Safety Assessment of Coriander Seed Oil

Name of Applicant: Nestec Ltd.

Contact person(s): Nigel Baldwin, Intertek Cantox

Novel Food Classification: 2.1.

Introduction

An application for the authorisation of oil derived from coriander seed (*Coriandrum sativum L.*) was submitted to the Food Safety Authority of Ireland (FSAI) by Nestec Ltd. in accordance with *Article 4* of the novel food Regulation (EC) No. 258/97. The application was accepted by the FSAI on July 21st, 2011.

Coriander Seed Oil (Type C) is rich in mono-unsaturated fatty acids and is derived from coriander seed by solvent extraction. The applicant intends marketing coriander seed oil in food supplements to be consumed at levels of 600 mg daily.

Coriander seed oil is a novel ingredient within the category of "Foods and food ingredients consisting of or isolated from plants and food and food ingredients isolated from animals, except for foods and food ingredients obtained by traditional propagating or breeding practices and having a history of safe food use", as per *Article 1.2(e*) of the novel food Regulation. The application dossier was prepared pursuant to Commission Recommendation 97/618/EC and in order to assess wholesomeness, coriander seed oil is considered in Class 2.1.; "Complex Novel Food from non-GM sources - the source of the novel food has a history of use in the Community".

I. Specification of the novel food

The novel ingredient is a triglyceride oil particularly rich in the mono-unsaturated fatty acid petroselenic acid (C18:1 cis-6) (60-75%). It also contains relatively minor proportions of other fatty acids including linoleic acid, oleic acid, palmitic acid and stearic acid. The shelf life of the novel ingredient is 12 months under light-restricted

airtight conditions at a temperature of 20° C or less, though final data on stability will not be available until 2012.

II. Effect of the production process applied to the novel food

The production process for the novel ingredient involves mechanical pressing of the seed followed by extraction with hexane. Hexane is an extraction solvent permitted for use in food production as long as residues in the final food do not exceed 1mg/kg. The crude oil is then refined and stabilised using standard protocols and materials.

III. History of the organism used as the source of the novel food

Non-GM seeds of *Coriandrum sativum* L. are purchased from Bulgaria. The fruit and leaf of *Coriandrum sativum* L. have a history of consumption in the EU while distilled essential oil of coriander has been used as a food and fragrance for more than a century.

IV. – VIII.

Non-GM seeds of *Coriandrum sativum* L. are used and therefore these sections are not applicable.

IX. Anticipated intake/extent of use of the novel food

The applicant intends to market the novel ingredient in food supplements at levels that would not exceed 600mg/day (200mg tablets three times daily) which is equivalent to 10mg/kg bw/day for a 60kg individual. The supplements are not intended to replace any other food in the diet and are to be labelled appropriately. Background intake of coriander seed oil from natural sources was estimated using UK consumption data and on the basis that the oil represented approximately 20.4% of total seed weight. Proposed consumption levels of the novel ingredient (600mg/d) are approximately twenty times greater than the average intake of coriander seed oil from the diet (28.4 mg/person/day, consumers only) but only three times the estimated highest intake from the diet (230 mg/person/day). In a 'worst case scenario' the combined intake from the diet and coriander seed oil supplements is estimated to be approximately 830 mg/day. It is noted that some of the UK consumption data could be considered dated, e.g. 1992-3 for teenagers but is still of value.

X. Information from previous human exposure to the novel food or its source

Coriander seed oil does not have a history of consumption within the EU. However coriander has been cultivated in the EU for a considerable number of years with whole and ground seeds used in seasoning and as an ingredient in curry powder. Though there is a potential for allergenicity or sensitisation as a result of the consumption of, or contact with coriander, there have been no reports of such reactions to coriander seed oil, which is essentially free of protein.

XI. Nutritional information on the novel food

Coriander seed oil is intended for use in food supplements to impart purported benefits on skin and hair. The primary constituent of coriander seed oil is the monounsaturated fatty acid petroselenic acid (60-75%) along with minor proportions of other fatty acids including of linoleic acid, oleic acid, palmitic acid and stearic acid. There is relatively little information provided by the applicant on the nutritional impact of coriander seed oil or its primary constituent petroselenic acid.

XII. Microbiological information on the novel food

The microbiological status of the novel food is satisfactory and supported by batch test results.

XIII. Toxicological information on the novel food

There are few studies relating specifically to the safety of coriander seed oil. This is in contrast to the substantial number of studies carried out on the distilled essential oil of coriander seeds. The safety of the novel ingredient is primarily based on the history of safe use of coriander seeds as a culinary ingredient forming a normal part of the diet. This is supported by data submitted by the applicant on a 13-week oral toxicity study in rats at dose levels of up to 1000 mg/kg bw/day, and a small number of subchronic toxicity studies conducted at dose levels of up to 6000 mg/kg bw/day.

