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MS 1265-3 (2005) (English): CODE OF GOOD IRRADIATION PRACTICE – PART 3: FRESH FRUITS AND VEGETABLES FOR INSECT DISINFESTATIONS AND AS QUARANTINE TREATMENT (FIRST REVISION)

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MALAYSIAN STANDARD

MS 1265 : PART 3 : 2005

CODE OF GOOD IRRADIATION PRATICE – PART 3 : FRESH FRUITS AND VEGETABLES FOR INSECT DISINFESTATIONS AND AS QUARANTINE TREATMENT (FIRST REVISION)

ICS : 67.020

Descriptors : code of practice, irradiation, ionising, radiation, treatment. fresh fruits, vegetables, insect disinfestations, quarantine treatment

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Tel: 60 3 88858000
Fax: 60 3 88885060

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Section 2, P. O. Box 7035
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Selangor D.E.
Tel: 60 3 5544 6000
Fax: 60 3 5510 8095

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CONTENTS

Committee representation

The Food and Agricultural Industry Standards Committee (ISC A) under whose authority this Malaysian Standard was developed, comprises representatives from the following organisations:

Department of Agriculture

Department of Standards Malaysia

Federal Agricultural Marketing Authority

Federation of Malaysian Manufacturers

Malaysian Agricultural Research and Development Institute

Malaysian Association of Standards Users

Malaysian Palm Oil Association

Ministry of Agriculture and Agro-based Industry

Ministry of Health Malaysia

Ministry of Health Malaysia

Universiti Kebangsaan Malaysia

Universiti Putra Malaysia

The Working Group on Food Irradiation which developed this Malaysian Standard consists of representatives from the following organisations:

Department of Fisheries Malaysia

Department of Veterinary Services Malaysia

Federation of Malaysian Consumers Associations

Malaysian Agricultural Research and Development Institute

Malaysian Institute for Nuclear Technology Research

Ministry of Health Malaysia

SIRIM Berhad (Secretariat)

Universiti Putra Malaysia

FOREWORD

This Malaysian Standard was developed by the Working Group on Food Irradiation under the authority of the Food and Agricultural Industry Standards Committee.

MS 1265 consists of the following parts, under the general title *Code of good irradiation practice*:

- *Part 1: General*

- *Part 2: Bulb and tuber crops for sprout inhibition*

- *Part 3: Fresh fruits and vegetables for insect disinfestations and as quarantine treatment*

- *Part 4: Cereal grains for insect disinfestations*

- *Part 5: Dried fish and dried salted fish for insect disinfestations*

- *Part 6: Bananas, mangoes and papayas for shelf-life extension*

- *Part 7: Fish, frog legs and shrimps for the control of microflora*

- *Part 8: Prepackaged meat and poultry for the control of pathogens and/or to extend shelf-life*

- *Part 9: Spices, herbs and vegetable seasonings for the control of pathogen and microflora*

- *Part 10: Dried meat and dried salted meat of animal origin for insect disinfestations, control of moulds and reduction of pathogenic microorganisms*

This Malaysian Standard is the first revision of MS 1265: Part 3, *Guidelines for irradiation of foods: Part 3: Irradiation of fresh fruits for insect disinfestation (as a quarantine treatment).*

Major modifications in this revision are as follows:

a) the scope of the standard has been revised to cover irradiation treatment for insect disinfestation for fresh vegetable products;

b) new radiation source has been added; and

c) the examples for the principal pest of national and international economic and quaratine importance in connection with fresh plant products have been updated with reference to ICGFI Document No. 7, *Code of good Irradiation practice for insect disinfestation of fresh fruits*, Vienna, 1991.

This Malaysian Standard cancels and replaces MS 1265: Part 3: 1992, *Guidelines for irradiation of foods: Part 3: Irradiation of fresh fruits for insect disinfestation (as a quarantine treatment).*

Compliance with a Malaysian Standard does not of itself confer immunity from legal obligations.

CODE OF GOOD IRRADIATION PRACTICE - PART 3: FRESH FRUITS AND VEGETABLES FOR INSECT DISINFESTATIONS AND AS QUARANTINE TREATMENT (FIRST REVISION)

1. Scope

1.1 This Malaysian Standard describes the code of good irradiation practice for insect disinfestations and as quarantine treatment for fresh fruits and vegetables. This standard is directed primarily to the treatment needed to control certain insect pests commonly associated with various fresh fruits and vegetables.

