



Introduction to the conservation of tropical fruits

Abstract



Complete version
<http://technofruits2001.cirad.fr>

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Tropical fruits are increasingly present on European markets and increasingly familiar to consumers. Their nutritional qualities are praised in numerous advertisements that encourage housewives to know, choose and purchase these fruits for their levels of vitamins, magnesium, antioxidants or micro-nutrients. The trend towards linking the quality of this produce with health has led scientists to focus research on the techniques that conserve these qualities for the consumer and enable their

improvement during production and harvesting in the producer country. Research work covers the following aspects:

- **before the harvest:** quality build-up and improvement in fruits (improvement of harvesting dates, especially for mango);
- **post-harvest:**
 - the maintaining of this quality and the lengthening of the life of tropical fruits (the final aim would be the sea transport of practically

ripe fruits). This would make it possible to improve the taste qualities of the produce and to reduce export costs by favouring sea transport rather than air freight;
- the use of conservation techniques that allow for consumer requirements and wishes, with maximum use of natural substances or the limiting of storage techniques whose effects on human health are not yet known ■



French regulations concerning post-harvest treatments of tropical fruits and vegetables

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The use of chemical or natural substances on fruits and vegetables is a common practice and makes it possible to address the quality of harvested produce. It is particularly useful for tropical fruits and vegetables whose transport sometimes takes a long time. Appropriate substances and techniques can be used so that this produce conserves appearance and organoleptic qualities that meet consumer demand.

Post-harvest treatment: use on fruits and vegetables of products that are in the agricultural practice and food technology category

The phytosanitary aspect

The use of post-harvest treatments is subject to regulations in both the

sphere of food, with regard to food additives, and that of agriculture, with regard to the use of pesticides.

The use of pesticides in agriculture is governed by a series of very precise legislative acts, for reasons of the health and environmental risks inherent in the unsuitable use of such products.

It should be noted that:

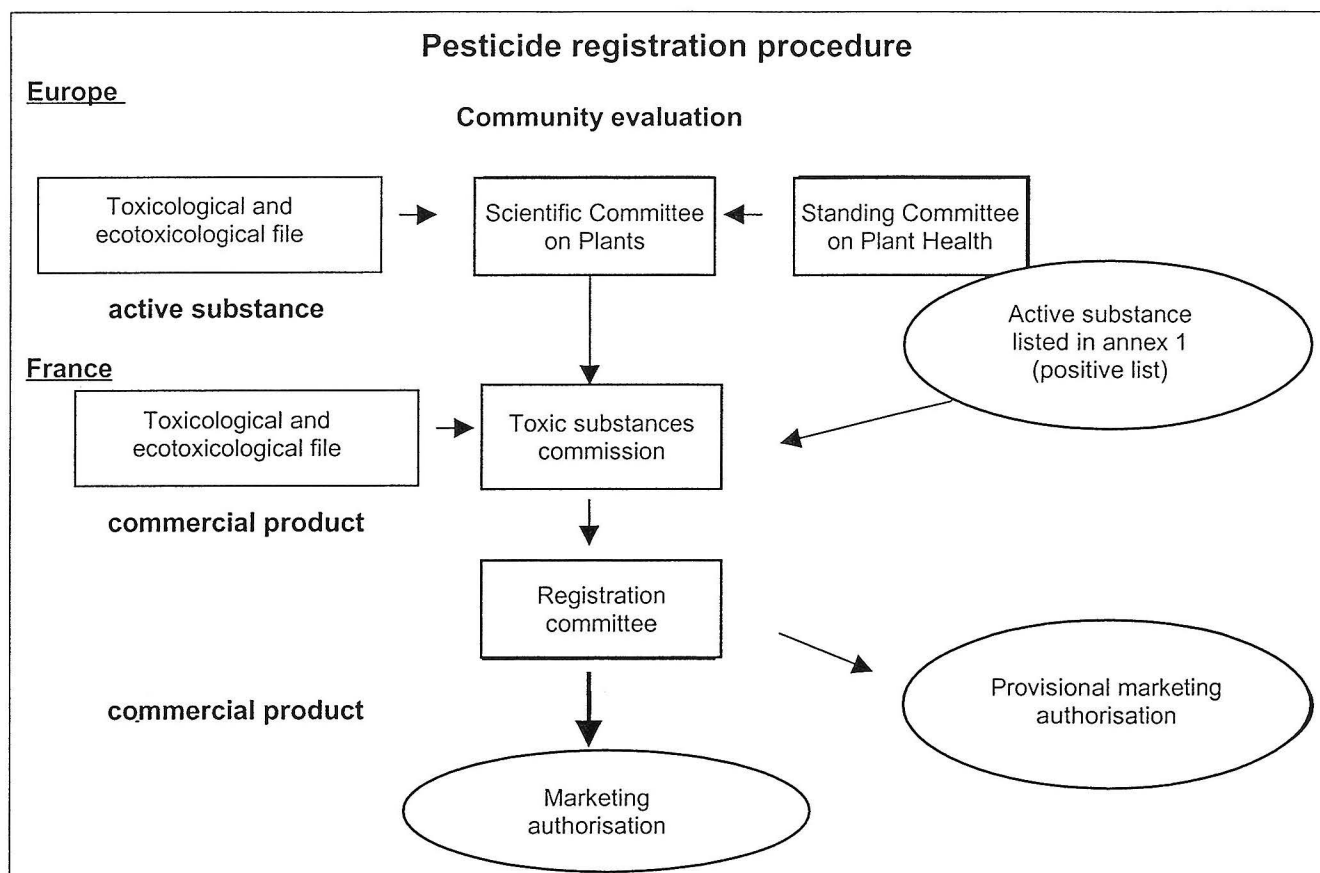
- 'The sale, use and possession of products ... for which a marketing authorisation has not been awarded is forbidden...'
- 'The use of products (pesticides) under conditions other than those laid down in the authorisation decision and mentioned on the label is forbidden, ...'