Absorption, Distribution, Metabolism and Excretion (ADME)

The long-chain fatty acids that constitute the novel ingredient are readily absorbed from the gastrointestinal tract and metabolised via the fatty acid pathway and the tricarboxylic acid cycle. However, the results of some *in vitro* studies suggest that triglycerides containing petroselenic acid are hydrolysed at slower rates relative to other triglycerides, which could result in differences in the ADME of the novel ingredient relative to other vegetable oils. A 10-week rat feeding study comparing the *in vivo* absorption of triglycerides from the novel ingredient with those from other oils such as sunflower oil and olive oil showed that petroselenic acid was absorbed at similar rates to oleic acid. However, significantly higher levels of linoleic acid and lower levels of arachidonic acid were observed in tissue and blood lipids of animals fed the novel ingredient compared to those fed the high-oleic sunflower oil. The suggestion by the study authors is that petroselenic acid is metabolised in the liver via chain elongation and β-oxidation that may in turn negatively impact on the synthesis of arachidonic acid from linoleic acid.

Toxicity

There is little data available on the acute toxicity of coriander seed oil. However, a guideline-compliant 13-week oral toxicity (gavage) study in rats using the novel ingredient yielded a NOAEL of 1,000 mg/kg body weight/day, which represented the highest dose tested. Minor biochemical and physiological changes were seen at this dose

level, the former indicative of minor perturbations in lipid homeostasis. These findings were not considered adverse. Comparison of this NOAEL with the anticipated intake of 10mg/kg bw/day based on daily consumption of a supplement containing 600 mg coriander seed oil by a 60 kg individual provides a margin of safety of 100. If the NOAEL is compared with an intake of 830 mg from a supplement containing 600 mg coriander seed oil together with a high intake of 230 mg/person/day from the diet, the margin of safety is 72.

A rat feeding study compared a diet of 12% coriander seed oil (approximately 6,000 mg/kg bw/day) in addition to 2% corn oil, with high-oleic sunflower oil, sunflower oil, olive oil, or rapeseed oil. The animals fed coriander seed oil exhibited extensive fatty infiltration and fatty cysts, accompanied by degenerative change in hepatocytes compared to controls rats. Only moderate, non-degenerative fatty infiltration of the hepatocytes was observed in the other treatment groups (high-oleic sunflower oil, sunflower oil, olive oil, or rapeseed oil). The authors suggested that the fat infiltration seen in the test group could have resulted from limited hydrolysis of triglycerides containing petroselenic acid and/or limited hepatic metabolism of petroselenic acid. Another study of similar duration and dose levels by the same research group recorded comparable body weights and food consumption levels between test and control groups, but weights and lipid levels of test animal livers were significantly higher.

Two guideline-compliant *in vitro* genotoxicity assays (bacterial mutagenicity and mutagenicity in L5178Y mouse lymphoma cells) did not identify any results of concern. Data on carcinogenicity or reproductive toxicity of the novel ingredient was not provided by the applicant while clinical studies in humans have not been conducted with coriander seed oil.

Allergenicity

Coriander has been reported to have allergenic properties which are likely to be associated with specific plant proteins. Since residual proteins are removed during the manufacturing/refining process, the novel ingredient is not anticipated to have allergenic properties. In addition, there have been no reports of allergenicity or sensitivity to coriander seed oil identified by the applicant in the literature.

Conclusions

The safety of coriander seed oil is based primarily on the history of safe use of coriander seeds as a culinary ingredient and this is supported by the *in vitro* and *in vivo* data provided by the applicant. From a nutritional perspective there are no safety concerns arising from consumption of the novel ingredient at the proposed levels, which represent almost three times the highest intakes from the normal diet. The minor biochemical and physiological changes observed at the NOAEL dose level are not unexpected considering the prolonged administration of a high lipid load and are not considered an adverse reaction to the novel ingredient *per se*. The toxicological

safety margins of 100 (food supplement alone) and 72 (food supplement and regular diet) calculated on the basis of a NOAEL of 1000 mg/kg bw/day are satisfactory. The significant impact on lipid metabolism observed in response to the higher dose of the novel ingredient (6,000 mg/kg bw/day) must be seen in the context that this represents 600 times the intended daily intake of the food supplement. While there are some limitations to the toxicological data with respect to studies on carcinogenicity, reproductive toxicity, genotoxicity and clinical studies, the safe history of consumption of coriander products and the relevant safety margins allow for a reasonable determination of safety at the proposed use levels.

Recommendation

The Food safety Authority of Ireland has not identified any safety concerns with the consumption of food supplements containing coriander seed oil at the proposed use levels of 600mg/day and therefore considers that this novel ingredient meets the criteria for novel food set out in *Article 3.1.* of the novel food Regulation.