatory acceptance.

Ethylene oxide (ETO), an important fumigant for the disinfection of spices, herbs and dry ingredients, has come under increasing pressure from regulatory authorities on both human health and environmental grounds. It was banned in the European Union in 1991 and is under review in the USA. Irradiation is the most likely and effective alternative to ETO, although heat treatments are in use for some products. Irradiation is already widely used to disinfect spices. Globally, the volume of irradiated spices and dried vegetable seasonings increased from 10 000 tonnes in 1990 to 60 000 tonnes in 1995. There is a need for improved availability of irradiation equipment in spice producing countries.

Over the past five years, irradiation equipment has become more readily available for research and commercial use. Equipment must be available for food industry applications research for irradiation to be better used. New equipment designs will be needed to better fit irradiation into some commodity and infrastructure applications as other competitive technologies such as chemical fumigants are phased out.





# Regulations that Affect Trade in Food and Agricultural Products

## International

Harmonization of sanitary and phytosanitary measures was negotiated intensely under GATT, particularly during the Uruguay Round. The subsequent establishment of the World Trade Organization (WTO) in 1995 and the administering of the Agreements on Sanitary and Phytosanitary Measures (SPS) and the Technical Barriers to Trade (TBT) Agreement will eventually have a profound influence on the flow of free trade in food and food products.

An important principle, that of equivalence, was agreed to in these negotiations. The principle of equivalence in GATT relates to recognizing the validity of alternatives for achieving a desired outcome. Equivalence will be key to moving regulatory agencies from prescriptive treatments to standards and to focusing on outcomes rather than on specific processes. Governments are bound to accept any measures which can achieve the same results. This principle should result in greater acceptance of irradiated foods in international trade.

Under the SPS and TBT Agreements, the level of protection deemed appropriate by a government, if justified technically, cannot be challenged. Measures taken to achieve the level of protection can be challenged. Measures should not be more trade restrictive than necessary to achieve a legitimate objective. Efforts should be made to ensure that national regulations do not discriminate against irradiated foods, processed according to the principle of the Codex Standard.

The SPS Agreement applies to all sanitary and phytosanitary measures which may directly or indirectly affect international trade. Intended to guide harmonization, the Agreement encourages the recognition of

internationally agreed treatments (including irradiation) and only allows control measures that are scientifically justified. Economic risk assessments of potential harm resulting from insufficient or ineffective pest control measures are allowed, but the SPS Agreement does not allow arbitrary or unnecessarily restrictive control measures. The clauses on transparency of control measures will result in a decreased ability to place unnecessary restrictions on food effectively treated with irradiation for pest or disease control

The TBT Agreement was prepared to ensure that technical regulations and standards, including those for packaging, labelling, inspection methods and standards, do not create unnecessary obstacles to international trade. Like the SPS Agreement, it is intended to harmonize technical regulations and standards so they do not become unnecessary barriers to trade. Trade restrictions cannot be more restrictive than necessary to fulfil a legitimate objective. Legitimate objectives are assessed on the basis of available scientific and technical information, related processing technology or intended end use of products.

The Codex Alimentarius Commission of the Food and Agriculture Organization (FAO) and the WHO has issued its recommended standards for the irradiation of food. Codex has prepared its General Standard for Irradiated Foods and Recommended International Code of Practice for the Operation of Radiation Facilities Used for Treatment of Food. These have been recommended to all Codex member governments for acceptance since 1984. Provisions concerning labelling of pre-packaged irradiated food have been adopted by Codex in its General Standard for Food Labelling since 1991. These standards state that irradiated foods should be accompanied by shipping documents identifying the





irradiator, date of treatment, lot identification, dose and other details of treatment. Countries are encouraged to harmonize their regulations on Codex principles before the end of 1998.

In summary, measures to handle technical or pest problems shall not be more trade restrictive than necessary to achieve a legitimate protection objective. To ensure that national regulations would withstand challenge, efforts should be made to ensure that no discrimination against irradiated food, processed according to the principle of the Codex Standard, is introduced into regulations. Governments that have introduced import regulations stricter than recognized international standards, guidelines and recommendations may be requested to furnish justifications based on scientific principles and proper risk assessments to the WTO.

The International Consultative Group on Food Irradiation (ICGFI), a joint group under the aegis of FAO, WHO and the International Atomic Energy Agency (IAEA), has issued a number of guidelines and recommendations to complement the Codex General Standard for Irradiated Foods. They cover all aspects of treatment, handling and distribution of irradiated foods and provide a good basis for preparing the detailed protocols needed to implement commercial irradiation.

