Opinion on certain aromatic hydrocarbons present in food (expressed on 20/1/1999)

Terms of Reference

The Committee was requested to undertake a toxicological evaluation of five aromatic hydrocarbons benzene, toluene, xylene, ethylbenzene and styrene in the context of risk to public health arising from dietary exposure with particular reference to olive oil.

Background

A problem arose in internal Community trade as a consequence of the alleged presence of trace amounts of certain aromatic hydrocarbons with particular reference to olive oil. The Commission services organized a "Workshop on the presence of aromatic hydrocarbons benzene, ethylbenzene, xylene, toluene and styrene in the foodstuffs and particularly in olive oils in the European Union" (Brussels, 15 May 1996) [1], whose proceedings are available. To assist the Commission in the framework of Regulation 315/93, the SCF was requested to provide an initial evaluation of risk to human health arising from dietary exposure to the substances in question.

Exposure

Single-ring aromatic hydrocarbons are widely distributed in the environment and can also be present in food naturally and/or as contaminants.

Benzene can be synthesized naturally in some plants and can therefore be present in some foods; it also has been reported as a contaminant in foods. Concentrations reported are in the range of 1 to 40 g/kg in meat and meat products, fish and fish products, fruit and nuts; in the case of coffee up to 150 g/kg [2]. In a survey conducted in the UK concentrations in other foods, including oils and fats, were below the limit of detection of 1 g/kg. The average UK dietary intake of benzene was estimated to be in the range of 0.5-2.4 g/person/day [3].

Human exposure to benzene most commonly occurs via inhalation (99.9 %) [3]; exposure from ambient and indoor air has been estimated to be at about 90 g/day (Canada) and 180-1300 g/day (USA) [4].

Toluene has been reported as a contaminant in meat, poultry, fish, oils and fats, and milk products with levels from 6 to 76 g/kg; in the case of coffee up to 350 g/kg [2]. In a UK survey the average dietary intake was estimated to be 7.7 g/person/day, with the largest contributions to this intake being made by milk (14 % of total), milk products (13 % of total) and beverages (12 % of total) [3]. The average daily exposure by inhalation from ambient air has been estimated to be 106 g [6].

Xylenes have been reported as contaminants in meat, fish, nuts and in fatty foodstuffs. The average concentrations were low and in many cases below the limit of determination (2 g/kg); in the case of coffee values range up to 210 g/kg and in the case of tea up to 500 g/kg [2]. Concentrations of p-/m-xylenes have been found in meat products, poultry and fish up to 34 g/kg and of o-xylene up to 19 g/kg. An average UK dietary intake of xylenes was estimated to be less than 5 g/person/day [3].

The average daily intakes of o-, m- and p-xylene by inhalation from ambient air have been estimated to be 106 g, 176 g and 71 g respectively [5]. The daily exposure through inhalation has been estimated to be 70 g in rural areas and < 2000 g in urban areas [6].

Ethylbenzene is widely distributed in the environment, particularly in the ambient air, and has been reported as a contaminant in fish, meat, oils and fats, and nuts up to 10 g/kg [5]; in some samples of cheese, muscat grape and in the herb dill concentrations reported were in the range from 70 to 1000 g/kg [2]. In 1995 average dietary intakes of 0.3 g/day (lower bound of estimate) and 4.2 g/day (upper bound of estimate) were estimated in the UK [5]. Another estimation in the UK in 1996 mentioned 3.9 g/day as an average dietary intake and a high level dietary intake of 6.5 g/day [1]. The average daily exposure by inhalation from ambient air has been estimated to be 843 g [4].

Styrene occurs naturally in various types of fruit in quantities at about 0.1 g/kg and has also been reported as a contaminant in some foods [1]: in the case of coffee up to 360 g/kg and beer up to 200 g/kg [2]. The average dietary intake of styrene in the UK was estimated to be in the range of 1 to 4 g/person/day [7].

As far as olive oil is concerned, few data exist; some studies were presented at the EU Workshop in 1996 [1,2]. In addition, a recent study was carried out in the laboratory of the Government s Chemist, Athens [8], which provided results similar to those reported earlier. In the case of benzene values reported in a German study [1] carried out on a number of samples not specified were below 10 g/kg (67 % of the 1994 samples and 90 % of the 1995 samples). Values reported in a French study [1] carried out in 1994 on 53 samples range from 0.1 to 294 g/g (94 % below 100 g/Kg, 91 % below 25 g/kg and 66 % below 10 g/kg). A recent Greek study [8], carried out on 108 samples, reported values ranging from 0 to 158 g/kg (98 % below 100 g/kg, 97 % below 25 g/kg and 65 % below 10 g/kg).