1.2 The purpose of irradiation as referred to in this standard is to accomplish appropriate and effective control of insects which infest fresh fruits and vegetables.

1.3 The control of such insects may accomplish two kinds of useful effects as follows:

a) Prevent the transfer of insects from one locality to another which might occur in the shipment of infested fresh plant products. Such a transfer could lead to the establishment of the insects in a new area.

b) Prevent insect damage to the foods

1.4 The irradiation treatments referred to in this standard are developed to secure adequate disinfestation of the fruits and vegetables to serve as a quarantine treatment.

2. Normative reference

The following normative reference is indispensable for the application of this standard. For dated reference, only the edition cited applies. For undated reference, the latest edition of the normative reference (including any amendments) applies.

MS 1265: Part 1, *Code of good irradiation practice - Part 1: General*

3. Pre-irradiation treatment of fruits and vegetables

3.1 In general, except for providing packaging to prevent post-irradiation re-infestation, there are no special requirements for treatment or handling of the fresh plant products before irradiation, but the fresh products to be irradiated shall be obtained from growers who follow good agronomic practices.

3.2 The crop should be aerated to remove heat absorbed in the field as soon as possible and be of good overall quality.

3.3 The optimum use of pest management would provide high quality commodities with a minimum pest population at the time of harvest.

3.4 In the case of some tropical fruits, a pre-irradiation heat-treatment for fungal disease control could be useful. In order to control spoilage due to fungi, these fruits may be given a pre-irradiation treatment with hot water. For example; papayas – 20 min at 49 °C or 10 min at 50 °C; mangoes – 10 min at 50 °C or 5 min at 55 °C; bananas – 5 min at 50 °C. The inclusion of an approved chemical fungicide in the water may be beneficial.

3.5 In addition to the standard culling for quality, grade and size ordinarily done, a pre-treatment inspection by the plant quarantine authorities may be performed to assure a minimal level of infestation

4. Packaging

4.1 Packaging customarily used for unirradiated the fruits and vegetables are satisfactory, provided it is adequate to prevent re-infestation.

4.2 The packaging material in contact with the fresh plant products covered by this guideline should not undergo significant alteration of its functional properties nor yield toxic materials which can transfer to the food as a result of irradiation at the doses employed.

4.3 The size and the shape of containers which may be used for irradiation are determined in part by certain aspects of the irradiation facility. The critical aspects include the characteristics of product transport systems and of the irradiation source, as they relate to the dose distribution obtained within the container (see Clause 6).

4.4 The irradiation procedure will be aided if the product packages are geometrically well-defined and uniform. With certain irradiation facilities, it may be necessary to limit use to certain package shapes and sizes.

4.5 Packaging materials used shall comply with the requirements of the legislation currently enforced in the country.

5. Pre-irradiation storage and transport

The use of irradiation for insect disinfestation imposes no special storage requirements but short pre-irradiation storage and transport periods are advantageous. It is recommended that the storage employed be such as to protect the fruit or vegetable quality (for instance, in maintenance of the temperature).

6. Irradiation

6.1 Facility requirements and operation; process parameters and critical operational control points; ionising radiation sources employed

6.1.1 The requirements and guidance regarding certain irradiation process parameters and irradiation facilities and their operation should be referred to MS 1265: Part 1.

6.1.2 The ionising radiation which may be employed in irradiating fresh plant products is limited to the following:

a) Gamma rays from the radionuclides Cobalt-60 or Caesium-137;

b) X-rays generated from machine sources operated at or below an energy level of 5 MeV (Million Electron Volts); and

c) Electrons generated from machine sources operated at or below an energy level of 10 MeV.

6.1.3 It should be noted that the use of electrons for the treatment of bulky foods may be limited because of poor penetration.

6.1.4 It is not possible to distinguish irradiated from non-irradiated product by inspection, therefore, it is important that, in the operation of an irradiation facility appropriate means, such as physical barriers, be employed for keeping the irradiated and non-irradiated product separate.

6.1.5 Indicator devices which change colour or which otherwise undergo some easily determined and time-stable change when exposed to radiation at the doses required are commercially available. Such devices, common in the radiosterilisation industry, used as a paper sticker, or equivalent, and attached to each product unit, such as a carton, could assist the operator in identifying irradiated product.

