

**Evaluation of
Cardamom seed oil
for Use as a Cigarette Ingredient**

December 2005

INTRODUCTION

Cardamom seed oil (CAS # 8000-66-6) is currently used worldwide at levels below **5 ppm** in selected cigarette brands manufactured and/or distributed by Philip Morris International. This document is a review of current published toxicology information of cardamom seed oil abstracted from online toxicity databases.

TOXICITY DATA ON UN-BURNED MATERIAL

The following information was generated from the MICROMEDEX database tool <http://csi.micromedex.com> on December 6th 2005, unless otherwise indicated.

Overview

Cardamom seed oil is obtained naturally from dried ripe seeds of *Elettaria cardamomum*. The essential oil (2-8%) contains eucalyptol (cineol), sabinene, *d,α*-terpineol and acetate, borneol, etc. The fixed oil (1-2%) consists of glycerides of oleic, stearic, linolenic, palmitic, caprylic and caproic acids. It is used in the flavouring of liqueurs¹.

As a food flavouring additive, the material has been assessed under the provisions of the *Federal Food, Drug and Cosmetic Act, section 201 (s)*, by the Expert Committee of the USA Flavour and Extract manufacturer's Association (FEMA), to be generally recognized as safe (GRAS) under current conditions of use.

Cardamom seed oil is a common cosmetic ingredient.

This material appears on the list of "Permitted Additives to Tobacco Products in the United Kingdom" (Department of Health, 2003) at a maximum level permitted for inclusion in cigarettes of 0.15 % w/w tobacco.

The following information was generated from the RTECS – Registry of Toxic Effects of Chemical Substances, a database of MICROMEDEX Systems (<http://csi.micromedex.com>) on December 6th 2005.

Health hazard data

Acute toxicity

LD50/LC50 - LETHAL DOSE/CONC 50% KILL

Rat

LD50 - ROUTE: Oral; DOSE: 5 gm/kg [Food and Cosmetics Toxicology. (London, UK) V.1-19, 1963-81. For publisher information, see FCTOD7. (12,837,1974)]

Rabbit

LD50 - ROUTE: Skin; DOSE: >5 gm/kg [Food and Cosmetics Toxicology. (London, UK) V.1-19, 1963-81. For publisher information, see FCTOD7. (12,837,1974)]

¹ The Merck index, an encyclopedia of chemicals, drugs, and biologicals ; eleventh edition, 1989

Genetic effects

DNA REPAIR

Bacteria - B Subtilis

DOSE: 19 mg/disc [Shokuhin Eiseigaku Zasshi. Food Hygiene Journal. (Nippon Shokuhin Eisei Gakkai c/o Shokuhin Eisei Senta, 2-6-1 Jingumae, Shibuya-ku, Tokyo 150, Japan) V.1- 1960-(25,378,1984)]

MUTATIONS IN MICROORGANISMS

Bacteria - E Coli

DOSE: 2500 ng/plate (-S9) [Kanagawa-ken Eisei Kenkyusho Kenkyu Hokoku. Bulletin of Kanagawa Prefectural Public Health Laboratories. (Kanagawa-ken Eisei Kenkyusho, 52-2, Nakao-cho, Asahi-ku, Yokohama 241, Japan) No.1- 1971- ((9),11,1979)]

Bacteria - S Typhimurium

DOSE: 2500 ng/plate (+S9) [Kanagawa-ken Eisei Kenkyusho Kenkyu Hokoku. Bulletin of Kanagawa Prefectural Public Health Laboratories. (Kanagawa-ken Eisei Kenkyusho, 52-2, Nakao-cho, Asahi-ku, Yokohama 241, Japan) No.1- 1971- ((9),11,1979)]

TOXICITY DATA ON BURNT MATERIAL

Data on the toxicity of cardamom seed oil after combustion has been evaluated in a series of studies. The results of these studies may be found in the following references:

E.L. Carmines, 2002, "Evaluation of the Potential Effects of Ingredients Added to Cigarettes. Part I: Cigarette Design, Testing Approach and Review of Results" Food and Chemical Toxicology, 40:77-91. **PEER REVIEWED**

K. Rustemeier et al, 2002 "Evaluation of the Potential Effects of Ingredients Added to Cigarettes Part II. Chemical Smoke Composition" Food and Chemical Toxicology, 40:93 - 104. **PEER REVIEWED**

Roemer et al., 2002 " Evaluation of the Potential Effects of Flavor Ingredients Added to Cigarettes. Part 3. In Vitro Genotoxicity and Cytotoxicity" Food and Chemical Toxicology, 40:105-111. **PEER REVIEWED**

P.M. Vanscheeuwijck et al, 2002 " Toxicological Evaluation of Cigarettes without and with the Addition of Flavor Ingredients to the Tobacco. Part 4. Subchronic Inhalation Toxicity" Food and Chemical Toxicology, 40:113-131. **PEER REVIEWED**

Gaworski et al, 1998, "Toxicological evaluation of flavor ingredients added to cigarette tobacco: 13-week inhalation exposure in rats" Inhalation Toxicology, 10:357-381. **PEER REVIEWED**

Gaworski et al, 1999, "Toxicological evaluation of flavor ingredients added to cigarette tobacco: skin painting bioassay of cigarette smoke condensate in SENCAR mice" Toxicology, 139 1-17. **PEER REVIEWED**

These studies indicate that chemicals used in the production of cigarettes do not increase the overall toxicity of cigarette smoke.

DATA ON THE EFFECTS ON HUMAN HEALTH

In a maximization test in 25 male volunteers, a concentration of 4% of cardamom seed oil in petrolatum produced no sensitization reactions (Kligman, 1973). In a study of 25 workers in a spice factory, one worker was positive to cardamom on patch-test (Meding, 1993). In control test on 22 dermatitis patients without occupational exposure, one patient reacted to cardamom. No phototoxic effects were reported for cardamom seed oil (Urbach and Forbes, 1972).

Kligman, A.M. (1973) Report to RIFM, 13 June. (Cited in Opdyke, 1979).
Meding, B. (1993) Skin symptoms among workers in a spice factory. *Contact Dermatitis* 29:202-205.
Urbach, F. and Forbes, P.D. (1973) Report to RIFM, 8 February. (Cited in Opdyke, 1979).
Opdyke, D.L.J. (1979). *Monographs on Fragrance Raw Materials. Cardamom Oil*, pp. 180-181.

CONCLUSION

Cigarette smoking causes lung cancer, heart disease, emphysema and other serious diseases in smokers. Smokers are far more likely to develop serious diseases, like lung cancer, than non-smokers. There is no "safe" cigarette. Government health warnings about smoking apply to all cigarettes, regardless of the ingredients added, including those containing only tobacco and paper.

While Philip Morris International has not conducted human studies on the health effects of ingredients used in cigarette manufacture, studies have been conducted using scientifically accepted in vitro and in vivo toxicity assays with various ingredient mixtures (see Toxicity Data on Burnt Material above). These studies show there is no meaningful difference in the composition or toxicity of smoke when the smoke from cigarettes with added ingredients is compared to the smoke from cigarettes without added ingredients. These findings are supported by similar studies from the published literature. It is our scientific judgment, based on the best available data, that cardamom seed oil used in our cigarettes does not increase the overall toxicity of cigarette smoke.