In the case of toluene the German study reported that 30 % and 90 % of the 1994 samples and 55 % and 99 % of the 1995 samples were below 10 and 180 g/kg respectively. The French study reported values ranging from 14 to 174 g/kg (90 % below 150 g/kg, 65 % below 100 g/kg and 26 % below 50 g/kg). In the recent Greek study values reported range from 85 to 139 g/kg (99 % below 100 g/kg, 73 % below 50 g/kg).

In the case of xylenes the German study reported that 30 % and 90 % of the 1994 samples were below 10 and 280 g/kg respectively, and 82 % of the 1995 samples were below 280 g/kg. The French study reported the following data:

in the case of o-xylene the values range from 5 to 102 g/kg (95 % below 100 g/kg, 60 % below 50 g/kg and 17 % below 25 g/kg); for p- and m-xylene the values range from 11 to 548 g/kg (15 % below 50 g/kg and 45 % below 100 g/kg). The recent Greek study reported values of xylene (sum od o-, m- and p-isomers) ranging from 18 to 415 g/kg (94 % below 150 g/kg, 77 % below 100 g/kg, 40 % below 50 g/kg).

For ethylbenzene the German study reported that 68 % of the 1994 samples and 79 % of the 1995 samples were below 10 g/kg. The French study [1] reported values ranging from 3 to 95 g/kg (89 % below 50 g/kg, 18 % below 25 g/kg). The recent Greek study [8] reported values ranging from 0 to 50 g/kg (96 % below 25 g/kg, 62 % below 10 g/kg).

In the case of styrene, the German study reported that 25 % and 72 % of the 1994 samples and 35 % and 93 % of the 1995 samples were below 10 and 640 g/kg respectively. The recent Greek study reported values ranging from 6 to 60 g/kg (84 % below 25 g/kg and 27 % below 10 g/kg).

The SCF notes that no officially agreed assay methods exist. Since the studies were carried out in different laboratories, using different methods comparisons are difficult to make. However they are useful in giving a general picture.

Limits

For toluene, WHO [4,9] derived a TDI of 223 g/kg b.w. using a LOAEL for marginal hepatotoxic effects of 312 mg/kg b.w. per day (5 days/week) in a 13-week gavage study in mice and applying an uncertainty factor of 1000. On this basis a guideline value for drinking water of 700 g/l (rounded figure) was derived, allocating 10 % of the TDI to drinking water and assuming a daily consumption of two litres and a body weight of 60 kg [9]. Similarly, the SCF has taken one tenth of the TDI for exposure via food contact material. This has led to a specific migration limit of 1.2 mg/kg food.

For xylene, a TDI of 179 g/kg b.w. was derived by WHO [4] in 1993, from a NOAEL of 250 mg/kg b.w. per day (5 days/week) based on a decreased body weight at 500 mg/kg b.w. per day in a 103-week gavage study in rats and applying an uncertainty factor of 1000: On this basis, a guideline value for drinking water of 500 g/l (rounded figure) was derived, allocating 10 % of the TDI to drinking water. Using similar considerations, the SCF [9] derived a specific migration limit of 1.2 mg/kg food.

For ethylbenzene, a TDI of 97.1 g/kg b.w. was derived by WHO [4,9], from a NOAEL of 136 mg/kg b.w. per day (5 days/week), based on hepatoxicity and nephrotoxicity at 400 mg/kg b.w. per day in a limited 6 months study in rats, and applying an uncertainty factor of 1000: On this basis, a guideline value for drinking water of 300 g/l (rounded figure) was derived, allocating 10 % of the TDI. Similarly, the SCF derived a specific migration limit of 0.6 mg/kg food.

In the case of benzene, TDI s or restriction levels have not been established by WHO or SCF because benzene is a human carcinogen. WHO [4] derived concentrations in drinking water of 100, 10 and 1 g/l, corresponding to excess lifetime cancer risk of 1×10^{-4}, 1×10^{-5}, and 1×10^{-6}, respectively and recommended a guideline value for drinking water of 10 g/l.

For styrene, WHO [4,9] used a TDI of 7.7 g/kg body weight and calculated (allocating 10 % of the TDI to drinking water) a guideline value for drinking water of 20 g/l.

Although the SCF has not yet allocated a restriction level for styrene, it could be used as monomer for food packaging materials, provided that its residues are reduced as much as possible [10].

Conclusion

Based on the limited data presently available, the SCF considers it unlikely that intakes of benzene, toluene, xylenes, ethylbenzene and styrene via food, including olive oil, at the contamination levels reported to the Committee would contribute significantly to the risk to human health from other sources. In general, intakes from other sources, especially via inhalation, are more important. In order to ensure that sporadic high contaminations of food, especially with respect to benzene, is minimized, further studies are recommended on the origin of the substances as well as on the analytical methods.

References

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