



# Guidelines for the prevention of OTA occurrence in coffee

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EUROPEAN  
COFFEE  
FEDERATION

# Guidelines for the prevention of OTA occurrence in Coffee

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# 1 INTRODUCTION

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The European Coffee Federation, ECF, is the umbrella organization of the European coffee trade and industry, representing 15 National Associations and 32 Corporate Members. ECF offers a transparent forum for exchange, whilst promoting the sector's common interests in the largest coffee consuming continent.

ECF recognises the need for an effective EU regulatory framework that guarantees a high level of consumer protection and a level playing field for industry across Europe. Food safety is paramount to the coffee industry. ECF supports its Members so that their products meet the highest food safety standards, the latest legal requirements as well as other established international safety standards.

Ochratoxins are compounds that are naturally produced by certain moulds (fungi) of the genus *Aspergillus* and *Penicillium*. In the EU, maximum levels of the reference molecule in this group, ochratoxin A (hereinafter 'OTA'), are established in various food categories. These are stipulated in a Regulation (currently No. 1881/2006<sup>1</sup>, as amended).

OTA risk management in coffee is required from tree to finished product. Key factors include good harvesting, elimination of risky defects, rapid drying (moisture content between 8% & 12.5%<sup>2,3</sup>) and through clean and dry storage and transportation avoiding that the coffee be rewet. Indeed, EFSA identified that controlled environmental conditions, mainly humidity and temperature, may avoid fungal growth during storage. Furthermore, in their most recent risk assessment of OTA published in 2020, EFSA also stated that *'high temperatures, which are achieved e.g. during the roasting process, were shown to considerably decrease OTA by thermal degradation'*<sup>4</sup>.

It follows that, for green coffee, a maximum level is not established. In a previous EFSA risk assessment, they had additionally indicated that *'data on green coffee and cacao beans are not considered as they are not consumed as such, and because dietary exposure of products thereof is already considered with the corresponding processed products'*<sup>5</sup>. That logic was applied by the European Commission to risk management, when setting maximum levels for finished products only.

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<sup>1</sup> Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs; Official Journal L 364 of 20 December 2006. Consolidated version January 2022: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02006R1881-20220101>

<sup>2</sup> International Coffee Organization (Resolution 420). Exceptions to the 12.5% maximum moisture content shall be permitted for specialty coffees that traditionally have a high moisture content, e.g. Indian Monsooned coffees.

<sup>3</sup> In certain EU Member States, national legislation stipulates slightly different moisture contents. For example, in Spain, Royal Decree 1676/2002 requires a moisture content of  $\leq 13$ .

<sup>4</sup> EFSA Risk assessment of ochratoxin A in food; Wiley Online Library on 13 May 2020.

<sup>5</sup> EFSA Opinion of the Scientific Panel on contaminants in the food chain [CONTAM] related to ochratoxin A in food; Wiley Online Library on 9 June 2006.

For coffee, the key provisions of this legislation are currently:

- 5 µg/kg (= parts per billion [ppb]) maximum level for roasted coffee
- 10 µg/kg maximum level for soluble (instant) coffee

The Regulation is being updated and a reduction in the applicable maximum levels, based on the latest available data, is currently being considered.

A mistake commonly made in contracts and controls is to apply the maximum level of roasted or soluble coffee to the green coffee intended to its manufacture. The reason why this is not necessary is due to the fact that OTA can be effectively controlled and managed at a later stage, namely during the roasting process. In their most recent OTA risk assessment (see footnote 3), EFSA has noted from studies that losses ranging from 70% to > 90% have been observed at temperatures above 180°C, such as used for coffee roasting.

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## **2 OBJECTIVE**

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The overall objective of these guidelines is to explain how the coffee trade and industry ensure a legally compliant finished product.

Over the next pages the importance of Good Agricultural Practices (GAP) and the implementation of Hazard Analysis and Critical Control Points (HACCP) shall be highlighted so as to ensure roasted and soluble coffee compliance with the European OTA legislation.

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## **3 EU FOOD HYGIENE LEGISLATION: HACCP**

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Enterprises in the coffee chain, including raw material importers and coffee producers, will at some point need to apply controls to guarantee product safety. These are usually represented in a concise process flow diagram with underlined points, where hazards may occur.

In the producing Countries, Good Agricultural Practices (GAPs) are predominant. GAPs are introduced aiming at making all-round improvements rather than focusing on a couple of critical points. They are also easier to set up and have no need for a detailed description that can be subject to verification by food safety authorities. However, they are an ideal starting point to ensure coffee quality.