ICGFI has also established a registry of irradiators that meet good operations standards. This registry is important because many domestic regulations for food irradiation demand that a food irradiation facility meet international as well as domestic standards. Only those facilities which comply with established criteria concerning proper operation under appropriate supervision and regulatory control are included in the ICGFI registry.

## Regional

Regulations on food irradiation vary widely among countries - from broad acceptance of several food classes to limited accep-

tance of a few food items, and from prohibition to complete silence. Such disharmonious regulations are in themselves barriers to trade in irradiated foods. Harmonization of trade regulations is an important step towards resolving trade issues. As a result of a UNDP/IAEA/FAO Asian regional workshop held in Australia in 1993, a model food irradiation regulation for the Asia-Pacific region was developed based on the principle of the Codex Standard and relevant recommendation of the ICGFI. The model regulation ensures that food irradiation contributes to improved public health, reduces post-harvest losses and overcomes quarantine barriers without undue risk to safety, health or the environment. It covers definitions, general requirements, treatment of food, control procedures, labelling, re-irradiation, import and export of irradiated food and sanctions. Through the efforts of ICGFI and the IAEA in the past few years, this model regulation has also been widely accepted by representatives of regulatory authorities in Africa and Latin America. The Association of South-East Asian Nations (ASEAN) and most countries in Asia and the Pacific are in the process of introducing a common regulation on food irradiation based on this model regulation.

Members of the Regional Plant Protection Organization (RPPO), including the North American Plant Protection Organization (NAPPO), recognized the effectiveness of irradiation as a broad spectrum quarantine treatment of fresh fruits and vegetables. These endorsements are very important, given the leadership role played by regional plant protection organizations in the development of domestic plant phytosanitary regulations. NAPPO issued a standard on irradiation as a phytosanitary treatment in April 1997.

## National

Trade differences have been created when countries allow the irradiation of foods for export only and not for domestic consumption. These differences should be viewed as trade barriers. Countries should be encouraged





to ensure they have sufficient domestic clearances to allow both exportation and domestic use of irradiated foods. Governments are requested to accept irradiated food on the basis of food classes and not require approval processes for individual foods. ICGFI has

prepared a guideline to assist countries to reduce the non-tariff trade barriers created when foods must be approved on an individual basis as opposed to a general approval of irradiation for a particular application, or approval of a class of irradiated foods.

## Conclusions and Recommendations

Food imports and exports are important to the health of nations and peoples, yet trade barriers caused by pests, diseases and food safety issues continually threaten or inhibit trade. Several technologies work to remove these trade barriers; irradiation is a technology that could assist to improve trade.

Unfortunately, there are several constraints to the use of irradiation, and therefore constraints to improved food trade. Inadequate and disharmonious regulatory approvals for irradiation, labelling issues and lack of consumer and industry information constrain the use of irradiation.

The following recommendations are made to improve trade in irradiated foods.

- ❑ The agreement establishing the WTO and the two technical trade agreements, the SPS and the TBT, should be followed. Governments should not discriminate against irradiated foods processed according to the Codex Standard.
- ❑ Regulations approving irradiation vary widely, are often inadequate and are disharmonious between trading partners. Actions to improve regulatory approvals of irradiation where it could improve trade are recommended.

- ❑ Research that will provide regulators with information upon which to base policy decisions, and provide the food industry with information relating to commercial issues, is needed to improve regulatory approvals and trade in irradiated foods.
- ❑ The mandatory labelling of irradiated foods when competitive treatments (such as fumigation) do not require labelling is an unfair barrier to trade, increases costs and inhibits industry. Labelling for the consumer level should be voluntary. Where irradiation is used to resolve technical constraints to trade its use should be notified in documentation available to industry and trade officials.
- ❑ Providing good information to consumers is the responsibility of every link of the marketing chain. Governments approving irradiation to improve trade should defend their decision, discussing the factors that led to approval, and the benefits to the country, industry and public of improved trade measures. Industry should discuss more openly the requirements of food handling so consumers have a fuller understanding of the realities of agriculture and food processing.





## Bibliography

*Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture*, Rep. UNDP/IAEA/FAO Regional (RCA) Workshop on Harmonization of Regulations to Facilitate Trade in Irradiated Foods, Lucas Heights, Australia, December 1993, IAEA, Vienna (Internal report).

