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Reasonable precaution: evolution of voluntary allergen labelling in terms of risk assessment

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1. Abstract

In the past few decades, the prevalence of food allergies reached such a height that it brought about public health measures worldwide. As currently these diseases can often only be treated with a strict lifelong elimination diet, patients must be aware of the presence of allergens in food products. In most countries, food components triggering allergic reactions must be displayed on food packages as long as they are deliberately added to the product as ingredients, and are listed in relevant regulations. However, these regulations do not handle potential allergen presence coming from accidental cross-contamination. As a consequence, application of the so-called voluntary precautionary allergen labelling (PAL) (e.g. „may contain traces of X", „made in a factory also processing X", etc.) became common practice. As the use of these labels is hardly ever based on risk assessment, partly because of the lack of regulatory allergen thresholds, it is very hard to decide whether the product actually represents a risk. It causes loss of trust and increased risk-taking behaviour in affected consumers. The latest research in the field aims to introduce risk assessment in the practice of voluntary allergen labelling by determining allergen thresholds. This, in combination with good allergen management practices, would improve the reliability of allergen labelling and with that the safety and quality of life of patients living with food allergies.

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2. Introduction

Of adverse food reactions, the most well-known ones are caused by conventional food safety hazards (e.g. pathogenic microorganisms, chemical contaminants, etc.) and they will manifest in anyone in the population upon sufficient acute or chronic exposure. However, in the past decades other types of adverse reactions came into focus that are triggered by such food components that are normally considered safe for the majority of people. Such adverse reactions include non-immune-mediated intolerances (e.g. lactose intolerance) and immune-mediated disorders (allergies, celiac disease). The prevalence of food allergies is estimated to be 5-10% depending on geographic regions, while the average global prevalence of celiac disease is 1%. In both cases the culprit components are such proteins that, as we mentioned before, are not posing a hazard for the healthy population, thus they must be handled as a special food safety issue (Scherf et al., 2016, Tedner et al., 2022).

Currently neither allergies, nor celiac disease can be cured; they can be managed with an often lifelong diet aiming for the elimination of the triggering components. Diet adherence requires that patients are aware of the presence of allergens and toxic proteins in foods, which in the European Union is legally supported by regulation 1169/2011/EU on the provision of food information for consumers. The regulation lists 14 allergens (cereals containing gluten, crustaceans, egg, fish, peanut, soy, milk, nuts, celery, mustard, sesame, lupine, mollusks, sulphur-dioxide) that must be labelled on the package of the product in ways described by the regulation if they were added to the product deliberately as an ingredient. Except for sulphur-dioxide there are no legal thresholds of tolerable amounts for allergens that would allow allergen-free claims, which means that a de-facto zero tolerance is in effect. As we will describe later in more detail, this situation puts all stakeholders in difficult positions when it comes to allergen management, labelling, or analysis. In the case of gluten-free products that were specifically produced for celiac patients there is a threshold: according to implementation regulation 828/2014/EU, in line with the recommendation of Codex Alimentarius, a product can be labelled as gluten-free if its gluten content does not exceed 20 mg/kg (Codex Alimentarius, 2008, European Parliament, 2011, European Council, 2014).

In spite of the existence of similar regulations worldwide, product recalls due to undeclared allergens are one of the most common food safety issues in the EU (European Council, 2020), in the United States (Spotz, 2018), and in Australia and New Zealand as well (Food Standards Australia and New Zealand, 2023). A survey from FoodDrinkEurope indicates that these cases are caused by two major reasons. One of them is connected to packaging: either the product ends up in the package of another product, or its own package carries a wrong label. The other reason is accidental cross-contact that results in the presence of undeclared allergens (Food Drink Europe, 2022). The risk of such cross-contamination is very high as in most food industry settings products with different allergen profiles are very often produced on shared equipment, and allergen presence of this kind is not handled by the mentioned regulations. Without official guidance, the voluntary application of the so-called precautionary allergen labelling (PAL) became common practice to warn consumers of potential risk (Gendel, 2013, Popping and Amigo, 2018).