Across the chain, operators will be conducting HACCP controls. These are a management system in which food safety is addressed through the analysis and control of biological, chemical and physical hazards from the reception of green coffee to the final product.

These operations are governed by EU Food Hygiene legislation<sup>6</sup>, which defines the measures and conditions necessary to control hazards and to ensure fitness for human consumption of a foodstuff (Article 2). One of the measures is that food business operators shall put in place, implement and maintain permanent procedures based on the *Hazard Analysis and Critical Control Points* principles (Article 5). These HACCP principles consist of the following:

- a) **Identify any hazards** that must be prevented, eliminated or reduced to acceptable levels;
- b) **identify the critical control points** at the step or steps at which control is essential to prevent or eliminate a hazard or to reduce it to acceptable levels;
- c) **establish critical limits** at critical control points which separate acceptability from unacceptability for the prevention, elimination or reduction of identified hazards;
- d) establish and implement effective **monitoring procedures** at critical control points;
- e) establish **corrective actions** when monitoring indicates that a critical control point is not under control;
- f) establish procedures, which shall be carried out regularly, to verify that the measures outlined in subparagraphs (a) to (e) are **working effectively**;
- g) establish **documents and records** commensurate with the nature and size of the food business to demonstrate the effective application of the measures outlined in subparagraphs (a) to (f).

This principle is mentioned in detail as it is helpful to fully grasp the legal basis for the expectations of inspection Authorities.

**To be stressed, that when following the above HACCP principles in coffee manufacturing plants, OTA will be identified as a control point or operational pre-requisite and not as a critical control point. As a control point, OTA in coffee is a low food safety risk and not likely to occur.**

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## 4 HACCP/QUALITY ASSURANCE

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### 4.1 Introduction

The following five-step approach is recommended:

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<sup>6</sup> Regulation 853/2004 of 29 April 2004 on the Hygiene of Foodstuffs; Official Journal L139 of 30 April 2004.

- a) Acknowledge the Hazard
- b) Identify the Critical Sampling Points (CSP)
- c) Establish criteria for OTA control
- d) Apply a decision tree
- e) Establish a system of monitoring and documentation

The next sections elaborate on this in a more detailed manner.

#### **4.2 Acknowledge the Hazard**

OTA shows kidney toxicity in different animal species and kidney tumors in rodents. OTA is genotoxic both in vitro and in vivo; however, the mechanisms of genotoxicity are unclear<sup>7</sup>. Moreover, coffee seems to be a small contributor<sup>8</sup>. Food Business Operators (FBOs) must take measures to reduce the long-term intake of OTA, but these measures must be proportional to the actual risk and to the modest share of coffee.

Furthermore, whereas EFSA notes OTA itself is genotoxic, overall coffee is not. This has been confirmed by the International Agency for Research on Cancer (IARC), a division of the World Health Organization, that found no conclusive evidence for a carcinogenic effect of drinking coffee<sup>9</sup>.

#### **4.3 Identify Critical Sampling Points**

FBOs should identify Critical Sampling Points (CSP). In this particular case, FBO refers to the roasters or soluble coffee manufacturers.

For green coffee, the first possible CSP is the sample provided in offer of trade. Additional CSPs are receipt of a pre-shipment or so-called outturn sample (if provided) and of course samples from all batches of green coffee subsequently arriving at the factory. Green coffee from each CSP must be checked for conformity.

#### **4.4 Establish criteria for OTA control**

As a first step, FBOs should check that the coffee is compliant with the required humidity level. Only in case the humidity is within the required range, should the next steps be sufficient towards ascertaining acceptability.

Once done, the FBO should then check whether the green coffee meets the three following criteria:

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<sup>7</sup> EFSA Risk assessment of ochratoxin A in food; Wiley Online Library on 13 May 2020.

<sup>8</sup> Coronel *et al.*, Assessment of the exposure to ochratoxin A in the province of Lleida, Spain, Table 4; Food and Chemical Toxicology (2009): <https://doi.org/10.1016/j.fct.2009.09.005>

<sup>9</sup> IARC PRESS RELEASE N° 244 on IARC Monographs evaluate drinking coffee, maté, and very hot beverages; 15 June 2016.

- a) Sensorial control for an earthy/mouldy smell;
- b) Physical control for visual defects;
- c) Sensorial control for earthy/mouldy taste in the cup.

If suspicions are raised on the basis of these criteria, it is advisable to isolate that green coffee and proceed to analyse a sample for OTA.

#### ***a) Sensorial control for an earthy/mouldy smell***

An earthy or mouldy smell should systematically trigger further investigation. The major advantage of using smell as an indicator is it is spread much more homogeneously in a lot than the actual mould and the nests of OTA and is therefore less dependent on hit-or-miss sampling.