(Law No 525 of 2 November 1943 concerning the organisation of the

control of pesticides for agricultural use, the latest amendment being Law No 99-574 of 9 July 1999 – Agricultural orientation law)

To determine the risks related to pesticides and issue marketing authorisations with full knowledge of the facts, the Ministry of Agriculture possesses several decision-making and concertation authorities, and especially the Commission of pesticides for agricultural use and similar products (made up of experts on the subject) and the Committee for the registration of pesticides for agricultural use and similar products (consisting of representatives of the various ministries concerned and the *Institut national de la recherche agronomique*).

Marketing authorisations are issued by the Ministry of Agriculture and Fisheries after an opinion from the



Commission of pesticides for agricultural use. The authorisation specifies the uses authorised by the Registration Committee. It also lays down the dosages to be used, the maximum residue limits (MRLs) and the pre-harvest interval for products used in the field.

Furthermore, the pesticides examined must consist of the active substances entered in a community positive list

(Decree of 5 May 1994 transcribing the European directive 91/414/EEC into French law).

A list of products with marketing authorisations is available from the *Direction Générale de l'Alimentation, sous direction de la qualité et de la protection des végétaux*. It can also be consulted on the Internet (<http://www.agriculture.gouv.fr/wiphy>), making it possible to be informed about the frequent changes in marketing authorisations following meetings of the Registration Committee and to obtain information about the utilisation specified in the authorisation and certain MRL data.

The marketing authorisation and the uses that it allows are French legislative acts and applied in metropolitan France and overseas departments and territories in accordance with regulations specific to them.

Only a few products are registered for post-harvest use for crops likely to interest producers in the tropics. No pesticides are registered for the post-harvest treatment of the other classic tropical crops (especially pineapple, avocado, mango, etc.).

Marketing authorisations are issued for 10 years, at the end of which the manufacturer can request a renewal for 10 years. If this application is not made, the product is no longer registered. Benomyl thus lost its authorisation for post-harvest treatments after the abandoning of the request for renewal of the authorisation by the firm producing the commercial product previously used.

Through these commercial products, bitertanol has had provisional clearance for sales for 2 years, renewable once for the same period

of time, and that may finally lead to a marketing authorisation (source: *DGAL/SDQPV bureau des produits antiparasitaires et des matières fertilisantes*).

The marketing authorisation also specifies the MRLs that are partially listed at the 'e-phy' website. More precise information is available in the specific legislation (**Order of 5 August 1992 concerning maximum pesticide residue levels**, available in the series entitled *Documentation législative en production et protection des végétaux*, published by the Mission de Coopération Phytosanitaire).

This information on MRLs is particularly useful for producers of tropical fruit and vegetables and importers of produce from third countries that might use products that are not registered in France and in Europe for post-harvest treatments, insofar as treatments are applied at production. Care must be taken that these uses controlled by the producer countries simply respect the MRLs in force in the importing country.