3. The disadvantages of the application of PAL

As precautionary allergen labelling in most cases is put (or not) on the product without actual risk assessment, two scenarios can happen. One of them is that the voluntary label is not present when it should be. Studies show that products without PAL may contain allergen contamination from trace amounts to thousands of mg/kg (Do et al., 2018). The other very common occurrence is that the precautionary label is present on the product unnecessarily, which further reduces food choices for allergic consumers for no reason (Martínez-Pineda and Yagüe-Ruiz, 2022).

Consequently, very often neither patients nor healthcare professionals can understand what these labels really mean. The diversity of the wording of PAL itself causes confusion. DunnGalvin and co-workers (2015) found that while 80% of patients would never buy a product that displays „not suitable for X allergy sufferers", this ratio drops to 40-50% when the product says „was made in a factory also processing X". These results also highlight the reduction in consumer trust and the risk-taking behaviour it causes. Such cases also occur when after consuming a product displaying an unwarranted label without experiencing symptoms, the patients conclude they are cured of their allergies, which may lead to further risky consumer behaviours (DunnGalvin et al., 2015, 2019a).

The harmonisation of voluntary allergen labelling is an urgent necessity. The key to this process is the application of suitable risk assessment procedures to make an informed decision on the application of PAL. The missing link necessary for risk assessment are the allergen thresholds mentioned earlier, which had been unavailable for a long time. However, new scientific results from the past 20 years are about to bring a shift in paradigm to this field (DunnGalvin et al., 2019b).

4. A brief history of allergen thresholds

Allergens, as discussed in section 2, differ from conventional food safety hazards, but it was proven that the risk they pose could be assessed with traditional risk assessment methods with the help of special statistical models. One of the most suitable methods for this purpose is the probabilistic model that compares probability distributions to determine the size of the population that can be expected to experience an allergic reaction at certain exposure levels taking into account threshold doses (Spanjersberg et al., 2007, Crevel et al., 2014).

For a long time it was questionable whether it is possible to establish threshold doses at the population level, because there was no high quality, comparable data available. Although double-blind placebo-controlled food challenges (DBPCFC) that can be used to generate such data had been around for a good while, they were primarily considered diagnostic rather than toxicological tools. Due to this reason, test designs were not suitable to determine even individual threshold doses, as the most common goal was to confirm the presumed diagnosis with the first dose administered. Besides, DBPCFC tests varied greatly in protocol including, but not limited to the selection of participants, doses and timing of allergen administration, the applied food matrix, and the form of the allergen (e.g. native, processed, isolated, etc.). All these factors, in combination with the variability of individual thresholds did not allow the establishment of threshold doses for quite some time (Bindslev-Jansen et al., 2002, Taylor et al., 2002).

To solve this problem, in the early 2000s a standardised DBPCFC protocol was proposed that is specifically aimed to determine the NOAEL (No-Observed Adverse Effect Level=the highest concentration that does not trigger an adverse reaction) and LOAEL (Lowest Observed Adverse Effect Level=the lowest concentration that triggers an adverse reaction) values of individual allergens, which is the basis of threshold determination (Taylor et al., 2004, Crevel et al., 2008).

As time went by, the amount and quality of data increased considerably and it became evident that it is possible to find such threshold doses that are safe for the majority of the allergic population. The calculation of thresholds must be handled with great care though due to the large individual variety among patients: the estimation requires the application of advanced statistical methods. It is important to note that due to the food safety nature of allergens and the limitations of threshold studies, it is impossible to determine such thresholds that would protect 100% of the affected population. Such a goal would bring us right back to the current situation of zero tolerance which has already proven not to be feasible and leads to the labelling problems we are already experiencing (Crevel et al., 2007, 2008). So, it is necessary to determine the level of acceptable risk involving all relevant stakeholders (e.g. patients, healthcare professionals, legislators, etc.) (Madsen et al., 2020). It requires the most accurate knowledge on thresholds possible. A good example of threshold determination and their application in risk assessment is the VITAL (Voluntary Incidental Trace Allergen Labelling) system established by the Allergen Bureau of Australia and New Zealand that we introduce in the next section.

