Opinion of the Scientific Panel on Food Additives, Flavourings, Processing Aids and Materials in Contact with Food (AFC) on

hydrocyanic acid in flavourings and other food ingredients with flavouring properties

Question No EFSA-Q-2003-0145

Adopted on 7 October 2004

SUMMARY

The Scientific Panel on Food Additives, Flavourings, Processing Aids and Materials in Contact with Food is asked to evaluate substances used as flavourings or present in flavourings or present in other food ingredients with flavouring properties. In particular, the Panel is asked to advise the Commission on the implications for human health of hydrocyanic acid (HCN) in the diet.

The Panel noted that cyanogenic glycosides present in plants, as sources of hydrocyanic acid, are relatively non-toxic until HCN is released. This can occur as a result of enzymatic hydrolysis by β-glucosidases following maceration of plant tissue, or by the gut microflora. Depending on the specific glycosides the hydrolysis products can be, besides sugar moieties and HCN, benzaldehyde (for amygdalin, prunasin, sambunigrin,), p-hydroxybenzaldehyde (for dhurrin) and acetone (for linamarin). The potential toxicity of a cyanogenic plant depends primarily on its capacity to produce HCN.

The Panel noted further that:

1. Following oral administration, HCN is readily absorbed and rapidly distributed in the body via the blood.

2. HCN absorbed from the gut is metabolically converted to the less toxic thiocyanate. Other detoxification pathways include combination with vitamin B_{12} or some sulphur-containing amino acids. Acute toxicity results when the rate of absorption of HCN is such that the metabolic detoxification capacity of the body is exceeded.

3. Cases of human intoxication and chronic neurological effects have occurred from the ingestion of processed plants. This is particularly apparent when processing practices change as a result of trading practices or uncertain food supply.

4. The cyanide ion inhibits enzymes associated with cellular oxidation and causes death through energy deprivation. The symptoms, which occur within a few minutes, may include constriction

of the throat, nausea, vomiting, giddiness, headache, palpitations, hyperpnoea then dyspnoea, bradycardia, unconsciousness and violent convulsions, followed by death.

5. The occurrence of intoxication symptoms depends upon the rapidity of the increase in HCN concentration in the tissues. In the case of cyanogenic glycosides, the route of exposure, the nature of the cyanogenic compound, the dose, and the ability of the organism to detoxify cyanide determine the symptoms.

6. The available toxicity data show that cyanogenic glycosides from certain plants could produce acute toxic effects. Thus fatalities have occurred from e.g. consumption of stone fruit kernels.

7. The chronic uptake of HCN, in sub-acutely toxic doses, may be involved in the pathogenesis of certain conditions including disturbance of thyroid function and neuropathies. The thyrotoxic effects of cyanide depend on its conversion to the iodine antagonist, thiocyanate.

8. Human cassava-eating populations showed ophthalmological and neurological symptoms which are associated with exposure to HCN, though it is likely that other nutritional or metabolic deficiencies affecting the cyanide detoxification mechanism are also involved (e.g. sulphate and zinc deficiencies).

9. Several epidemiological studies in cassava-eating populations, which established an association between cyanide exposure and spastic paraparesis, amblyobia ataxia or tropical ataxia neuropathy (TAN) and possibly goitre have also been considered. However, the data are highly confounded by other nutritional and environmental factors. Adequate long-term toxicity studies in animals fed a diet containing HCN or cyanogenic glycosides are also lacking.

10. Limited data from the UK show that the average and high (97.5^{th} percentile) daily intake of HCN from its use in flavours or flavour ingredients were 46 and 214 μg/person, which correspond to approximately 0.8 and 3.6 μg/kg bw/day respectively.
Data of from a Norwegian dietary survey show that the average and high (97.5^{th} percentile) daily intake of HCN among consumers amounts to respectively 95 and 372 μg/person or 1.4 and 5.4 μg/kg bw/day.

Cassava flour is used as a staple food mainly outside Europe; a consumption of 200 g/person would lead to an estimated intake level of 30 μg HCN/kg bw for a 60 kg adult. In accordance with the JECFA view such an intake would not be associated with acute toxicity. The highest level of HCN found in retail marzipan paste is 20 mg HCN/kg. Assuming on one sitting a person of 60kg consumes 100 g marzipan containing such a level, that intake would be equivalent to 2 mg HCN or to 0.03 mg/kg bw.

The Panel concluded that the current exposure to cyanide from flavouring ingredients (97.5^{th} percentile) is unlikely to give rise to acute toxicity. For chronic exposure the overall data were not considered adequate to establish a numerical no-observed-adverse-effect level (NOAEL) or Tolerable Daily Intake (TDI) in humans. In view of the lack of adequate data on chronic toxicity, the Panel supports the continued application of limits for the presence of HCN in foods and beverages.

KEY WORDS
Hydrocyanic acid, Prussic acid, Cyanide, Amygdalin, Linamarin, Prunasin, Flavourings