*International Atomic Energy Agency*, Trade Promotion of Irradiated Food, IAEA, Vienna (1985).

*International Consultative Group on Food Irradiation*, Facts about Food Irradiation, ICGFI/IAEA, Vienna (1995).

*International Consultative Group on Food Irradiation*, Workshop on the Implications of GATT Agreements on Trade in Irradiated Food, Marseilles, November 1995, ICGFI/IAEA, Vienna (Internal report).

*International Consultative Group on Food Irradiation*, Control of Irradiated Food in Trade - A Compilation of Principles and International Recommendations for Regulatory Control Measures, ICGFI/IAEA, Vienna (1995).

*International Consultative Group on Food Irradiation*, Guidelines for the Authorization of Food Irradiation Generally or by Classes of Food, ICGFI/IAEA, Vienna (1994).

*Korunic, Z.*, et al., The effects of diatomaceous earth on grain quality, J. Postharvest Biol. Technol. (1995).

*Loaharanu, P.*, "Acceptance and application of irradiation as a quarantine treatment of fresh fruit and vegetables", Annu. Mtg North American Plant Protection Organization, Ottawa, ON, October 1994.

*Marcotte, M.*, Improving Food and Agriculture Productivity - and the Environment. Canadian Leadership in the Development of Methyl Bromide Alternatives and Emission Control Technologies, Environment Canada, Ottawa, ON (1995).

*Marcotte, M.*, What Have We Learned About Consumer Acceptance of Irradiated Food, Nordion International Inc., Kanata, ON (1995).

*Mitchum, E.*, "Development of a carbon dioxide quarantine treatment for omnivorous





**Mitchum, E.**, "Development of a carbon dioxide quarantine treatment for omnivorous leafroller, western flower thrip, pacific spider mite, and grape mealy bug on table grapes", Annu. Int. Res. Conf. on Methyl Bromide Alternatives and Emissions Reductions, San Diego, CA, November 1995.

**Moy, J., Wong, L.**, "Irradiation as a quarantine treatment of tropical fruits", Annu. Int. Res. Conf. on Methyl Bromide Alternatives and Emissions Reductions, San Diego, CA, November 1995.

**Neven K.**, "Combination treatments for pome fruit for quarantine", Annu. Int. Res. Conf. on Methyl Bromide Alternatives and Emissions Reductions, San Diego, CA, November 1995.

**North American Plant Protection Organization**, The Application of Irradiation Technology as a Quarantine Treatment, Proc. NAPPO Colloq., Orlando, FL, October 1994.

**Protect - It**, Ready to Use Insecticidal Dust for Insect Control in Stored Grain and Warehouses, Health Canada Label Registration No. 24259 Pest Control Products Act, Hedley Technologies, Vancouver (1995).

**Rhodes, A.A. (Ed.)**, Irradiation Disinfestation of Dried Fruit and Nuts, United States Agriculture Research Service and Economic Research Service, Washington, DC (1986).

**Sharp, J.**, "Mortality of blueberry maggot larvae to gamma irradiation", Annu. Int. Res. Conf. on Methyl Bromide Alternatives and Emissions Reductions, San Diego, CA, November 1995.

**Shellie, K., Mangan, R.**, "High temperature controlled atmosphere for disinfesting grapefruit of Mexican fruit fly", Annu. Int. Res. Conf. on Methyl Bromide Alternatives and Emissions Reductions, San Diego, CA, November 1995.

**World Health Organization**, Food Technologies and Public Health, WHO, Geneva (1996).

**World Trade Organization**, Agreement on the Application of Sanitary and Phytosanitary Measures, WHO, Geneva (1995).

**United Nations Environment Programme**, Montreal Protocol on Substances that Deplete the Ozone Layer: 1994 Report of the Methyl Bromide Technical Options Committee, UNEP, New York (1994).







