



Bisphenol F in mustard

Occurrence of bisphenol F in mustard

A Swiss producer of mustard informed the Swiss Federal Food Safety and Veterinary Office (FSVO) that quality controls showed bisphenol F in his products.

The laboratories of the FSVO confirmed these findings by own analyses. Bisphenol F was formed during production of mustard under controlled laboratory conditions, but only when seeds of white/yellow mustard (*Sinapis alba*, synonym *Brassica alba*) were used. With seeds of brown (*Brassica juncea*) or black mustard (*Brassica nigra*) no formation of bisphenol F was observed. White/yellow mustard is used for the production of mild mustard types, while brown and black mustard is used for spicy/hot mustards.

The laboratories of the FSVO subsequently analyzed 61 market samples of different types and brands of mustard. Bisphenol F was detected in 48 samples, the other 13 samples were below the detection limit of 0.01 mg/kg. The mean value of all samples was 1.84 mg/kg with a median of 1.3 mg/kg. The highest bisphenol F content of 8.35 mg/kg was found in a mild mustard. In general, high levels of bisphenol F were found predominantly in mild mustards, while in spicy/hot mustards mainly low levels were detected.

Formation of bisphenol F

Bisphenol F obviously is formed during mustard production from a natural ingredient of mustard grains. Based on the chemical structure of bisphenol F and in view of the differing composition of the mustard species it may be concluded that bisphenol F is formed from the glucosinolate glucosinalbin. Glucosinalbin only occurs in white/yellow mustard, but not in brown or black mustard, which would explain the different levels of bisphenol F in mild and spicy/hot mustard types.

The laboratories of the FSVO were able to show, that an acid like acetic acid, which is typically added as vinegar during production of mustard, is necessary for the formation of bisphenol F. Heat treatment of the mustard paste accelerated the formation of bisphenol F. In contrast, other ingredients like sugar, salt or curcuma had no effect.

The mechanism leading to the formation of bisphenol F has still to be unraveled in detail. But presumably, a dimerization of 4-hydroxybenzylalcohol or the reaction of similar cleavage products of glucosinalbin may be involved.

Absorption and excretion of bisphenol F

Analyses of the laboratories of the FSVO showed that bisphenol F contained in mustard is rapidly absorbed but not retained for a longer period in the human body. It is excreted completely via urine, almost exclusively in its glucuronidated form. The highest concentration in urine is reached after 2 to 3 hours. Base line levels are reached again after a further few hours.

Margin of exposure

The FSVO concluded that in view of the available data regarding the toxicity of bisphenol F it would not be appropriate to deduce a tolerable daily intake (TDI) value. Instead, the Margin of Exposure (MOE) approach was applied.

For the determination of the MOE, the LOAEL (Lowest Observed Adverse Effect Level) of 20 mg/kg bodyweight/day observed in a subacute study in rats was used. A factor of 3 for the extrapolation from LOAEL to NOAEL (No Observed Adverse Effect Level), a factor of 6 for the extrapolation from subacute to chronic toxicity and a standard factor of uncertainty of 100 was applied. The ratio of human exposure to the lowest LOAEL determined should thus be at least 1'800.

Consumption estimates

Information on typical portion sizes of mustard are available from a pilot study on food consumption in Switzerland: The mean single portion size was 8.12 g, the median 4.53 g, and the largest single portion was 65 g. The maximum amount of mustard consumed per day was 88 g. Based upon the market situation (in particular domestic production, imports and exports) the FSVO estimates that the average daily consumption of mustard is between 1 and 2 g per person.

Risk assessment of bisphenol F in mustard

Based upon the LOAEL of 20 mg/kg bodyweight/day found in a subacute oral study in rats, a person would have to consume 80 g of mustard with the highest observed concentration of bisphenol F of 8.35 mg/kg to pass the postulated MOE of 1'800. This would, however, represent an extraordinarily high daily consumption, which would be very much higher as the average daily consumption of mustard in Switzerland. In addition, the FSVO is not aware of any evidence or epidemiological study suggesting adverse/detrimental effects of elevated consumption of mustard.

Based upon the current state of research and scientific knowledge, the FSVO thus considers the risk of bisphenol F in mustard produced from seeds of white/yellow mustard for the health of consumers as low.

In contrast to bisphenol A, bisphenol F in mustard is not derived from synthetic materials, packaging or other anthropogenic sources of contamination, but is presumably formed during production of mustard from naturally occurring glucosinabin. This unexpected and surprising finding sheds new light on the risk linked to the family of bisphenols.

Further information

A short report on bisphenol F (available in German and French) can be downloaded from the web pages of the FSVO:

<http://www.blv.admin.ch/themen/04678/04711/06141/index.html?lang=de>

<http://www.blv.admin.ch/themen/04678/04711/06141/index.html?lang=fr>