Although not every mould species generates OTA, such smelling coffees does have a higher likelihood of having OTA contamination.

#### ***b) Physical control for visual defects***

“Visually clean” does not mean zero defects. Traditionally the requirements of NYBOT or LIFFE grading<sup>10</sup> were used.

However, Food Business Operators should be mindful of the following defects linked to the presence of OTA:

- Insect infested beans. The green coffee bean is protected from contamination by the skin of the coffee cherry. Therefore, the presence of insect infested beans will clearly indicate that the protection of the skin has been breached at some point and contamination may have reached the bean. Broca beans, are distinguished by small (0.3—1.5 mm dia.) dark holes, often on opposite sides of the bean. The path can be at any angle, including longitudinally. Some beans may have extended damage and three or more perforations are common.
- Fungus damaged beans are recognized by yellow to reddish brown “powdery” spots (spores) in early stages of the attack, which grow in size until covering the entire bean. The fungus damaged beans release spores that will contaminate other beans. The skin of the cherry normally protects the coffee bean itself from contamination with spores.
- Full black or partial black beans are easily distinguished by their opaque color.

#### ***c) Sensorial control for earthy/mouldy taste in the cup***

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<sup>10</sup> <https://www.theice.com/products/15/Coffee-C-Futures>  
<https://www.theice.com/products/37089079/Robusta-Coffee-Futures>

An earthy, musty or mouldy taste is a clear indicator that the green coffee batch might have been exposed to OTA.

In case of suspicions of OTA contamination based on the above, the FBOs should define how to sample the concerned green coffee. Traditionally it was recommended to take samples throughout the lot, with a minimum of 5 kilo per 20 tons. However, in practice 1kg well homogenized and representative of the lot could also be sufficient. The key here is to cautiously grind down the whole sample and ensure that a representative analytical sample was taken.

It is recommended that the FBO should choose a lab for the OTA-analysis which holds an ISO 17025 accreditation, demonstrating that they operate competently and generate valid results. A CEN method for determination of OTA in roasted coffee exists<sup>11</sup>. For green coffee, although there is no standard prescribed method of analysis, following that standardized analytical method for roasted coffee, EN 14132, would be the best recommendation.

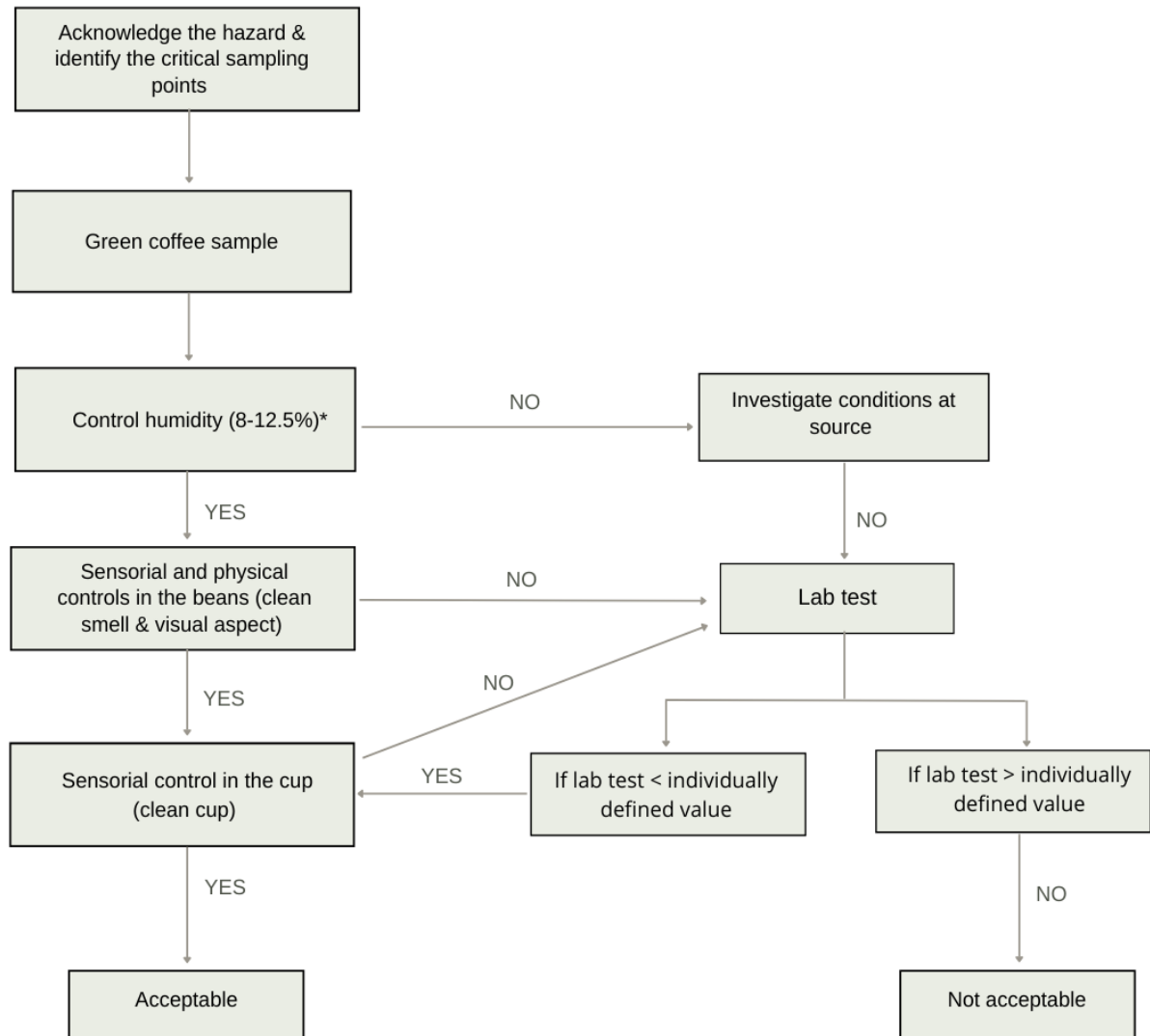
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<sup>11</sup> UNI EN 14132:2009: Determination of ochratoxin A in barley and roasted coffee using immunoaffinity column clean up and high performance liquid chromatography (HPLC). This method has been validated for OTA contents in roasted coffee in the range from 0,2 µg/kg up to 5,5 µg/kg.



