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Safety Assessment of Food Flavor - Cinnamaldehyde

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A flavor is a substance which may be a single chemical entity or a blend of chemicals of natural or synthetic origin whose primary purpose is to provide all or part of the particular flavor or effect to any food or other product taken orally. Food flavorings are an essential element in foods. Flavoring substances can be divided into artificial flavoring substances and nature-identical flavoring substances. Artificial flavoring substances are those substances which have not yet been noticed in natural products whereas nature identical flavoring substances are present in natural products intended for human consumption. Toxicological studies on flavoring compounds should be made according to necessity and adequacy. If a substance is consumed at high levels and there is no previous experience, with its use or it does not occur naturally in food, more direct toxicological data are essential [1,2]. The interpretation of toxicological tests requires the determination of a dosage level at which no adverse effects are observed.Aldehydes occur as natural (flavoring) constituents in a wide variety of foods and food components. They have been grouped into saturated aldehydes (e.g., formaldehyde, acetaldehyde), α, β- unsaturated aldehydes (e.g., acrolein and crotonaldehyde), and aldehydes containing a second functional group (e.g., furfural, cinnamaldehyde).

Cinnamaldehyde occurs naturally in Chinese cinnamon oil from the leaves and twigs of *Cinnamomum cassia* Blume. It has also been identified in Sri Lanka, Seychelles, and Japanese (*Cinnamomum loureirii* Nees) cinnamon bark and in other cinnamon species in varying amount. Thus, the genus *Cinnamomum* becomes the major source of cinnamaldehyde. We can notice various species of the genus *Cinnamomum* in Madagascar, Myanmar, Vietnam, Cambodia; Laos, Indonesia, Sumatra and Malaysia [3]. Cinnamaldehyde is a pale yellow liquid with a warm, sweet, spicy odor and pungent taste reminiscent of cinnamon. It has the following properties: mp-7.5°C; bp 252°C at 101 kPa (760 mm Hg), with partial decomposition, bp 128- 130°C at 2.7 kPa (20 mm Hg); specific gravity at 20°C: 1.1102; refractive index at 20°C: 1.61949. It is oxidized to cinnamic acid when exposed to air [4]. Cinnamaldehyde is widely used as a flavoring agent with a maximum permitted levels as high as 6400 ppm in fruits and juices, 3500 ppm in baked goods, 2200 ppm in breakfast cereals, 2000 ppm in baby food and desserts, and 1100 ppm in chewing gum. Cinnamaldehyde is also used as a fragrance in cosmetics, soaps and detergents. Cinnamaldehyde is often used as a stomachic, an antipyretic and an antiallergic drug and as a tonic in traditional Chinese medicines [5,6].

The acute toxicity of cinnamaldehyde is relatively low, with LD50 values ranging from 0.6 to more than 2 g/kg in various species. The LD50 of cinnamaldehyde in white rats, white mongrel mice and guinea pigs was reported as 3.4 g/kg. The LD50 of cinnamic aldehyde in mice by the ip route was reported as 2.318 g/kg. The acute dermal LD50 in rabbits was reported as 0.59 ml/kg by Shelanski [7-10]. Cinnamaldehyde in toothpaste could be the reason for allergic contact dermatitis and allergic contact stomatitis. North American Contact Dermatitis Research Group suggested that cinnamaldehyde might be a frequent cause of allergic reactions to perfumes [11-15].

Cinnamaldehyde is a widely used flavoring agent, and some 180,000 kg of it is consumed each year in foods, 39,000 kg from the use of cinnamon and 141,000 kg deliberately added as a flavor. It has been estimated that 95% of its consumption is as a flavoring material and that its usage will grow by about 3% per year over the next 5 years [16,17]. Thus, cinnamaldehyde has a high potential for human consumption in the world. FEMA (The Flavor and Extract Manufacturers' Association of the USA) has given GRAS (Generally Recognized as Safe) status for cinnamaldehyde. Cinnamaldehyde is also approved for use by the Food and Drug Administration of the United States. The Joint FAO/WHO Expert Committee on Food Additives at first set an Acceptable Daily Intake (ADI) of 1.25 mg/kg body weight. The World Health Organization has established a temporary ADI of 0.7 mg/kg body weight [18-20]. From our studies, we suggest that WHO should lower the suggested ADI level (0.7 mg/kg body weight) for cinnamaldehyde [21-25]. The Council of Europe included cinnamaldehyde in the ADI of 1.25 mg/kg for total cinnamyl compounds. RIFM (Research Institute for Fragrance Materials) has observed its potential for sensitization and limited the use in perfumes for skin contact at 1% in the formula. Eugenol and limonene have been in conjunction with cinnamaldehyde as quenchers to neutralize the irritation reaction that some individuals have towards it [4,7,26]. In this context, regulatory agencies, researchers and policy makers may need to pay more attention to the possible toxicity of food flavorings.

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