

ESA Statement on Pyrrolizidine Alkaloids in Herbs and Spices

[March 2023]

The European Spice Association e.V. (ESA) is the umbrella organization representing the European spice industry. ESA brings together the expertise of a wide group of people to promote the use of pure, safe and wholesome herbs and spices that are true to name and provide the quality and safety that is expected by the consumer.

ESA member companies and national member associations are fully committed to ensure that herbs and spices intended for distribution are in compliance with the general principles and requirements of EU food law and safe for human consumption.

Introduction

Pyrrolizidine alkaloids (PA) are natural toxins that occur in a wide variety of plants, angio-sperm families of the *Boraginaceae* (all genera), *Asteraceae* (tribes *Senecioneae* and *Eupatorieae*) and *Fabaceae* (genus *Crotalaria*). Over 6,000 plant species are expected to generate PA to protect against external stress factors such as herbivores or climatic conditions, making them probably the most widespread natural plant toxins in the world.

The International Agency for Research on Cancer (IARC) has classified 3 PA namely lasiocarpine, monocrotaline and riddelliine as '*possibly carcinogenic to humans*' (Group 2B). Some studies found the liver as the main target organ of toxicity, showing various degrees of progressive liver damage (centrilobular hepatocellular necrosis), and venoocclusive disease. The toxicity of PA differs, but up to now, the toxicity of individual PA is not known due to lack of data.

With very few exceptions, PA-producing plants are not consumed as food. Cases of direct poisoning in humans due to confusion of similar-looking plants, i.e. unintentional consumption of PA plants (weeds) are rare and well documented. However, health risks for humans can arise from the consumption of food subject to contamination with PA plants. Such contamination of food crops with PA plants can occur, for example, through spot contamination of fields and the unintentional collective harvesting of the weeds with the food crops.

Dietary exposure to PAs should be subject to the ALARA principle (as low as reasonably achievable), due to the potentially adverse health effects. To achieve this, management measures aimed at avoiding and reducing contamination of food, e.g. weed control (removal/reduction), are required to reduce the presence of PAs in raw and processed food.

Pyrrrolizidine alkaloids as contamination in herbs or spices

With a few exceptions (e.g. borage), the plant species traded as herbs and spices are not known to form toxic PAs themselves. PA findings in products of the spice industry are classified as a contamination which may be caused by unintentionally harvested weeds or seeds containing PA.

In order to determine the status of PA levels in herbs and spices, ESA, together with national associations, collected data. The data so far show that spices growing on trees, as roots or as barks are unlikely to be affected. Mainly plants that grow near the ground in the fields, such as herbs or seeds, are vulnerable to contamination.

Inspections of fields showed that PA-containing weeds are not distributed evenly, but grow in “spots”, among crop plants itself or in nearby cultivated and non-cultivated areas.

The spice industry has identified potentially affected products and ESA supports companies and associations in the countries of origin in the education and training of growers in these areas. In the past years, the amount of PA have been reduced significantly.

ESA recognises the difficulties that growers face in controlling the risk of contamination by PA-producing weeds, as weed control measures need to be adjusted annually to reflect the natural variations of climate conditions.

ESA endorses the work of the Codex Alimentarius Commission in their Code of Practice and recommends the enhanced management practices at farm and primary processing stages.

EU maximum levels of pyrrrolizidine alkaloids in herbs and spices

EU Commission Regulation (EU) 2020/2040ⁱ of 11 December 2020 entered into force on July 1st, 2022 amending Regulation (EC) No 1881/2006 as regards maximum levels of pyrrrolizidine alkaloids in certain foodstuffs.

	Foodstuffs	Maximum Level [µg/kg]
8.4.8.	Borage leaves (fresh, frozen) placed on the market for the final consumer	750
8.4.9.	Dries herbs with the exception of the dried herbs referred to in 8.4.10.	400
8.4.10.	Borage, lovage, marjoram and oregano (dried) and mixures exclusively composed of these dried herbs	1000
8.4.11	Cumin seeds (seed spice)	400

The maximum values defined in the Contaminants Regulation refer to the sum of 21 pyrrrolizidine alkaloids and 14 co-eluting ("co-detected") pyrrrolizidine alkaloids.

Foodstuffs already placed on the market may remain on the market until the end of 2023 if they do not pose a health risk to the consumer. The use of a dehydration factor to evaluate the

analytical results of PA tests is not permitted, as the maximum levels have been defined for the already dried product.

Sampling for PA testing

Sampling is a crucial factor in obtaining reliable analytical test results. As PA-containing weeds occur as spot contamination, it is difficult to obtain a representative sample of the batch.

ESA recommends the sampling procedure defined in Regulation (EC) No 401/2006 ⁱⁱ Section E4 Sampling procedure for mycotoxins in spices, as the non-homogeneous distribution of mycotoxin contamination is very similar to that of PA compounds. The number of incremental samples depends on the weight of the specific batch.

Recommended method of analysis

The method recommended by ESA for the analysis of PA in herbs and spices is the BfR method for the determination of pyrrolizidine alkaloids (PA) in plant material by SPE-LC-MS/MS (2014).ⁱⁱⁱ The limit of quantification (LOQ) should be 10 ppb ($\mu\text{g}/\text{kg}$) or less for each substance.

Reduction of PA contamination in herbs and spices

The difficulty of controlling unintentional PA contamination shows a dimension that exceeds all previous standards of good agricultural practice for the cultivation of herbs and spices.

With regard to a general mitigation strategy for the risk of PA contamination, ESA members are continuously working on guidelines and information sheets for growers. Based on current knowledge and investigation, ESA endorses the work of the Codex Alimentarius Commission in their Code of Practice^{iv} and recommends the enhanced management practices at farm and primary processing stages to reduce and control the potential contamination of dried herbs and spices with PA.

To reduce the spread of PA-plants early detection and identification followed by action to prevent contamination of food, is essential.

PA-plants have to be identified in the different stages of growth. For establishing an integrated weed management system, it must be recognized how different PA-plants react to particular management measures. Therefore, it is important to keep the ecology of the specific plant in mind. Influences of weather or climate must be taken into account. Plants self-seed at a specific time or on contact. The plant has to be weeded out before that point in time.

In addition to the measures at agricultural level, every producer has to assess raw material and supplier specific risks and act accordingly within its food safety management system.

Actions have to be implemented "from farm to fork" to reduce the PA content in the finished products and to ensure safe products for consumers.

References

Commission Regulation (EU) 2020/2040 setting maximum levels of pyrrolizidine alkaloids in certain foodstuffs.

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R2040&from=EN>

ⁱⁱ Commission Regulation (EC) No 401/2006 laying down methods of sampling for the control of mycotoxins in foodstuffs.

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006R0401&from=DE>

ⁱⁱⁱ BfR method protocol (BfR-PA-Tea-2.0/2014)

<https://www.bfr.bund.de/cm/349/determination-of-pyrrolizidine-alkaloids-pa-in-plant-material.pdf>

^{iv} Codex Alimentarius Commission CAC/RCP 74-2014 Code of Practice for weed control to prevent and reduce pyrrolizidine alkaloid contamination in food and feed

<https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/>