6.1.6 It is important that adequate records of the operation of the irradiation facility be kept, and that fruits and vegetables, which have been irradiated be identified by its origin, lot numbers or other suitable means. Such measures to enable verification of the irradiation treatment are likely to be required by regulatory agencies.

6.2 Amount of radiation used (absorbed dose)

6.2.1 General

6.2.1.1 The most important parameter in the irradiation process is the amount of ionising energy absorbed by the target material. This is termed 'absorbed dose'. The unit of absorbed dose is the Gray (Gy). One Gy is equal to the absorbtion of one joule per kg. The dose employed will depend on the kind of insects and stages present and the criterion of acceptability of the treatment (i.e. no adult insect will emerge capable of flight or reproduction). It is important that the food should receive the minimum absorbed dose required to achieve the desired effect and that the uniformity ratio be maintained at an appropriate level. This requires thorough dose mapping.

6.2.1.2 The control of the irradiation procedure so as to deliver a prescribed dose entails a number of considerations, important among which is the technology for measuring dose, which is termed 'dosimetry'. It is recommended that manuals on dosimetry procedures be consulted. Refer to bibliography for the list of references on dosimetry procedures.

6.2.2 Doses to control various insect pests

6.2.2.1 The movement of plant pests in national and international commerce can be prevented either by total embargo of the host commodities that could disseminate such pests or by allowing the movement of these commodities subject to certain quarantine restrictions. Irradiation of the fruit or vegetable to disinfest them is one approach for enabling shipment of fruit or vegetable within quarantine restrictions.

6.2.2.2 The examples of the principal pests of national and international economic and quarantine importance in connection with fresh plant products are given Annex A.

6.2.2.3 Infestation of fruit flies occurs when the adult female lays. eggs in the fresh plant produce. Later these hatch and larvae emerge, which, feed and develop in the produce and in this manner damage it. On maturation, the larvae leave the produce and undergo pupation. In packaged fresh produce, pupation may take place in the container. In produce which is not packaged, pupation may occur in the surroundings most likely in the soil.

6.2.2.4 For example, seed weevils can infest mangoes at an early stage and result in damage either to the fruit or seed on emergence of adults.

6.2.2.5 The sensitivity of an insect to radiation varies with the life stage at the time of irradiation, it in general being greater in stages involving active cell division. This activity is greatest in the egg stage and diminishes in later stages. In adults, the gonads have greater sensitivity than the rest of the body due to active reproductive cell division. The irradiation treatment with adequate sub-lethal doses prevents reproduction at this stage. The effect of irradiation at one stage may carry over to a later stage.

6.2.2.6 The criterion for acceptance of a quarantine treatment is the prevention of emergence of adult insects capable of flight or of adult insects capable of reproduction. The minimum absorbed dose required to produce an acceptable level of quarantine security is based on dosage mortality data, and confirmatory tests under simulated commercial conditions. These should employ sufficient numbers of the pest to verify that the proposed treatment will provide the required level of quarantine security.

6.2.2.7 The recommended absorbed radiation doses to provide treatment of fresh plant products to meet this criterion are as follows:

a) Fresh plant products subject to infestations by insect eggs, larvae, pupae or adults, except those listed in the following sections.

   Exposure of any insect stage present to a minimum absorbed dose of 300 Gy in order to prevent emergence of normal adults from treated eggs, larvae or pupae or to sterilise any treated adults present or emerging from treated larvae or pupae.

b) Fresh plant products subject to infestation by *Tephritidae* eggs or larvae.

   Exposure of any eggs or larvae present to a minimum absorbed dose of 150 Gy in order to prevent emergence of normal adults from pre-adult stages.

c) Fresh plant products subject to infestation by eggs or larvae of Queensland fruit fly, *Dacus tryoni.*

Exposure of any eggs or larvae present to a minimum absorbed dose of 75 Gy in order to prevent emergence of normal adults.

d) Mangoes subject to infestation by any stage of mango seed weevil, *Stemochaetus* (*Cryptorhynchus*) *mangiferae.*

Exposure of any pre-adult insect stage present to a minimum absorbed dose of 300 Gy in order to prevent emergence of normal adults from pre-adult stages or to sterilise any treated adults present or emerging from treated larvae or pupae.

e) Deciduous fruit and other hosts of codling moth, *Cydia* (*Laspeyresia*) *pomonella.*

Exposure of any stages present to a minimum absorbed dose of 250 Gy in order to prevent emergence of normal adults.