Foodstuffs

In foods, the use of additives is regulated by a set of legislation whose key act is the **order of 2 October 1997, last amended by the Order of 31 July 2001**, abrogating to a considerable extent the **Order of 14 October 1991** concerning the additives permitted in the manufacture of foodstuffs for human consumption.

This act lists all the additives that can be used in foodstuffs and, when applicable, the maximum quantities authorised according to the use and the foodstuff concerned.

Unprocessed fruit and vegetables form a category of products that are clearly identified in the texts: *'... unprocessed foodstuffs are those that have not undergone any treatment causing a substantial change to their original state. However, they may for example have been divided, separated, sliced, boned, chopped, flayed, peeled, moulded, cut, washed, pared, deep-frozen, frozen, refrigerated, ground or shelled, packaged or not.'* (**Order of 2 October 1997 - Art. 13**).

Numerous food additives (especially colorants and sweeteners) are not permitted on unprocessed products. The additives authorised on unprocessed fruit and vegetables are classified in the following categories:

- **Annex III B. Foodstuffs in which a limited number of additives in Annex III A can be used** (Annex III A groups the additives generally authorised in foodstuffs but not applied to unprocessed foodstuffs except for exceptions specified for gases).
- **Annex III C. Preservatives and antioxidants authorised under certain conditions**
Part 1: sorbates, benzoates and p-hydroxybenzoates
Part 2: sulphur dioxide and sulphites
Part 3: other preservatives
- **Annex III D. Other permitted additives**
- **Annex IV. Permitted carriers and carrier solvents**

The notion or principle of *quantum satis* is often used in the case of these additives. The meaning of this is specified in **European Directive 95/2/EC**, which gave rise to the French acts studied: *'8. In the Annexes to this Directive, 'quantum satis' means that no maximum level is specified. However, additives shall be used in accordance with good manufacturing practice, at a level not higher than is necessary to achieve the intended purpose and provided that they do not mislead the consumer.'*

It can be noted that pesticides are not mentioned in the text of the **Order of 4 October 1997**. The particularity of post-harvest treatments is highlighted by the maintaining of a chapter referring to them in the 1991 order: *'7. The provisions of the Order of 14 October 1991, amended, referred to above are abrogated with regard to food additives, with the exception of (...) and provisions concerning the use of the following post-harvest treatment substances: chlorprophame, imazalil, imazalil sulphate, imazalil nitrate, diphenylamine, benomyl, ethoxiquin, ethylene and thiabendazole on potatoes (in relation with the abovementioned Order of 5 August 1992).'*

This is a transitional situation and prefigures the net distinction between two types of substance, as planned in the **European directive 95/2/EC concerning food additives**: *'Whereas, pending specific provisions pursuant to Council Directive 91/414/EEC of 15 July 1991 concerning the placing of plant protection products on the market, and pursuant to Council Directive 90/642/EEC of 27 November 1990 on the fixing of maximum levels for pesticide residues in and on certain products of plant origin, including fruit and vegetables, certain substances belonging to this category are provisionally covered by this Directive;...'*

The presence of references to the pesticides that can be used in post-harvest treatments in two different categories of acts complicates their

Reminder of a few definitions

- **'Quarantine pest'** - a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled;
- **'Pest'** - any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products.

Source: INTERNATIONAL PLANT PROTECTION CONVENTION - FAO, 1997

interpretation. Information concerning the evolution of authorisations are not systematically mentioned in the *Journal Officiel* and search for information must take into account the catalogue of authorised substances published by the DGAL, which alone provides regularly updated information.

Some more specific orders may complete broad-based acts. In the case of tropical fruits, an order concerns litchi, whose shell is not edible. It gives information concerning the use of SO₂ and specifies that the residual level in the shell may attain 250 mg/kg (**Order of 1 July 1998** authorising the use of sulphite as technological aids for the post-harvest treatment of litchis and table grapes).

Treatment by ionising radiation

Extension of storage life, disinsectisation and microbial decontamination of fruit and vegetables can also be obtained by using gamma radiation with cobalt 60 or caesium 137 or by means of an electron beam with energy of 10 million electron-volts (Mev) or less.

Three acts regulate the use of these techniques for dried fruits and pulses, for strawberries and for deep-frozen aromatic herbs such as garlic, chives, watercress, tarragon and parsley (**Order of 6 January**

1988 on the treatment of dried fruits and pulses by ionising radiation, **Order of 29 December 1988** on the treatment of strawberries with ionising radiation and the **Order of 16 May 1990** on the treatment of deep-frozen aromatic herbs with ionising radiation).

