CODEX ALIMENTARIUS COMMISSION E

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World Health Organization

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CODEX COMMITTEE ON CONTAMINANTS IN FOODS

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PROPOSAL FOR NEW WORK ON A CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF OCHRATOXIN A CONTAMINATION IN PAPRIKA

(Prepared by Spain)

The Committee is invited to consider the proposal for new work as presented in the project document based on the considerations given in paras 1-6.

BACKGROUND

1. Ochratoxin A (OTA) is a toxic fungal metabolite classified by the International Agency for Research on Cancer (IARC) as a possible human carcinogen (Group 2B). The Joint FAO/WHO Expert Committee on Food Additives (JECFA) has evaluated the risk of OTA through food intake[1] and has established a Provisional Tolerable Weekly Intake (PTWI) of 100 ng/Kg b.w.

2. OTA is produced when conditions of water activity, temperature and nutrition needed for growth of fungi of the genera *Aspergillus* and *Penicillium* are present. OTA contamination can occur during cultivation, and due to its chemical structure, is stable during storage and resists, generally, industrial processing procedures.

3. The main commercial pepper variety produced and traded worldwide is *Capsicum annuum*. According to FAOSTAT, the top ten paprika-producing countries are[2]:

Rank	Area	Production (Int $1000)*	Production (MT)*
1	India	1583930	1445947
2	China, mainland	309285	282342
3	Pakistan	222299	202934
4	Bangladesh	192942	176134
5	Peru	188335	171929
6	Thailand	152617	139322
7	Myanmar	136184	124321
8	Ethiopia	104065	95000
9	Viet Nam	98589	90001
10	Ghana	96397	88000

** Last data published from 2011*

4. The purpose of this code of practice (CoP) is to serve as a guide of good hygiene practices in order to prevent and reduce the OTA content in paprika, reaching the lowest levels possible (ALARA principle), providing practical information to help both governments and the industry involved to comply with their respective responsibilities in ensuring the food safety of these products.

[1] Evaluation of certain food additives and contaminants (Sixty-eighth report of the Joint FAO/WHO Expert Committee on Food Additives). WHO Technical Report Series, No. 947, 2007 [169-180].

[2] The descriptor used for the FAOSTAT data analysis was "Chillies and peppers, dry", which corresponds to "Red and cayenne pepper, paprika, chillies (*Capsicum frutescens; C. annuum*); allspice, Jamaica pepper (*Pimenta officinalis*). Uncrushed or unground fresh pimentos are considered to be vegetables".

5. Since Spain is one of the major countries involved in the paprika trade worldwide[3], we have been working on the issue of OTA in this spice with all the stakeholders at the national level for a long time. As a result of all these efforts, in 2010 we all agreed on a Code of Practice to prevent and reduce the OTA content in paprika, based on sound science and experience from the food business operators (FBOs), which was published on the website of the Spanish Food Safety and Nutrition Agency (AESAN). We are aware that at least one paprika-producing country has adapted this CoP to its national legislation in order to eventually reduce the OTA content to the lowest achievable level. The abovementioned national CoP could serve as a basis to draft the Codex CoP.

6. A project document is attached to this paper, as well as the national code of practice abovementioned.

[3] According to FAOSTAT, Spain is the third main importer of dried chillies and peppers (after USA and Malaysia) and the fourth main exporter of this commodity (after India, China and Peru) (last published data from 2011).

PROJECT DOCUMENT

Proposal to Undertake New Work on a
Code of Practice for the Prevention and Reduction of Ochratoxin A Contamination in paprika

1. Purposes and Scope of the Standard.

The Draft Code of Practice for the Prevention and Reduction of Ochratoxin A (OTA) Contamination in paprika, as a risk management measure, would provide a uniform orientation for the control and management of paprika contamination by OTA. The very specific conditions in the collection of peppers and processing of paprika require specific measures to prevent and reduce the OTA present in these products. Therefore, the purpose of this code of practice would be to serve as a guide of good hygiene practices in order to prevent and reduce the OTA content in paprika, thus reaching the lowest levels possible (ALARA principle).

