SciCom

Scientific Committee of the FASFC

Opinion 22-2018 of the Scientific Committee of the FASFC concerning action levels for chromium in fresh fruits and vegetables.

Background and question

The FASFC has been confronted with high levels of total chromium in samples of fresh vegetables analyzed during self-control by an operator. However, there are currently no legal standards for chromium in fresh vegetables (and fruits).
The Scientific Committee has been requested to propose action limits for chromium in fruits and vegetables in order to provide the FASFC a scientific basis in view of the protection of the safety of the food chain.

Chromium has various oxidation states (Cr^{3+} en Cr^{6+}) with each a different toxicity. Cr^{3+} is not very toxic, whereas Cr^{6+} is carcinogenic and genotoxic. Because of the different toxicity between Cr^{3+} and Cr^{6+}, the Scientific Committee is of the opinion that proposing action limits for total chromium in fruit and vegetables is of little relevance. That is why the Scientific Committee has calculated separate action limits for Cr^{3+} and Cr^{6+} in fruit and vegetables.

Method

The action limits for Cr^{3+} are calculated by dividing the tolerable daily intake (TDI) of Cr^{3+} by the consumption data at the 97.5^{th} percentile of each category of fresh fruit or vegetables considered. This method is described in the document "Inventory of actions and action limits and proposals for harmonization in the context of official controls - Part 1: Action limits for chemical contaminants" (FASFC, 2017).

In the particular case of Cr^{6+}, no TDI has been proposed by a recognized food safety authority (eg. EFSA or JECFA). Therefore, the Scientific Committee has calculated an “exposure level of low health concern for the consumer" by applying the Margin of Exposure (MoE). To propose action limits, this "exposure level of low health concern" was then divided by the P97.5 consumption data for the category of fresh fruits or vegetables considered.

These action limits were then evaluated for their relevance taking into account the chromium levels usually found in fresh fruit and vegetables.

Results and discussion

In foodstuffs (including fresh fruit and vegetables) Cr^{3+} is the most stable and the most common oxidation level, while in water and in soil contaminated by industrial activity Cr^{6+} is the most stable and the most common oxidation level.

Cr^{6+} can be present in food, but in very small quantities (in the order of µg/kg), because food is a reducing environment that promotes the conversion of Cr^{6+} to Cr^{3+}. This is certainly the case for fruit and vegetables.

For the precise determination of Cr^{3+} and Cr^{6+} in foodstuffs, it is therefore crucial that a suitable analysis method is used that takes into account the different oxidation levels (speciation). Otherwise, the measured levels are unreliable.

The calculated action limits range from 30 to 400 mg/kg for Cr^{3+} and from 15 to 100 µg/kg for Cr^{6+}, depending on the vegetable or fruit considered:

- Concerning Cr^{3+}, these action limits are much higher than the levels of total chromium found in fresh fruits and vegetables (whether Belgian (see Table 3) or European (EFSA, 2014b) data). Indeed, even considering the total chromium as being exclusively in Cr^{3+} state, the action limits of 30 to 400 mg/kg are never exceeded (the maximum levels observed by a Belgian operator and by the EFSA (2014b) are 6,3 mg/kg in broccoli and 1,1 mg/kg in chili pepper respectively). It therefore appears that dietary exposure to Cr^{3+} is not a risk for the consumer;
- Concerning Cr^{6+}, the amounts in foodstuffs reported in the scientific literature (measured through non-validated chemical analysis of Cr^{6+}) sometimes exceed the calculated action limits from 15 to 100 µg/kg. For example, in the case of fungi, the amounts of Cr^{6+} observed vary between 8,5 µg/kg and 813 µg/kg, while the calculated action limit is 30 µg/kg. However, the reliability of the measured Cr^{6+} levels in foodstuffs identified in the literature is questioned because of the reduction that occurs from Cr^{6+} to Cr^{3+} in organic medium and doubt about the precision of the chemical analysis method.

Conclusions

The Scientific Committee does not consider it appropriate to propose action limits for total chromium contained in fresh fruits and vegetables as Cr^{3+} and Cr^{6+} have largely deferring toxicities (Cr^{3+} is a low toxic, while Cr^{6+} is carcinogenic and genotoxic). The Scientific Committee has calculated action limits for Cr^{3+} and Cr^{6+} separately. They range from 30 to 400 mg/kg for Cr^{3+} and from 15 to 100 µg/kg for Cr^{6+}, depending on the vegetable or fruit considered.

For Cr^{3+}, these action limits are much higher than the levels of total chromium measured in fresh fruit and vegetables (both for the Belgian and European (EFSA, 2014b) data), so it seems that exposure to Cr^{3+} via the food does not pose a risk to the consumer.

As far as Cr^{3+} is concerned, the levels in food (measured via non-validated chemical analysis of Cr^{6+}) that are found in the scientific literature exceed the calculated action limits of 15 to 100 µg/kg. However, the reliability of the measured Cr^{6+} levels in foodstuffs identified in the literature is questioned because of the reduction that occurs from Cr^{6+} to Cr^{3+} in organic medium and doubt about the precision of the chemical analysis method.

The Scientific Committee therefore recommends to develop laboratory tests that can analyze Cr^{3+} and Cr^{6+} separately and to develop certified reference material, as well as to conduct scientific studies to estimate the ratio of Cr^{6+} and Cr^{3+} in fruit and vegetables.

The full text is available on this website in dutch and in french.