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Assessing food allergy risks from residual peanut protein in highly refined vegetable oil

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ABSTRACT

Refined vegetable oils including refined peanut oil are widely used in foods. Due to shared production processes, refined non-peanut vegetable oils can contain residual peanut proteins. We estimated the predicted number of allergic reactions to residual peanut proteins using probabilistic risk assessment applied to several scenarios involving food products made with vegetable oils. Variables considered were: a) the estimated production scale of refined peanut oil, b) estimated cross-contact between refined vegetable oils during production, c) the proportion of fat in representative food products and d) the peanut protein concentration in refined peanut oil.

For all products examined the predicted risk of objective allergic reactions in peanut-allergic users of the food products was extremely low. The number of predicted reactions ranged depending on the model from a high of 3 per 1000 eating occasions (Weibull) to no reactions (LogNormal). Significantly, all reactions were predicted for allergen intakes well below the amounts reported for the most sensitive individual described in the clinical literature.

We conclude that the health risk from cross-contact between vegetable oils and refined peanut oil is negligible. None of the food products would warrant precautionary labelling for peanut according to the VITAL® programme of the Allergen Bureau.

1. Introduction

Highly refined peanut oil is considered to pose a risk to people with peanut allergy (EFSA, 2004, 2007). Although that risk has not been characterised, controlled clinical challenges suggest that it is negligible (Hourihane et al., 1997).

Refined vegetable oils may be produced on the same equipment and therefore cross-contact between non-peanut refined vegetable oils and refined peanut oil can occur. Since refined peanut oil contains small amounts of peanut proteins (Crevel et al., 2000; Ramazzotti et al., 2008), refined non-peanut vegetable oils and food products produced with these can unintentionally contain very small levels of peanut protein residues. Evidence exists for the allergenicity of peanut oil (various grades of refinement) based on the response of peanut-allergic individuals in skin prick testing and is probably due to low levels of biologically active peanut proteins remaining in the oil fraction (Moneret-Vautrin et al., 1998; Olszewski et al., 1998). The study of Hourihane et al. 1997 tested crude peanut oil and refined peanut oil in 62 peanut-allergic patients in a double blind placebo controlled food challenge. None of the subjects reacted to the refined peanut oil, but six reacted with mostly subjective reactions to crude oil. While the dose of peanut oil administered in the food challenge was reported, the peanut protein content of the refined oil was not, and thus the dose of peanut proteins administered is not known. Further, it is not known if these patients were representative of the total peanut-allergic population, as subsequent open challenge with peanut showed only mild reactions.

Recently, a substantial quantity of high quality clinical threshold dose data (n = 750) on objective allergic reactions to peanut protein of the peanut-allergic population was collected and used for threshold dose distribution analyses which informed among others the scientific review of the VITAL® scheme (Voluntary Incidental

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Abbreviations

LOAEL	lowest observed adverse effect level
N/RBD	neutralised refined bleached and deodorised
NL	Netherlands
NOAEL	no observed adverse effect level
UK	United Kingdom
VITAL®	Voluntary Incidental Trace Allergen Labelling

Trace Allergen Labelling) (Allen et al., 2014; Taylor et al.,2014). Most of the studies on which the data set was based, did not exclude participants with a history of severe reactions and/or anaphylaxis (Taylor et al., 2015). Allergen risk assessment using probabilistic techniques enables quantitative estimation of the probability of an allergic reaction after the consumption of a food product that contains an allergen (Spanjersberg et al., 2007; Crevel et al., 2007; Rimbaud et al., 2010; Remington et al., 2013, 2015). In this paper, we assess the predicted percentage of objective allergic reactions associated with residual peanut protein in refined non-peanut vegetable oil used as an ingredient in consumer food products. By designing several scenarios, varying relevant factors, such as the percentage of cross-contact, concentrations of contaminated vegetable oil and proportion of contaminated products, the probabilistic allergen risk assessment approach provides insight into how these factors affect the possible health risk for the peanut allergic population.

