Food allergens – food safety hazard

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Abstract. Food allergy is a life-threatening chronic condition that substantially impairs quality of life. It constitutes a significant public health problem that affects children and adults and is a considerable burden on health, medical systems and emerging economies. Food allergy is defined as an adverse health effect arising from a specific immune-mediated response that occurs reproducibly on oral exposure to a given food and which can be mediated by food-specific IgE antibodies, by cellular mechanisms or by both. Appropriately managing food allergies has become an issue for the food industry because of the rising number of individuals with food allergies. Current initiatives to support consumers at risk include a recognised standard for manufacturers seeking to eliminate an allergen from their production, and the integration of food allergy into training for food business operators.

1. Introduction

Food allergies are a distinctive food safety issue that only affect part of the world’s population, with the effects ranging from mild discomfort to, in the worst case, fatalit[y [1]. Food allergies harm only specific parts of the population sensitive to food allergens; this is a significant difference to the other common food safety issues, as microbial or chemical contamination, which impair everyone. Food allergy is defined as an adverse health effect arising from a specific immune response that occurs reproducibly on exposure to a given food [2] or as an adverse reaction to food in which immunologic mechanisms have been demonstrated [3]. According to [4], adverse reactions to food have been classified into different groups on the basis of the pathogenic mechanism. They include immunological reactions, which can be mediated either by IgE antibodies, by cells (non-IgE-mediated) or both (mixed), and non-immunological responses (food intolerance), which are dependent on enzyme deficiencies or pharmacological reactions or, in the majority of cases, arise by unknown mechanisms. Food allergy is recognised as an important public health issue, requiring collaboration between multiple stakeholders, including the food industry, to be effectively addressed. Management of allergens in the food industry aims to assure the safety of allergic consumers, but has proved particularly challenging because of the unique attributes of food allergy and food allergens. Accurate allergen labelling, minimizing unintended allergen presence and circumspect use of meaningful precautionary labelling where required form the cornerstones of effective allergen management. Currently, there are no accessible cures for food allergy. Strict allergen avoidance remains the most efficient allergy management to avoid an allergic reaction, which can be severe and occasionally life-threatening [5].
2. Food allergens

Successful allergen avoidance depends on the identification of the relevant food allergen. In order to enable consumers to immediately identify relevant allergens, the European Union (EU) food information regulation [6], and in Serbia, the Rulebook on declaration, labelling and advertising of food [7] and the Rulebook on health correctness of diet foods [8] require mandatory labelling of 14 allergenic foods or food groups if they are ingredients in the manufacturing of foods. These food groups are: 1. Cereals containing gluten, namely: wheat (such as spelt and khorasan wheat), rye, barley, oats or their hybridised strains, and products thereof, except: (a) wheat based glucose syrups including dextrose, (b) wheat based maltodextrins, (c) glucose syrups based on barley and (d) cereals used for making alcoholic distillates including ethyl alcohol of agricultural origin, 2. Crustaceans and products thereof, 3. Eggs and products thereof, 4. Fish and products thereof, except: (a) fish gelatine used as carrier for vitamin or carotenoid preparations, (b) fish gelatine or Isinglass used as fining agent in beer and wine, 5. Peanuts and products thereof, 6. Soybeans and products thereof, except: (a) fully refined soybean oil and fat, (b) natural mixed tocopherols (E306), natural D-alpha tocopherol, natural D-alpha tocopherol acetate, and natural D-alpha tocopherol succinate from soybean sources (c) vegetable oils derived phytosterols and phytosterol esters from soybean sources (d) plant stanol ester produced from vegetable oil sterols from soybean sources, 7. Milk and products thereof (including lactose), except: (a) whey used for making alcoholic distillates including ethyl alcohol of agricultural origin (b) lactitol, 8. Nuts, namely: almonds (Amygdalus communis L.), hazelnuts (Corylus avellana), walnuts (Juglans regia), cashews (Anacardium occidentale), pecan nuts (Carya illinoinsensis (Wangenh.) K. Koch), Brazil nuts (Bertholletia excelsa), pistachio nuts (Pistacia vera), macadamia or Queensland nuts (Macadamia ternifolia), and products thereof, except for nuts used for making alcoholic distillates including ethyl alcohol of agricultural origin, 9. Celery and products thereof, 10. Mustard and products thereof, 11. Sesame seeds and products thereof, 12. Sulphur dioxide and sulphites at concentrations of more than 10 mg/kg or 10 mg/litre in terms of the total SO2 which are to be calculated for products as proposed ready for consumption or as reconstituted according to the instructions of the manufacturers, 13. Lupin and products thereof and 14. Molluscs and products thereof.