2. Relevance and timeliness of the Standard.

OTA is produced when conditions of water activity, temperature and nutrition needed for growth of fungi of the genera *Aspergillus* and *Penicillium* are present. OTA contamination can occur during cultivation, and due to its chemical structure, is stable during storage and resists, generally, industrial processing procedures. The main commercial pepper variety produced and traded worldwide is *Capsicum annuum*. Specific measures can be taken to prevent and reduce the presence of OTA in paprika.

OTA is a hazard to human health. It is a toxic fungal metabolite classified by the International Agency for Research on Cancer (IARC) as a possible human carcinogen (Group 2B). The Joint FAO/WHO Expert Committee on Food Additives (JECFA) has evaluated the risk of OTA through food intake[1] and has established a Provisional Tolerable Weekly Intake (PTWI) of 100 ng/Kg b.w.

Therefore, it is necessary a Code of Practice for the Prevention and Reduction of Ochratoxin A Contamination in paprika that allows taking into account the very specific conditions that occur in the collection and processing of paprika. Thus, the effectiveness of other risk management measures to prevent the presence of OTA in this product would be improved considerably.

3. Main aspects to be covered.

The code of practice would include specific measures of hygiene in the production of paprika in order to prevent contamination by OTA at all stages of the production chain (collection, processing, storage and transportation of paprika).

4. Assessment against the Criteria for the establishment of work priorities.

This proposal complies with the following criteria for establishing priorities of work:

- **Consumer protection from the point of view of health and food safety** (by reducing consumer dietary exposure to ochratoxin A from paprika).

5. Relevance to the Codex strategic objectives.

This proposal is consistent with the Strategic Goal 1 of the CAC Strategic Framework for 2014-2019.

6. Information on the relation between the proposal and other existing Codex documents.

This new work is related to certain Codex documents listed below:

- CAC/RCP 1-1969 General Principles of Food Hygiene
- CAC/RCP 42-1995 Code of Hygienic Practice for Spices and Dried Aromatic Plants
- CAC/RCP 51-2003 Code of Practice for the Prevention and Reduction of Mycotoxin Contamination in Cereals, including Annexes on Ochratoxin A, Zearalenone, Fumonisins and Tricothecenes
- CAC/RCP 63-2007 Code of Practice for the Prevention and Reduction of Ochratoxin A Contamination in Wine
- CAC/RCP 69-2009 Code of Practice for the Prevention and Reduction of Ochratoxin A Contamination in Coffee

7. Identification of any requirement for and availability of expert scientific advice.

No requirement of expert scientific advice identified.

8. Identification of any need for technical input to the standard from external bodies.

No anticipated need for external contributions.

9. Proposed time-line for completion of the new work, including the start date, the proposed date for adoption at Step 5 and the proposed date for adoption by the Commission.

Date of start:	2015
Proposed date for adoption at Step 5:	2016
Proposed date for adoption by the Commission:	2017

[1] Evaluation of certain food additives and contaminants (Sixty-eighth report of the Joint FAO/WHO Expert Committee on Food Additives). WHO Technical Report Series, No. 947, 2007 [169-180].

CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF OCHRATOXIN A CONTAMINATION IN PAPRIKA

1. INTRODUCTION

Ochratoxin A (OTA) is a toxic fungal metabolite classified by the International Agency for Research on Cancer (IARC) as a possible human carcinogen (Group 2B). The Scientific Panel on Contaminants in the Food Chain of the European Food Safety Authority (EFSA) has evaluated the risk of OTA through food intake[1] and has established a Tolerable Weekly Intake (TWI) of 120 ng / Kg_{bw}.day.

OTA is produced when conditions of water activity, temperature and nutrition needed for growth of fungi of the genera *Aspergillus* and *Penicillium* are present. OTA contamination can occur during cultivation, and due to its chemical structure, is stable during storage and resists, generally, industrial processing procedures. The main commercial pepper variety produced and traded is *Capsicum annuum*.

After harvest, the crop is sorted, washed (optional at this stage), dried (sun or hot air dryers), stored and traded. The moisture content and temperature of the skin must be kept low to prevent the OTA production.

The purpose of this code of practice is to serve as a guide of good hygiene practices in order to prevent and reduce the OTA content in paprika, reaching the lowest levels possible (ALARA principle), providing practical information to help the industry involved to comply with the maximum limits set out in legislation[2].