## 4.5 Apply a decision tree

The entire process to check green coffee is summarized in the following decision tree.



\* *except for some specialty coffee*

#### **4.6 Establish a system of monitoring and documentation**

Every Food Business Operator should establish their own HACCP-based system of monitoring and documentation of OTA-management. Whereas the elements of an HACCP system are very company specific, some more general recommendations are:

- Clearly identify the person(s) responsible for entry control of the coffee.
- Establish a system to feed the results of finished product spot-checks back into the green coffee buying operation. For example, in case it would be observed that roasted or instant coffee contamination gradually increases, this would be indicative that green coffee quality evaluation was likely not strict enough. The cut-off level for risky defects (cherries, skins, husks, insect-damaged beans) may for instance need to be set stricter.
- Keep records of “problematic origins”. See also paragraph 5.2. It is feasible that certain suppliers may need to be instructed in regard to their Good Agriculture Practices, in particular as to how to prepare their coffee better or to improve their drying processes. It is important to be able to show to Food Safety Authorities that corrective systems are in place from the side of the buyer.

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## **5 GREEN COFFEE BUYING: ADDITIONAL RECOMMENDATIONS**

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### **5.1 Contractual requirements**

Using the European Standard Coffee Contract (ESCC)<sup>12</sup> or incorporating its key requirements is recommended. The ESCC is linked to the ICO Code of Practice “Prevention and reduction of Ochratoxin A contamination in coffee” to determine whether parties have done the necessary to supply coffee of sound and merchantable quality. The ESCC also specifies that one criteria to determine whether coffee is unsound is an excessive moisture level. Moisture has been shown to be the main risk factor for OTA formation after the first processing stage.

The ESCC deliberately does not mention a figure for excessive moisture because this is regulated elsewhere, namely in ICO Resolution 420 (for reference, see footnote 2).

This provides for a quality standard for exported green coffee and specifies maximum moisture levels as follows:

- for both Arabica and Robusta, not to have a moisture content in excess of 12.5%, measured using the ISO 6673 method.

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<sup>12</sup> available from [www.ecf-coffee.org](http://www.ecf-coffee.org)

- Where moisture percentages below 12.5% are currently being achieved, exporting Members shall endeavour to ensure that these are maintained or decreased.
- Exceptions to the 12.5% maximum moisture content shall be permitted in Members States such as Spain where national legislation provides so, or for specialty coffees that traditionally have a high moisture content, e.g. Indian Monsooned coffees. However, such coffees should be clearly identified by a specific grade nomenclature.

It is generally recommended therefore to include the key provisions (no less than 8 and no more than 12,5% moisture, measured using the ISO 6673 method) in bilateral green coffee contracts with suppliers, specifying that the 12,5%<sup>13</sup> maximum must not be exceeded at the point of stuffing of the container.