Example of international differences and evaluation in case studies is given in the following. Allergen declaration requirements in the United States (US) are according to [9], which requires the declaration of eight allergens and sulphites but currently does not require the declaration of sesame seeds or lupin. These are: cereals containing gluten (i.e. wheat, rye, barley, oats, spelt or their hybridized strains – oats do not contain gluten, but they are commonly produced in the same location as gluten-containing cereals such as wheat, resulting in allergen cross-contact), crustaceans, eggs, fish, milk, peanuts, sesame, specific tree nuts (almond, cashew, hazelnut, pecan, pistachio and walnut). Due to the lack of data on prevalence, severity and/or potency, or due to regional consumption of some foods, the Committee recommended that some of the allergens, such as buckwheat, celery, lupin, mustard, oats, soybean and tree nuts (Brazil nut, macadamia, pine nuts), should not be listed as global priority allergens, but can be considered for inclusion on priority allergen lists in individual countries. Since current dietary trends include an increased consumption of plant-based foods and diets consisting of alternative protein sources, it was recommended that pulses, insects and other foods such as kiwi fruits be included in a watch list and evaluated for the priority allergen list when data on prevalence, severity and potency become available [12, 13, 14]. Finally, the Expert Committee recommended that foods and ingredients...
derived from the list of foods known to cause immune-mediated hypersensitivities should be evaluated on a case-by-case basis for exclusion from declaration on ingredient lists and/or on food packaging.

3. Food Allergen Management

In a global market, it is crucial that there is harmonized understanding of the food allergens and of the measures required to address allergy. In [15], a new Code of Practice on Food Allergen Management for Food Business Operators is presented, which provides guidance on allergen management beginning at primary production and continuing throughout the manufacturing process. Allergen management practices should be part of implemented food safety management systems (FSMS) including prerequisite programme (PRP) activities, good hygiene practices (GHPs), and, where appropriate, HACCP systems, in manufacturing, retail and food service [16,17]. Allergens need to be managed throughout the supply chain and production process. Treatments lethal for pathogenic microorganisms, such as heating, high pressure processing, etc. generally do not destroy allergenic proteins. Processes that degrade proteins, such as enzymatic or acid hydrolysis, should not be relied upon to eliminate or completely destroy allergenic proteins.

The new code is intended to facilitate a proactive approach to managing allergens in food production, rather than a reactive response once a food safety hazard has been identified. It provides guidance on allergen management throughout the production process, including controls to prevent cross-contact where an allergen is inadvertently transferred from a food containing an allergen to a food that does not contain the allergen. Taking a whole supply chain approach, the code spans primary production, manufacturing, and retail and food service, and supplements both of the newly-adopted, revised General Principles of Food. The HACCP plan should include allergens as an independent category of food safety hazard. This involves evaluating the hazards associated with the whole lifecycle of the product, starting with raw materials and assessing every step of the process through to labelling and packaging of the final food for sale. Manufacturers providing partially prepared foods or ingredients from business to business and not to the end consumer must also maintain a thorough allergen management program. The critical points where allergens can be introduced as ingredients or into foods during processing should be identified, and systems need to be established to prevent the unintentional cross contact of allergens to other products.

Allergen risk management starts with investigating the manufacturing process for allergen risks and hygiene, and includes activities to label allergens according to the ongoing work on allergen labelling by the Codex Committee on Food Labelling. The information obtained can be used to develop an Allergen Management Program (AMP). The implementation and use of an effective AMP in conjunction with an allergen risk review approach contributes to food businesses meeting food safety, quality and legal requirements [14].