2. DEFINITIONS

Paprika is the dried product obtained from the grinding of sorted healthy and clean fruits of several red varieties (and in this case sweet) of the genus *Capsicum* (pepper).

3. PAPRIKA PRODUCTION

The traditional production process is described in Figure 1.

The average yield of the process with respect to fresh produce is less than 15% (about 5-10 kg of fresh pepper to obtain 1 kg of pods). In the overall process 5-6% of the powder is lost.

The application of hazard analysis and critical control point (HACCP) techniques during the stages of production, drying, transport, processing and storage are essential to prevent the risk of a high content of OTA in the paprika.

It is also mandatory to have a traceability control system and different records to ensure proper implementation of HACCP.

4. RECOMMENDED PRACTICES

4.1 BEFORE HARVEST

In geographic areas where climatic conditions are favorable for contamination by mycotoxin-producing fungi (warm temperatures and high humidity), authorized fungicides should be applied, especially during fruit ripening, taking into account the maximum residue limits (MRLs) in force in the European Union (Regulation (EC) No 396/2005) and the corresponding processing factor due to desiccation, which is 5-6, but it is estimated that it can reach a value of 10.

Even though OTA-forming fungi are present in the earth, there is no evidence that they infect the raw material while it is still on the plant. However, although unlikely, this situation could happen as it occurs in other crops such as coffee.

Recommended agricultural practices to prevent the development and spore load from OTA- producing fungi on pepper plants are:

a) Implementation of regular good agricultural practices (GAP) at the proper time, such as weeding, improving soil texture and aeration, pruning, fertilization and proper irrigation. A soil with good drainage must be chosen in order to avoid accumulation of irrigation water.

b) The use of soil fungicides (metam-sodium, chloropicrin, 1,3-dichloropropene, etc.[3]) in the tasks of farm soil preparation may be beneficial to reduce the spore load of OTA-producing fungi. At sowing, use disinfected seeds to prevent mold and insects and carefully choose the planting season so that the collection of peppers takes place in the driest season. This good practice is essential in areas with warm and humid climate.

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[1] Opinion of the Scientific Panel on contaminants in the food chain [CONTAM] related to ochratoxin A in food. *The EFSA Journal (2006) 365, 1 – 56*

[2] Commission Regulation (EU) 105/2010 of February 2010 amending Regulation (EC) 1881/2006 setting maximum levels for certain contaminants in foodstuffs as regards ochratoxin A

[3] It has to be previously checked if the use of these products is allowed by the country legislation.

c) It is also essential the use of pesticides, whenever conditions require, thus minimizing fruits damage that may favor the entry and development of fungi, for example, through open galleries made by caterpillars. Establish an appropriate plantation density and prevent weeds proliferation during plant development.

d) Do not use spray irrigation during the flowering period. This could increase both the rate of normal dispersion of spores and the chances of fruit infection with OTA-producing fungi.

e) Do not use untreated organic waste during the crop which could allow the proliferation of OTA-producing fungi.

f) Clean and disinfect the tools used during cultivation.

g) Apply a proper crop rotation to regenerate the soil.

4.2 HARVESTING

It is important to collect the peppers in the optimum point of ripeness, when they present their most intense color, which indicates a higher content of natural pigments and lower water content.

Personnel involved in the task of collection should be properly trained in the prevention of mycotoxin contamination, and during the collection there should be an appropriate selection of fruits, discarding those showing symptoms of fungal contamination and those that present some kind of external damage. These fruits discarded should be removed from the planting area, thus avoiding contaminating the soil for cultivation. It is very important that during harvesting the peppers do not fall onto the ground so as to prevent contamination.

The boxes, containers and vehicles where the fruits are transported, as well as the tools used to collect them, should be properly cleaned and disinfected, in accordance with the principles of food hygiene[4].

It is also recommended to develop a control system for the OTA contamination in the production areas, as well as research studies on the factors affecting the formation of this mycotoxin.