6.3 Irradiation conditions

The irradiation area should be ventilated to minimise ozone build-up. Ozone can be phytotoxic to some fresh products. To eliminate the risk of re-infestation, the fruits or vegetables should be irradiated in insect-proof packages. If the fruit or vegetable has been refrigerated prior to irradiation, care should be taken to avoid moisture condensation on it during irradiation, and consequent phytotoxicity. It is essential to ascertain dose distribution patterns within any container, to ensure that the minimum absorbed dose satisfies the quarantine requirement while the maximum absorbed dose is not phytotoxic.

7. Post-irradiation handling and storage

7.1 With regards to the disinfestation process as covered by this standard, the essential post-irradiation handling requirement is that the fresh plant products be stored and shipped under conditions that will safeguard it from re-infestation by the pest of concern. The use of insect-proof packaging is one such way for preventing re-infestation.

7.2 Handling with regards to other requirements for the particular fruit or vegetable such as maintenance of the temperature, is not affected by the radiation-disinfestation process.

8. Labelling

8.1 All growers who produce fresh fruits and vegetables for export should be registered with the plant protection authorities and their identification codes should be included in all packages.

8.2 Foods that have been irradiated shall be labelled and labelling shall be in accordance with the current national legislation requirements.

8.3 Labelling should not only identify the food as irradiated, but also serve to inform the purchaser as to the purpose and benefits of the treatment.

8.4 Each package containing the food treated by ionising radiation may bear on it the international food irradiation symbol given in MS 1265: Part 1.

9. Re-irradiation

Irradiation of such products more than once is generally not recommended. For reference purposes, MS 1265: Part 1 provides provisions for re-irradiation of foods.

10. Quality of host fruits and vegetables

10.1 At the doses indicated (see 6.2.2), most fresh fruits and vegetables are not adversely affected. In particular, the following fresh produce have been found to be unaffected: apple, cantaloupe, cherry, currants, date, fig, guava, honeydew melon, mango, muskmelon, nectarine, papaya, peach, prune, raspberry, strawberry and tomato.

10.2 Other produce may exhibit phytotoxicity at the doses indicated, and for this reason, other than those listed above are considered for irradiation for insect disinfestation, it is necessary to evaluate the effect of irradiation at the needed dose-level before undertaking the use of irradiation for this purpose. In doing this, differences among varieties and origins of the fresh produce should be examined.

11. Final product specification

In terms of this standard the final product specification is that, in the irradiated fruit or vegetable, no adult insects will emerge capable of flight or reproduction.

Annex A
(informative)

Examples of the principal pest of national and international economic and quarantine importance with fresh plant products

Table A1. Fruit fly species of major international economic and quarantine importance

Scientific name	Common name	Primary economic hosts	Geographic origin
Anastreha fracterculus	South American fruit fly	Citrus, mango, other fruits	Mexico to South America
Anastrepha grandis	South American fruit fly	Cucurbits	South America, Panama, Mexico, USA
Anastrepha ludens	Mexican fruit fly	Citrus, mango, soft fruits	Mexico, Central America, USA
Anastrepha obligua	West Indian fruit fly	Mango, guava, spondias	Caribbean, Mexito to South America, USA
Anastrepha serpentina	Sapodilla fruit fly	Citrus, mango, guava, avocado	Mexico to South America, USA
Anastrepha striata	Guava fruit fly	Guava, cucurbits	Mexico to South America
Anastrepha suspensa	Caribbean fruit fly	Guava, rose apple Eugenia, citrus	Greater Antilles, Florida
Ceratitis capitata	Meditarranean fruit fly	Citrus, most fruits	Africa, Asia, Central and South America, Europe, USA, Belize
Ceratitis cosyra	Natal fruit fly	Soft fruits, citrus, coffee	Africa
Dacus cucurbitae	Melon fly	Citrus, most fruits, legumes	Africa, SE Asia, Pacific Islands
Dacus dorsalis	Oriental fruit fly	Citrus, most fruits	SE Asia, Pacific Islands
Dacus oleae	Olive fruit fly	Olive	Europe, Africa, W. Asia
Dacus passiflorae	Fiji fruit fly	Citrus, mango, guava, avocado, other fruits	Fiji, Indonesia, Malaysia, Japan, Philippines, Pakistan, Thailand
Dacus tryoni	Queensland fruit fly	Citrus, most fruits	Australia, French Polynesia
Dacus tsuneonis	Japanese orange fly	Citrus	Japan, China
Dacus zonatus	Peach fruit fly	Citrus, mango, guava, peach, fig	SE Asia
Dacus spp.	Carambola fruit fly	Various fruits	Suriname
Myiopardalis pardalina	Baluchistan melon fly	Melons	SW Asia
Rhagoletis cerasi	European cherry fruit fly	Cherries, honey-suckle, soft fruits	Europe
Rhagoletis cingulata	Eastern (USA) cherry fruit fly	Cherry, Prunus app.	USA, Canada
Rhagoletis completa	Walnut husk fly	Walnuts	USA
Rhagoletis fausta	Black cherry fruit fly	Cherry	USA, Canada
Rhagoletis indifferens	Western (USA) cherry fruit fly	Cherry	USA, Canada
Rhagoletis pomonella	Apple maggot	Apple	USA, Canada, Mexico