Food labelling for the presence of allergenic foods/ingredients must identify all foods that intentionally contain the particular food group or ingredients derived from that food. However, voluntary labelling for the possible presence of an allergen (e.g. “May contain”) should be reserved for situations that potentially represent genuine hazards. In recent years, there has been a proliferation of the use of precautionary allergen statements, which range in wording from “May contain” and “Processed in a facility”, to “Made on shared equipment”. This increase has limited consumer food choices. Alarmingly, food-allergic consumers, especially teens, are beginning to ignore precautionary statements, and take risks regarding the food they choose to eat. This can lead to trouble for both the consumer and the industry [18].

4. Allergen analysis

The analysis of a material or surface for the presence and/or amount of an allergen is a valuable tool for a risk-based approach to allergen management. Analytical test results can provide assurance and verification of critical controls within a comprehensive AMP and assist the implementation of a quantitative risk assessment. Understanding the nature of the allergen, its form (i.e. powder, liquid, homogenous or particulate) and its behaviour in the food in which it is used will play a major role in the
choice of methodology applied. Allergen analysis is appropriate for: confirmation of the allergen status of raw materials; validation of appropriate cleaning protocols; verification or ongoing monitoring of cleaning efficacy including flushing and push through volumes; environmental monitoring (which should run in parallel with microbiological and hygiene monitoring); monitoring the effects of critical changes in the process; identifying sources of cross contact; confirming risk assessment assumptions; assessing customer complaints; investigating potential control failures, and; assisting in verification of free-from claims. Analysis should be used for validation and verification purposes as part of a HACCP based food safety program [19].

Recommendations with the aim of protecting the modern buyer/consumer are development, improvement and implementation of allergen protocols and education of employees regarding precisely defined and consistent standards related to the management of safety of allergens, which lead to consistent and sustainable food safety management systems [17].

5. Allergen communications

At the food industry level, the distance between manufacturers and consumers has increased significantly, due to the global food trade, and labels with food allergen information have become even more important to prevent allergic reactions from occurring [20]. It is important to manage food allergies within local contexts. It is critical for countries to understand what allergens are common in a particular population, what foods need to be labelled and how to determine the allowable quantities of food allergens. National food safety competent authorities should: identify or develop a mechanism that regularly monitors the common food allergies in the national context; ensure clarity and readability of food allergen labels and provide education on how to read them, especially to the allergic population; develop or strengthen collaborative mechanisms with the private sector, particularly with food e-commerce platforms and restaurants, to ensure that food allergens are explained to their customers, for example in menus; support research and development of diagnostic tools that facilitate the detection of food allergies in humans and in foods; educate the population on the topic of food allergies through targeted communication campaigns aimed at raising awareness on the topic, and; contribute to global discussions, national case studies and relevant data [21,22,23].

6. Online Shopping

With the increasing rates of online grocery shopping, people with food allergy will rely more heavily on online food label information. This information should be presented in a way that assists consumers with their purchasing choice. Vigilance is required in ensuring online information regarding the ingredient and allergen content is correct, as shoppers are likely to assume that this information reflects the food that will be delivered. It is critical the information online clearly reflects what is on pack. Food manufacturers should have procedures in place that alert retailers and distributors when the allergen status of a food changes so that the shopping websites can be updated. For those who maintain the websites, it is recommended that measures are in place to ensure that the online food label information is up to date [23].

7. Food allergen recall

Food allergen recall is an action taken by a food business to remove unsafe food from distribution, sale and consumption. A consumer-level food recall involves the removal of unsafe or unsuitable food from all points in the production and distribution networks, including any affected food in the possession of consumers. The public must be informed of a consumer-level recall, and this usually involves the use of media such as newspaper advertisements, point of sale notices and publication of information about the recall [23].

8. Conclusion

Food allergies may impact only part of the world’s population, but that impact can be lethal. The absence of a comprehensive implementation report for food allergen labelling regulations has resulted in
proliferation of different risk mitigation strategies, leaving consumers uncertain and confused about the safety of food products. It is, therefore, extremely important that food labels contain sufficient information to enable allergic people to avoid the risks of allergic reactions. National strategies, activity by different stakeholders (allergic consumers, health professionals, public authorities and the food industry), identification of the predominance of food allergies, investigation into what foods should be labelled, and definition of appropriate levels of protection from the risks to food-allergic consumers due to the unintended presence of allergen(s) in food, remain pressing priorities.

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