4.3 POST-HARVEST

Freshly picked peppers should be moved to the dryer for processing as soon as possible after harvesting. The containers to be used to collect the pepper and transport it from farm to drying facilities must be clean, disinfected and dried before use or reuse. If necessary, they should be cleaned and disinfected before use or reuse, and must be suitable for the intended load. Pepper collected should always be protected from rain or moisture.

In case the drying process cannot be applied immediately, fresh fruits should be stored under a relative humidity below 80% and a temperature between 7-12 ºC to prevent the proliferation of OTA producing fungi.

4.3.1 Cleaning

Prior to drying, the harvested fruits should be washed to remove organic debris and dust, for which chlorinated water (100-150 ppm) can be used, rinsing afterwards to remove all traces of treatment. During this phase there should be a selection process to eliminate the peppers showing symptoms of fungal infection, even in a small part, because they can be the basis to contaminate a whole batch. This phase can be carried out on the farm.

4.3.2 Drying

The main purpose of the drying operation is to efficiently decrease the high water content of the just harvested peppers in order to get a stable and good quality product. To prevent the growth of OTA producing fungi, the fruit should be kept under low humidity conditions during the drying process and the moisture content in the final product should be below 11%. The drying process produces a dried product whose composition on a dry base is approximately 33% of seed, 8% of stalk and 58.5% of pod.

The fruits can be dried either using direct sun (taking 3 or 4 days during periods of high temperatures and 7 or 8 in colder seasons) or in hot-air mechanical driers using air of low relative humidity (RH) and temperature of 45-65 °C (from 10-12 hours). In areas where climatic conditions of high humidity and mild temperatures is preferable to use hot air dryers, since the sun drying process can be extended up to 20-25 days, which favors the growth of OTA producing fungi.

The OTA-producing fungi require favorable conditions during a certain period of time to grow and produce the toxin. The level of available water is the most important factor to be considered. At high water activity (a_w> 0.95) OTA-producing fungi will not likely grow, as fast-growing hydrophilic fungi and yeasts grow first. At lower water activity (a_w <0.80) the OTA-producing fungi can be present but not produce the toxin, and at a_w below 0.78-0.76 they cannot grow.

Therefore the most important point is to control the period of time in which the pepper stays in the drying yard, in the range of water activity where OTA-producing fungi can grow (a_w = 0.8-0.95). According to experimental results, five days or less in the drying yard is enough and effective to prevent OTA accumulation.

Recommended measures to dry the peppers efficiently are:

[4] Regulation (EC) 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs.

a) The drying yard should have sufficient slope to facilitate removal of water and be located away from contaminant sources such as dusty areas and should receive maximum sun exposure and air circulation, during most of the day, to speed up the drying of the fruits. Shady and low areas should be avoided. The fruits should be placed on elevated platforms or at least on a floor made up of suitable material free from contamination.

b) The surface for the drying yard should be selected according to the climate of the region, cost and quality of the dried product, as any type of surface has advantages and disadvantages. Plastic canvas in humid areas is inadequate, since it gets humid under the pepper layer, promoting fungal growth. It is necessary that the drying surface be cleanable easy to disinfect.

c) It is very important that the peppers are not in direct contact with the ground, according to section 3.2 of the Code of Hygienic Practice for Spices and Dried Aromatic Plants, as it is the main contamination source.

d) The fresh concrete floors may be used for the drying phase only when there is absolute certainty that the concrete is properly filled and free of excess water. It is more hygienic to place a plastic cover (suitable for food) covering the entire floor of fresh concrete as a moisture protection.

e) The pace and total time of the harvest should be based on the available area of the drying yard and the average time necessary for drying, considering both good and bad weather.

f) Precautions must be taken to protect the fruit from contact with domestic animals, rodents, birds, mites, insects and other arthropods during the processes of drying, handling and storage.

g) Workers in the drying yard should be properly trained in the prevention of mycotoxin contamination, including the proper use of the moisture measuring equipment.

h) Repair, clean, protect and maintain equipments in a clean storage area until the next season. Moisture measuring equipment should be regularly cross checked and calibrated once a year before harvest according to the ISO 6673 method.

i) During the drying process, the peppers should be turned to produce a uniform drying and damaged fruits should be discarded. Accumulation of fruits must also be avoided since it hampers the drying process and, therefore, increases its time. They should be extended to the utmost to facilitate aeration.