**Table 1. Treatments for fruits, vegetables and fresh horticultural products**  
(Issues are pest infestation and rapid spoilage)

	<b>Irradiation</b>	<b>Fumigants</b>	<b>Controlled atmospheres</b>	<b>Refrigeration / freezing and cold</b>	<b>Steam / heat/ hot air / canning</b>
<b>Range of application</b>	Broad spectrum pest control suitable for many fruits; quarantine level research needed for some pests; research needed on quality effects for some foods; irradiation can extend shelf-life of some products.	Broad spectrum pest control but not usually effective for internal pests; some products show quality defects resulting from fumigants.	Works well for products with long storage life; treatment may take several days; may prolong storage life; can be used in combination with other treatments such as irradiation.	Works well for temperate zone products; some tropicals sensitive to cold; often used in combination with other treatments such as controlled atmosphere or irradiation; freezing greatly extends storage, but can affect price.	Works well for some products; especially tropicals but can decrease shelf-life; canning commonly used, best storage, but decreased commodity price.
<b>Regulatory issues</b>	Good international approval; further domestic and quarantine approvals needed.	Current chemical treatments have domestic and quarantine approval; MB being phased out; other chemical treatments often not preferred; difficulty with new approvals.	Usually no domestic problems; quarantine approvals needed.	Usually no domestic problems; quarantine approvals needed.	Usually no domestic problems; quarantine approvals needed except for canning.
<b>Costs</b>	Low cost per unit of product; high capital costs; seasonality issues in some regions affect economic feasibility.	Low cost per unit of product; modern fumigation chambers have significant cost; cost of MB increasing.	Moderate cost per unit; capital costs of storage structures significant.	Moderate to high cost per unit; capital equipment varies in cost.	Moderate to high cost per unit; capital equipment cost significant; small scale canning can be moderately expensive; canning increases transport costs.
<b>Environmental issues</b>	Irradiators pose low environmental risks; low energy use.	MB is an ozone depleter; environmental concern about other fumigants.	Energy intensive.	Energy intensive; maintaining cold in transportation is costly; new refrigerants are required to meet environmental concerns.	Energy intensive.
<b>Consumer interests</b>	Good acceptance where sold; often preferred over chemical treatments; label requirements can be a constraint.	Not preferred by consumers, but not labelled, so consumers are unaware.	Good consumer acceptance and approval; no labelling issues.	Excellent consumer acceptance and approval; no labelling issues.	Good consumer acceptance and approval; consumer preference for canned products is variable.



**Table II. Treatments for grains, cereals, spices and other dry foods**  
*(Issues are economic losses from storage pests and microbial control.)*

	<b>Irradiation</b>	<b>Fumigants / pesticides</b>	<b>Controlled atmospheres</b>	<b>Cold or Heat</b>	<b>Diatomaceous earth</b>
<b>Range of application</b>	Broad spectrum pest control; applicable to entire category; commercially used for spices; very effective against storage pests and microbial contaminants; can be used in combination with diatomaceous earth or CO <sub>2</sub> .	Effective broad spectrum pest control; phosphine, MB and contact pesticides used; ETO used in spice bacterial control; Several pest species are resistant; chemicals offer lasting protection but treatments often repeated.	Works well for grains and cereals, but disinfestation takes several days; requires sealed storage facilities; useful for control in storage; not used for spices.	Treatments work well in regions where excessive cold or heat are the norm; cold treatment takes several days; heat treatment is faster. Cold aeration is often part of good storage practices.	Problems with older products; new products effective with less or no dust problems; treatment takes time; better for preventative or for storage; added benefit of suitability for storage facilities.
<b>Regulatory issues</b>	Good international approval; further domestic and quarantine approvals needed.	Phosphine has wide regulatory approval; MB and ETO being phased out; contact pesticides not preferred; difficult obtaining new approvals.	Usually none, other than occupational health.	None; if to be used for pre-shipment or quarantine, approval would be required.	Usually no problems; pre-shipment or quarantine approvals required.
<b>Costs</b>	Low cost per unit of product; high capital costs; fast treatment suitable for products in transit.	Low cost per unit of product; modern fumigation chambers have significant cost; cost of MB increasing.	Variable, depending on cost of CO <sub>2</sub> , location and presence and condition of storage facilities.	Prohibitive costs unless region is naturally either cold or hot. In this case, treatment is inexpensive, or free in the case of cold; heating will use some energy.	Older products lower grain quality; new products do not have same extent of quality downgrading; low cost per unit; used post-harvest reduces or eliminates later treatments.
<b>Environmental issues</b>	Irradiators pose low environmental risks; low energy use.	Not preferred; some products being phased out or reviewed. Several concerns about MB, ETO, phosphine.	No environmental risk, some energy use.	None. In cold climates it can be preferred.	No problems with new products; older products raise dust, equipment damage and occupational health issues.
<b>Consumer interests</b>	Preferred over chemical treatments; label requirements can be a constraint.	Consumers not informed; not preferred; growing pressure from processors to lower residues.	Controlled atmosphere processes are well accepted, but unlabelled.	Would be a preferred treatment if consumers knew of the process.	New products would likely be acceptable if consumers knew about it.