NOTES:

1. Data obtained from the Task Force Meeting on Irradiation as a Quarantine Treatment International Consultative Group on Food Irradiation (ICGFI), Chiang Mai, Thailand, 1986, as amended after ICGFI meeting, January 1991, Bethesda, Maryland, USA.

2. Inclusion of a commodity in table does not imply, necessarily, that it can be disinfested by radiation.

Table A2. Some other pests of major international economic and quarantine importance

Scientific name	Common name	Primary economic hosts	Geographic origin
LEPIDOPTERA			
Anarsia lineatella	Peach twig borer	Peach	Europe, Asia, Africa, Canada, USA
Cryptophlebia leucotreta	False codling moth	Cotton, coffee, deciduous fruit, mango, guava	Africa
Cydia molesta	Oriental fruit moth	Peach, other deciduous fruit	North and South America, Asia, Europe
Cydia funebrana	Plum Fruit moth	Prunus spp.	Europe, Cyprus, Algeria, Iran, Syria, Turkey, China
Epiphyas postvittana	Light brown apple moth	Deciduous fruit apple, pear	Australia, Hawaii, New Caledonia, New Zealand, U.K.
Lobesia botrana	Grape moth	Grapes, Prunus spp.	Europe
Prays citri	Citrus flower moth	Citrus	Europe, Asia, Africa
Sternochetus mangiferae	Mango seed weevil	Mango	Asia, Africa, Australia, Pacific Islands, West Indies
Helipus lauri	Avocado seed weevil	Avocado	Mexico, Central America
HEMIPTERA-HOMOPTERA			
Aleurocanthus woglumi	Citrus black fly	Citrus, ornamentals	Mexico, Asia, Florida, South and Central America, West Indies, Africa
Quadraspidiotus perniciosus	San Jose scale	Apple, pears, grapes, other fruit	North America, Asia, Europe, Africa, Australia
Pseudococcus spp.	Mealy bugs	Citrus, ornamentals	Various
DIPTERA			
Liriomyza trifolii	American serpentine leaf miner	Chrysanthemum, Cypsophila, tomato, cucurbits	North America, Europe, South and Central America, Africa, Caribbean, Asia
TYSANOPTERA			
Caliothrips fasciatus	Bean thrips	Beans	North America, Europe

NOTES:

1. Data obtained from the Task Force Meeting on Irradiation as a Quarantine Treatment International Consultative Group on Food Irradiation (ICGFI), Chiang Mai, Thailand, 1986, as amended after ICGFI meeting, January 1991, Bethesda, Maryland, USA.

2. Inclusion of a commodity in table does not imply, necessarily, that it can be disinfested by radiation.

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Acknowledgements

Dr Muhamad Lebai Juri (Chairman)	Malaysian Institute for Nuclear Technology Research
Puan Seri Azalina Mohd Ghazalli (Secretary)	SIRIM Berhad
Encik Ahmad Hazizi Aziz	Department of Fisheries Malaysia
Dr Maznah Ahmad	Department of Veterinary Services Malaysia
Dr Noraini Mohd Khalid	Malaysian Agricultural Research and Development Institute
Encik Mohd Sidek Othman	Malaysian Institute for Nuclear Technology Research
Puan Shamsinar bt Abdul Talib	Ministry of Health Malaysia
Prof Madya Dr Russly Abdul Rahman	Universiti Putra Malaysia

Printed by: SSP, SIRIM Berhad (443/2005)