4.3.3 Sorting and packaging

Once the peppers are dried, all those stained, immature, discolored and damaged fruits should be discarded. The elimination of a single piece of a contaminated fruit is not a preventive measure for the OTA contamination but it may contribute to increase the OTA levels of rest of the fruit, giving rise to the contamination of the entire batch or even other consignments that may be mixed.

Dried peppers should be inspected and sorted before carrying out the further processing and be submitted for laboratory analysis to determine the OTA levels, either in a systematic way in samples from areas with unfavorable weather conditions (high humidity and mild temperature), or on a regular basis in samples from areas where the contamination is low.

It is important to evaluate the effectiveness of the screening technique; hence it is necessary to keep the analytical results of all batches in order to demonstrate that effectiveness.

After removing the stalk (optional), and in case the peppers are not going to be processed immediately, the product is eventually compacted into bales.

The presses used must be clean and in good condition. Breathable and suitable for food contact raffia bags must be used, that should be tightly closed to prevent from insects or pests contamination. The dry pepper packed in bales should be stored in a closed warehouse, clean and ventilated, always protected from moisture.

4.4 TRANSPORTATION

The containers to be used to transport the dried pepper to milling facilities must be clean, dry and free of insects and visible fungal growth before use or reuse.

The batches should be protected from any accumulation of additional moisture by using covered or airtight containers or tarpaulins. Temperature fluctuations should be avoided since it may cause condensation on the product, leading to local accumulation of moisture and the subsequent development of OTA-producing fungi.

During ship transportation, precautions should be taken and temperature and humidity sensors should be used inside the containers in order to detect fluctuations that might cause contamination during transport. In addition, the cargo holds should be well ventilated with dry air to remove moisture resulting from respiration of spices and prevent condensation when moving from a warm area to a colder one, or overnight.

Bags of dried peppers should be well stacked and crossed over for mutual support in order to avoid the formation of empty vertical columns (chimneys). The top layer and sides of bags should be covered with materials that can absorb condensed water, such as silica gel or cardboard for protection against the growth of fungi that could result in OTA production.

During transportation, infestation by insects, birds and rodents should be avoided by using either containers resistant to insect and rodent, or authorized repellent chemical treatments. As an effective option, the pepper transported in containers can be fumigated with magnesium or aluminum phosphide.

During peppers loading and unloading, areas should be covered to protect against rain.

It is important that the operator select reliable transport service-providers that adopt this code of practice and ensure appropriate transport conditions.

4.5 PROCESSING OF THE DRIED PEPPER

The pepper should be processed as soon as possible at the processing plant.

The dried pepper is processed in a series of stages: Seeds elimination, crushing, grinding, cooling, mixing, sifting and sterilization.

After sterilization, the paprika is dried at 70 ° C until it gets to a moisture content lower than 12%. Afterwards it is cooled, sieved and packaged. Because pepper is hygroscopic, it must be packaged quickly after processing using a material that serves as a barrier to moisture.

The moisture content of the final product should range between 5% and 12% to prevent the proliferation of fungi.

4.6 STORAGE

The layout, design, construction, location and size of pepper storage areas should permit adequate maintenance, cleaning and/or disinfection.

When necessary, these areas should provide suitable conditions for handling and storage at controlled temperature and a sufficient capacity for maintaining foodstuffs at appropriate temperatures that can be monitored and, if necessary, recorded. The atmosphere should be maintained at a relative humidity of 55 to 60 per cent to protect the quality and prevent mold growth.