The provisions concerning the implementation of these techniques are applicable whatever the country in which the treatment is applied. In the case of imports, the importer must be capable of justifying that the treatments have been performed under the conditions laid down by French regulations (certificate, register, etc.).

In this particular case, in contrast with the post-harvest treatments involving pesticides, importers are requested to provide precise justification of the techniques used, even if the treatment has been performed in another country.

Specific treatments for eliminating quarantine pests

Within the framework of commercial movements of plant products, countries must take phytosanitary measures for the protection of their territories from pests that might cause damage therein.

The control of quarantine pests plans a number of treatments to eliminate

these organisms from batches of fruit and vegetables when there is a risk (preventive treatment) or when organisms have been detected (curative treatment). Fumigation enables very effective control of insects and can thus be used in the case of quarantine. Active substances of high toxicity are used and this must be within a strict framework laid down in the regulations:

- in particular, fumigation must be conducted under the control of plant protection service officials;
- the plant products for which the active substances are authorised are defined precisely and in certain cases may not subsequently be used as human or animal foodstuff (fumigation using hydrogen cyanide);
- for methyl bromide, reference is made in Annex I to treatments for fresh fruits. The expression 'fresh fruits' is specified in customs tariff nomenclature 0806 and 0807 where they are defined as 'Grapes, fresh or dried' and 'Melons (including watermelons) and papaws (papayas), fresh'.

Other treatment methods for fruits may enable the elimination of quarantine pests without the use of dangerous active substances. These are not therefore the subject of such detailed regulations. The method must be approved by the plant

protection service through its proved effectiveness in the destruction of pests and it must be commercially acceptable, with no harmful effects on the quality of the foodstuffs treated.

Cold and heat treatments are used in certain countries, in particular to control fruitflies. The regulations governing the importing of plant and plant products to Guadeloupe, Guiana and Martinique departments require cryotherapy treatment according to USDA standards for citrus fruits imported from countries not free of fruitflies (**Order of 3 September 1990 completed by the Order of 3 December 1991**). Obligations of this type also exist for mango imports.

Such procedures are also planned for EU citrus imports from third countries but are rarely implemented as other measures are more convenient to use.

Conclusion

Examination of the regulations on post-harvest treatment reveals the legal requirements.

The regulations cover the following concerns:

- **protection of consumers and especially of health.** Consumer health protection emerges as a priority concern. It requires regulation capable of appreciating an acceptable level of risk, whatever the site of production. The choice of MRLs is sufficient for pesticides and certain food additives. In contrast, knowledge of the application procedure is necessary for ionising radiation;
- **protection of the environment in the national or community territory;**
- **protection of the users of risk products in the national or community territory.**

These concerns only apply to the area under the sovereignty of the countries concerned and result in the more or less strict control of the use of certain substances ■

e-PHY : le catalogue officiel français sur internet des produits phytopharmaceutiques et de leur utilisation - Microsoft Internet Explorer

Adresse : http://www.agriculture.gouv.fr/lephy/

MERTECT FLOWABLE

Número homologation = 7300083

Société : NOVARTIS AGRO SA

Composition de la Spécialité
thiabendazole : 450 G/L

Formulation : POUDRE MOUILLABLE

Phrases de Risques/Prudence/Toxicologie :
Phrase de Risque : SSCL (CEE = SSCL) : SANS CLASSEMENT (e-phy/SSCL)
Phrase de Prudence : Y (CEE = Y) : VOIR ARRÊTÉS APPROPRIÉS SUR LES CLASSEMENTS ET L'ÉTIQUETAGE POUR LES CONSEILS DE PRUDENCE (e-phy)

LMR : thiabendazole
0 AGRUMES
3 BANANE
0,05 ENOUE

Usages Homologues
Usages en Retrait, en Refus

12054201 : H, 2 L/L, AGRUMES*TRAIT. PRODUITS RECOLTES*MALADIE D'ENTREPOSAGE
13154201 : H, 0,1 L/L, BANANIER*TRAIT. PRODUITS RECOLTES*MALADIES D'ENTREPOSAGE
15101201 : H, 0,26 L/L, BLE*TRAIT. DES SEMENCES*CARIE
15101202 : H, 0,26 L/L, BLE*TRAIT. DES SEMENCES*FUSARIOSES
15101208 : H, 0,26 L/L, BLE*TRAIT. DES SEMENCES*SEPTORIOSE
16361208 : H, 1 L/L, CHICOREE WITLOOF PRODUCTION DE CHICONS*TRAIT. DES PLANTS*PHOMA (PULVÉRISATION DES RACINES)