2. Materials and methods

2.1. Data

2.1.1. Concentration of peanut protein in refined peanut oil

Samples of highly refined neutralised, bleached and deodorised (N/RBD) food-grade peanut oil from commercial batches were obtained by FEDIOL, the European Vegetable Oil and Proteinmeal Association, from member companies across Europe. All oils had been produced in accordance with the FEDIOL Code of Practice for oil refining (http://www.fediol.eu/data/d0234.pdf) and were analysed for peanut protein content by the Institute of Food Research (Norwich) (IFR) using the method described by Rigby et al. (2011). The measured peanut protein concentration in refined peanut oil was 0.69 ± 0.3 mg peanut protein/kg (average ± sd) and based on 22 samples in which the concentration ranged from 0.070 to 1.756 mg/kg (IFR, personal commun.). It is important to note that these samples are representative of the major oil producers, but analysis results obtained would not necessarily translate to the outputs of all refiners, unless they were complying with the FEDIOL Code of Practice.

2.1.2. Consumption of food products

Food consumption data for several food products were derived from the National Food Consumption Survey 2003 of the Netherlands (NL) (Hulshof et al., 2004) in adults aged 19 to 30 years, and the National Diet and Nutrition Survey in the United Kingdom (UK), carried out between July 2000 and June 2001. This survey was held among adults aged 19 to 64 years (Office for National Statistics. Food Standards Agency, 2005).

The consumption distribution of food products as determined by those surveys was used. Products were selected for their relatively high contribution to fat consumption in the population, and included biscuits, margarine, ice cream and fried food (see Table 1).

Table 1
Intake of food products selected for study.

description	Country[a]	% fat	Product consumption (gram/eating occasion)	
			average	sd
Mixed oil	NL	100	11.1	(5)
Soy oil	NL	100	11.3	(11.2)
Sunflower oil	NL	100	10.0	(8.4)
Biscuits	NL	13.9	30.8	(25)
Frites pre-fried frozen	NL	14.3	135.9	(54)
Ice cream (dairy)	NL	11.2	103.8	(64.3)
Margarine 80% fat	NL	80	13.1	(11.5)
Margarine liquid 80% fat	NL	80	7.9	(5.6)
Margarine product 60% fat	NL	60	14.8	(8.2)
Margarine product 70% fat	NL	70	15.9	(7.1)
Cold sauce (mayonnaise, dressing)	NL	70	29.8	(18.8)
Fried Food	UK	14.7	179.8	(119.7)
Ice Cream	UK	11	115.5	(66.4)
Margarine	UK	80	16.7	(9.6)
Biscuits	UK	15.4	72.3	(63.0)

[a] Food consumption data were derived from the Dutch National Food Consumption Survey 2003, in this survey young adults from 19 to 30 years old were included (n = 750) (Hulshof et al., 2004). The National Diet and Nutrition Survey in the UK carried out between July 2000 and June 2001, was used. This survey was held among adults aged 19–64 years (http://www.food.gov.uk/science/dietarysurveys/ndnsdocuments/).

For the purposes of the risk assessment, all the fat in the included foods was assumed to consist of vegetable oils, which represents a worst-case situation. In the absence of consumption surveys covering specifically allergic individuals, it was assumed that users among the latter had a similar consumption pattern to non-allergic users.

2.1.3. Cross-contact scenarios

Scenarios were defined under which peanut protein could be present unintentionally in food products manufactured using refined non-peanut vegetable oils (Fig. 1). The scenarios took into account.

- The proportion of refined peanut oil production of the overall vegetable oil production in the UK, which is approx. 1% (SCOPA (http://www.scopa.org.uk/); personal commun).
- An estimated cross-contact percentage of refined vegetable oils with refined peanut oil during the oil refining process, that was suggested to be on average 2% (A) or a worst-case situation of 5% cross-contact (B) (FEDIOL, 2009).

Given the mean and standard deviation, a distribution was created for the measured peanut concentrations. Each scenario was combined with the distribution of measured peanut protein concentrations in refined peanut oil (0.69 ± 0.3 mg peanut protein/kg), and the percentage of fat (assumed to be all in the form of vegetable oil) in each food product (Table 1) to determine the final peanut protein concentration in the selected high-fat food products.

Fig. 1 displays a schematic representation of the various scenarios.

Scenario 1: product made with a refined vegetable oil produced immediately after production of refined peanut oil.
Scenario 2: product made with a refined vegetable oil mixture of which 1% of the oils has been produced immediately after production of refined peanut oil (peanut protein concentration is 100th of that in scenario 1).
Scenario 3: separate batches of the product made with separate batches of refined vegetable oils of which 1% had been produced