**Table III. Treatments for meat, poultry and marine foods**

*(Issues are microbial control; rapid spoilage. These products must be produced with good manufacturing practices. refrigeration, freezing or canning is required to safely extend storage life.)*

	<b>Irradiation</b>	<b>Chemical treatments</b>	<b>Controlled atmospheres</b>	<b>Heat / canning</b>
<b>Range of application</b>	Applicable to entire category; controls pathogenic and spoilage bacteria; extends storage; already used commercially.	Chlorine, tri-sodium phosphate (TSP) and some organic acid washes effectiveness for <i>Salmonella</i> control on whole carcasses; not as effective for other pathogens; does not extend storage.	Used on wholesale or retail products; can control microbial growth; does not eliminate contaminants.	Applicable to entire category; in widespread commercial use; changes product significantly; affects price; canning gives best storage.
<b>Regulatory issues</b>	Good international approval; domestic approvals either in place or required; process sometimes used without approval.	Approvals being sought or obtained depending on claims; limits on chlorine use in some regions.	Usually none.	Usually none; often the only method available for some products in some regions.
<b>Costs</b>	Low per unit cost; high capital costs not a serious issue in this commodity group; affects packaging costs.	Similar per unit and capital costs to irradiation depending on equipment royalties; chlorine treatment relatively inexpensive.	Moderate per unit cost; increases packaging costs.	Small scale canning equipment can be moderately expensive; inexpensive per unit costs; increases transportation costs but prevents spoilage losses.
<b>Environmental issues</b>	Irradiators pose low environmental risks; low energy use.	Concern about excessive use of chlorine; other products may or may not cause problems; increases water usage.	None.	None; increases energy and water usage.
<b>Consumer interests</b>	Preferred where sold; labelling issues concern food industry; labelling requirements can be a constraint.	Not labelled, so consumers do not know about them; high chlorine use results in product quality problems; chemical treatments not preferred.	Often only used for higher price retail products; good acceptance.	Consumer preferences vary but generally canned products cost less; causes significant loss of nutrients.



**Table IV. Treatment of non-food agricultural products – ornamental horticultural products, animal feeds, wood products, decorative objects, fibre products**  
*(Issues are pest infestation and sometimes spoilage organisms.)*

	<b>Irradiation</b>	<b>Fumigants / contact pesticides</b>	<b>Controlled atmospheres</b>	<b>Cold or heat</b>
<b>Range of application</b>	Applicable to entire category; preferable for animal feeds commercially used; also devitalizes weed seeds.	Broad spectrum pest control; phosphine and MB used; ETO and contact pesticides sometimes used; good pest effectiveness; chemicals offer lasting protection but treatments often repeated. some insects have already developed resistance to phosphine.	Used for some historical artifacts but treatment takes several weeks; not commonly used in this commodity group.	Steam and dry heat used for wood products, potential for horticultural products; steam extrusion used for animal feeds; cold can be used for small objects.
<b>Regulatory issues</b>	Often used on recommendation of quarantine officials; approval necessary only for quarantine uses.	Phosphine has wide domestic approval for stored products and limited quarantine approvals in some countries; MB and ETO are being phased out; contact pesticides not preferred; difficult to obtain new approvals.	None, unless used for quarantine.	Requires quarantine approval.
<b>Costs</b>	Competitive with fumigation; treatment in multipurpose irradiators at low cost is possible.	Low per unit cost; modern fumigation chambers require significant capital.	Varies depending on region; may add significantly to storage or transport costs.	Some treatments also change product, resulting in increased value, so difficult to determine.
<b>Environmental issues</b>	Irradiators pose low environmental risks; low energy use.	Phosphine has wide domestic and international approval; MB and ETO being phased out; contact pesticides not preferred.	None, other than energy use.	None, other than energy use.



Printed for the  
International Consultative Group on Food Irradiation (ICGFI)  
Vienna, Austria, 1998 by  
Bhaba Atomic Research Centre (BARC)  
Trombay  
Mumbai 400 085  
India

The ICGFI Secretariat  
Joint FAO/IAEA Division of Nuclear Techniques  
in Food and Agriculture,  
Wagramerstrasse 5,  
P.O.Box 100,  
A-1400 Vienna, Austria

Tel.:(+43 1) 2060 - 21638  
Fax.:(+43 1) 20607  
E-Mail:Official.Mail@IAEA.ORG