Bilateral contracts with suppliers should also specify moisture and risk of condensation reduction measures, such as for example lining the container walls, the use of cardboard or another water-adsorbent sheet on top of the bags and/or the positioning of an appropriate drying agent (e.g. “dry-bags” suitable for food products) in the headspace.

The exact measures to be taken depend on the risk, which depends on the origin. Clearly, more anti-moisture measures are necessary for coffee shipped from a humid climate, than from a dry one.

Another aspect is the shipping itself, where traders and roasters may wish to include a provision in their contractual arrangements with shipping lines regarding the stowage of coffee containers, for instance: ‘stow away from heat, cool stow and sun/weather protect’ or ‘stow in protected places only, away from heat and radiation’. Exposure to the sun, even in moderate climates, results in large day/night temperature swings and substantially increases the risk of condensation and hence re-wetting coffee.

## **5.2 Risk management based on Countries of origin**

No origin as such is “OTA free”. Therefore, a tighter analytical surveillance plan is recommended for origins that have been known to be problematic or that are new to the buyer in order to build knowledge on the OTA level in these crops.

Following the HACCP principles above, traders and roasters should document and evaluate their results (monitoring analyses as well as random checks).

Consolidated OTA data and their evaluation will help establish a risk pattern for the different origins.

In turn, that will enable to implement properly targeted control measures as well as specific feedback to suppliers to improve their performance.

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<sup>13</sup> Or 13% where national legislation provides so (e.g. Spain).

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## 6 NON-COMPLIANCE

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### 6.1 Green Coffee

For green coffee if there is exceedance of the humidity level, the contract between seller and buyer determines what to do.

### 6.2 Finished products

Finished products not complying with the EU maximum limits for OTA must, if still under company control, be blocked in the warehouse or be recalled from the market. In case of a recall, the National Food Safety Authorities must be notified (Regulation (EC) 178/2002<sup>14</sup> - Article 19 of the General Food Law).

Destruction of a non-acceptable lot should be carried out in line with national requirements to meet environmental standards and must result in total destruction of the lot to the extent of preventing human or animal consumption.

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## 7 QUESTION & ANSWER

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### 7.1 Is it required to analyze all incoming green coffee?

Since our internal data suggests that 88% of green coffee arrives with very low levels of OTA (2 µg/kg or less), testing of all green coffee would be unnecessary and disproportionate.

The application of a HACCP described in chapter 4 is the most appropriate tool to control OTA levels in the finished product. HACCP application will identify any case of suspicion of OTA contamination, for which an analysis is then required.

If the green coffee is to be analyzed, the total combined sample should be ground (this is notoriously difficult for green coffee) and homogenised thoroughly. Only then a smaller sample can go into the actual analysis. Testing without adequate homogenisation to ensure a representative sample may result in either a false rejection or a false sense of security. To be noted that test results even by well-performing laboratories may still show a variation of + or – 25% in each sample.

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<sup>14</sup> Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety; Official Journal L 031 of 1 February 2002. Consolidated version May 2021: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02002R0178-20210526>

With these uncertainties, it is not recommended to go to arbitration should sampling and analysis reveal that contractual OTA specifications have been exceeded only marginally.

## **7.2 Is it useful to ask the supplier for a “maximum OTA” certificate?**

Requesting a certificate to guarantee a certain maximum level of OTA in green coffee may seem superficially to be an attractive option to allocate responsibility in the commercial chain. However, we recommend against it as it will be of limited assurance. If the supplier is an exporter in a coffee producing Country, the best such a certificate can achieve (assuming that sampling and analysis have been done properly) is to provide a snap-shot picture, bearing in mind that OTA formation may occur throughout the chain.

After testing, the coffee may have become wet again, be it at the exporter’s premises (stuffing of the container in the rain) or during later storage or transport. Essentially the same applies to testing after arrival in Europe, although the chain is shorter and the risk of a mishap after testing should in principle be correspondingly smaller. However, the basic problems with testing remain the same.

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## **8 CLOSING REMARKS**

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Bearing in mind that coffee is a minor contributor to OTA, these guidelines have further established an appropriate and practical way to deal with the risk of contamination. Following the recommended steps ensures safe and compliant coffee on the EU market.

These Guidelines are however an evolving document. Companies gain practical experience of how to manage their operations. Furthermore, the applicable legislation also evolves on the basis of the most recent risk assessment. To ensure the guidelines remain up to date and practical, the ECF Contaminants Committee welcomes input or suggestions based on the latest information and strategies for best practice. Please address any comments or questions to [ecf@ecf-coffee.org](mailto:ecf@ecf-coffee.org)