



## **Antimony in Foodstuffs – Literature Review and Consumer Risk Assessment**

*Ursina Morgenthaler, Institute of Geography, University of Bern*

*Beat Brüscheiler, Federal Food Safety and Veterinary Office*

*Adrien Mestrot, Institute of Geography, University of Bern*

### **Key words**

Antimony, food, occurrence, exposure, risk

### **Aim of the study**

This study aimed to produce a comprehensive review of published data and Swiss enforcement laboratory analyses on antimony (Sb) concentrations in foodstuffs, their sources, speciation, and potential health risks to consumers.

### **Material and methods**

The data on antimony values in foodstuff was collected from a thorough and extensive survey of scientific as well as grey literature. Some data was also obtained directly through the Federal Food Safety and Veterinary Office. The data was then checked and only data with valid quality control were reported and visualized.

### **Results and significance**

**Toxicology, Speciation, and Guidelines** - Sb toxicity depends strongly on its chemical form. Trivalent Sb (SbIII) is more toxic than pentavalent Sb (SbV), with potential gastrointestinal, developmental, cardiovascular, genotoxic, and carcinogenic effects. Other Sb species are poorly studied. The WHO's tolerable daily intake (TDI) is 6 µg/kg bodyweight/day, while the US EPA's reference dose is more conservative at 0.4 µg/kg/day. Legal limits for Sb in food are rare; Switzerland and the EU have none, though both regulate Sb migration from food contact materials (40 µg/kg food) and set drinking water limits (5-10 µg/L).

**Sources of Dietary Exposure** - Food contamination can occur via environmental uptake (soil, irrigation water), processing, or leaching from Sb-containing packaging (notably PET). Total diet studies (TDS) in multiple countries show generally low Sb levels in most foodstuffs, with higher exposures in infants due to their greater intake relative to body weight. Elevated exposures are mainly found in populations near Sb-contaminated sites.

**Findings by Food Category** - The review found that Sb levels in most food categories are generally low with a few exceptions. Grains and grain products typically contain minimal Sb unless grown in contaminated areas, while vegetables and legumes are usually low but sometimes present high outliers, particularly in leafy greens, dried onions and garlic, or mung beans. Fruits consistently show negligible levels, and beverages, including water and juices, are generally safe. Mushrooms, can accumulate significant amounts of Sb and contribute substantially to the tolerable daily intake for frequent consumers. Sb concentrations in game meat are highly variable due to contamination from bullet fragments, which can pose a significant risk. Some dairy products - particularly whey - can approach tolerable intake levels for infants. Other categories such as meat, fish, eggs,

herbs, and composite foods are mostly low risk, though occasional high concentrations in spices, honey, or seafood from polluted waters warrant attention.

Risk Assessment for consumers in Switzerland - Using Swiss consumption data, cumulative Sb intake from all foods is estimated at 49 µg/day (11.5% TDI) for average consumers and 153 µg/day (36% TDI) for high consumers—well below the WHO-TDI. However, these are upper-bound estimates assuming maximum reported concentrations. Risk is negligible for most foods, but mushrooms, game meat, and certain dairy products can reach levels of concern for specific consumer groups.

Key Knowledge Gaps & Recommendations - The report highlights several knowledge gaps. Analytical methods for Sb lack standardization, and high detection limits hinder accurate comparisons across studies. Speciation data are scarce, limiting the ability to accurately assess the risk based on the more toxic trivalent form. There is a need for targeted monitoring of high-risk foods such as mushrooms, game meat, and whey, as well as investigation into the sources of occasional high outliers in vegetables and legumes. Understanding whether contamination arises from environmental exposure, processing, or packaging is essential, and ongoing surveillance of Sb migration from food contact materials could inform future regulatory measures.

Overall Conclusion - For the general Swiss population, dietary Sb exposure is well below health-based guidance values. However, specific foods and consumer groups—notably wild mushroom foragers, high consumers of game meat, and infants consuming whey-based formula—may face elevated risks. Addressing analytical gaps, expanding speciation studies, and targeted surveillance of high-risk foods are essential to ensure continued consumer safety.

#### **Publications, posters and presentations**

None so far.

***Project 4.24.06***

***Project duration 9 months***