Mode d'accès :
• Accueil
• Usages (cultures, parasites...)
• Produits phytopharmaceutiques
• Substances Actives
• Sociétés
• Mouvements
• Toxicologie

Recherche Libre
Correctif de dernière minute
Télécharger le catalogue des usages
Télécharger Adobe Acrobat Reader

Synthesis of food additives that can be used on unprocessed fruit and vegetables
(Order of 2 October 1997, selection of plants cultivated in the tropics)

N°E	Name	Foodstuff	Maximum amount	Source
E 290	Carbon dioxide	Unprocessed products	<i>quantum satis</i>	Annex IIIA
E 938	Argon			
E 939	Helium			
E 941	Nitrogen			
E 942	Nitrous oxide			
E 948	Oxygen			* Order of 31 July 2001
E 949	Hydrogen*			
E 300	L-Ascorbic acid	Unprocessed, frozen and deep-frozen fruits and vegetables; unprocessed refrigerated, pre-packed, ready-to-use, etc. fruit and vegetables (b)	<i>quantum satis</i>	Annex IIIB
E 301	Sodium-L-ascorbate Calcium-L-ascorbate			
E 302	ascorbate			
E 330	Citric acid			
E 331	Sodium citrates			
E 332	Potassium citrates			
E 333	Calcium citrates			
E 200	Sorbic acid	Dry and dried fruits	1 000 mg/kg	Annex III C Part 1
E 202	Potassium sorbate			
E 203	Calcium sorbate			
E 210	Benzoic acid			
E 211	Sodium benzoate			
E 212	Potassium benzoate			
E 213	Calcium benzoate			
E 220	Sulphur dioxide	Dry and dried fruits:	(mg/kg SO ₂)	Annex III C Part 2
E 221	Sodium sulphite	- apricots, peaches, grapes, plums and figs	2 000	
E 222	Sodium hydrogen sulphite	- bananas	1 000	
E 223	Sodium metabisulphite	- apples and pears	600	
E 224	Potassium metabisulphite	- others (including shell fruits)	500	
E 226	Calcium sulphite			
E 227	Calcium hydrogen sulphite			
E 228	Potassium hydrogen sulphite	Dried coconut	50	
E 230	Biphenyl, diphenyl	Surface treatment of citrus	70 mg/kg	Annex III C Part 3
E 231	Orthophenylphenol	Surface treatment of citrus	12 mg/kg	Annex III C Part 3
E 232	Sodium orthophenylphenate		alone or mixed, expressed as orthophenylphenol	
E 445	Glycerol esters of wood rosins	Surface treatment of citrus	50 mg/kg (b)	Annex III D
E 473	Sucrose esters of fatty acids	Fresh fruits, surface treatment	<i>quantum satis</i>	Annex III D
E 474	Sucroglycerides			
E 416	Karaya gum	Coating for shell fruits	10 g/kg	Annex III D
E 901	White and yellow beeswax	Coating agents for, among other fruits :	<i>quantum satis</i>	
E 902	Candelilla wax	- shell fruits	<i>quantum satis</i>	
E 903	Carnauba wax	- fresh citrus, melons, apples and pears (surface treatment only)	<i>quantum satis</i> (b)	
E 904	Shellac	- peaches and pineapples (surface treatment only)		
E 905	Microcrystalline wax	Melons, papayas, mangoes and avocados	<i>quantum satis</i> (b)	Annex III D
E 912	Montan acid esters	- Fresh citrus (surface treatment only)	<i>quantum satis</i>	Annex III D
E 914	Oxidised polyethylene wax	- Fresh melons, mangoes, papayas, avocados and pineapples (surface treatment only)	<i>quantum satis</i> (b)	
E 322	Lecithins	Coating agents for fruits	Authorised carriers and carrier solvents	Annex IV
E 432-436	Polysorbates		No maximum quantity specified	
E 470 a	Sodium, potassium and calcium salts of fatty acids			
E 471	Mono- and diglycerides of fatty acids			
E 491-495	Sorbitans			
E 570	Fatty acids			
E 900	Dimethylpolysiloxane	(b)		

(b) amended by the Order of 22 September 1999