KEY POINTS TO AVOID OTA CONTAMINATION IN PAPRIKA:

- **Prevention of fruit contamination on the plant**
- **Fruit selection, discarding completely the damaged peppers throughout the entire process**
- **Fruit drying without direct contact with the ground**
- **Hygiene, moisture and temperature control from the field to the consumer**

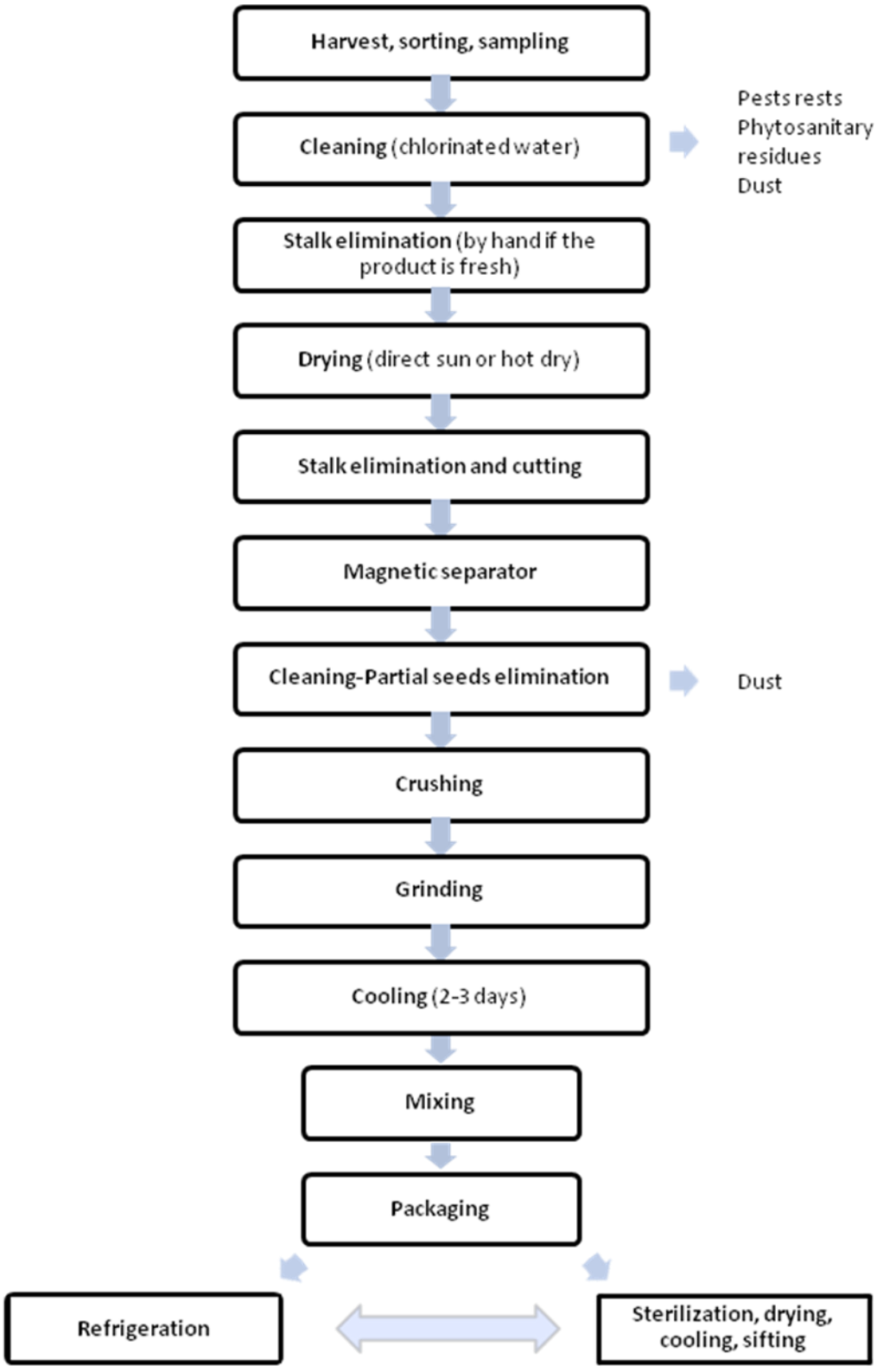

Figure 1. Paprika production process.

Notes on the flow chart:

- The process of stalk elimination is optional. Virtually all traded paprika comes from the full grinding of pepper with the stem attached.
- The seeds elimination process is also optional.
- Cooling only applies in the case of milling with traditional stone mills, less and less used. The modern impact grinding mill does not heat the product, so that the cooling step is not necessary.
- The ground paprika is recommended to be finally stored under refrigeration conditions in order preserve the color, but it is usually stored at room temperature.