5. Threshold doses as tools of risk assessment demonstrated by the example of the VITAL program

In 2007, using the ever-increasing set of clinical data, the Allergen Bureau of Australia and New Zealand launched the VITAL program (https://vital.allergenbureau.net), which aims to perform risk assessment based voluntary allergen labelling to increase their reliability alongside consumer knowledge and trust. The work started with an expert panel collecting and statistically analysing DBPCFC data retrieved from the literature and from clinical centres. Based on their results, the panel managed to establish so-called reference doses for several major allergens, which are the amount of protein that does not cause even slight objective symptoms in 95-99% of the allergic population upon a single-occasion ingestion. Since the launch of the program, reference doses have been updated multiple times using the latest data. In its current version, VITAL 3.0, there are reference doses for 14 allergens (ranging from 0.03 to 25 mg protein) (Taylor et al., 2014, Remington et al., 2020).

As a practical implementation of the VITAL system, guidelines with software support were created for the industry that can be used for quantitative risk assessment for every product and production line to predict the level of allergen contamination. This can be compared with the so-called action levels, which are calculated from the threshold doses and the serving size of the product and finally a decision can be made whether PAL is necessary or not. As long as the allergen contamination estimated during the risk assessment process remains below the action level, voluntary labelling can be omitted, while if it exceeds the action level, voluntary labelling is warranted. In this case, the system proposes the use of a single phrase: „X may be present”. With proper consumer education and with information on their personal level of sensitivity, patients will be able to decide whether the product would be safe for them. The application of the system is gaining increasing interest, currently VITAL is available as a supplementary certification scheme for food producers operating by the GFSI (Global Food Safety Initiative) approved food safety standard (Brooke-Taylor et al., 2018, https://vital.allergenbureau.net/vital-standard/).

6. Beyond labelling and risk assessment issues

Although significant progress has been made in the harmonisation process of allergen labelling, there is still a long way to go in the standardisation and implementation of international guidelines. The latest position of FAO and WHO also encourages risk assessment based voluntary allergen labelling, the application of reference doses, uniform labelling, and proper education (FAO and WHO, 2023). However, we must keep in mind that handling the problem of food allergies reaches beyond labelling, which is undoubtedly an important pillar of the process, but, as described above, its reliability is affected by a range of factors. Risk assessment cannot be effective if the food producer does not operate a robust allergen management system, preferably as an integral part of the food safety system. Guidelines for the development of allergen management systems had not been available for a long time, however, certain organisations, such as FoodDrinkEurope (currently their updated guideline is available (Food Drink Europe, 2022)) attempted to provide useful alternatives for the industry. Finally, in 2020 Codex Alimentarius published a new code of practice that specifically aims to provide a standardised guideline for all food producers to create good food allergen practices (Codex Alimentarius, 2020).

Food allergen management and risk assessment systems cannot work properly without reliable analytical methodologies though, which is another critical element of handling allergens. Reference doses and action levels cannot be used effectively if we cannot confirm compliance. An expert group of ILSI Europe studied the suitability of currently available analytical methods to determine VITAL reference doses. Their results indicate that the task is feasible in the case of many allergens, but the limitations of the methods must be taken into account and for the best outcome further development and harmonisation of methods will be necessary (Holzhauser et al., 2020). Special attention is needed for the routinely used immuno-analytical methods. A review introducing their major issues through the example of gluten analysis was recently published in a previous issue of this journal (Bugyi et al., 2022).

7. Conclusion

In this article, we attempted to provide a brief introduction to the history, current situation, and expected future of voluntary food allergen labelling. As a concluding remark, we would like to highlight again the multidisciplinary nature of this field: a reliable labelling system cannot be achieved without high quality clinical studies, excellent allergen characterization, precise analytical methods, good allergen management practices, and the education of patients and the healthcare professionals supporting them. Besides the pivotal role of the food industry, we must not forget other areas where food is produced and sold, such as hospitality, catering, the selling of non-prepacked food and webshops: allergen management and proper information must be provided in these settings as well.

Thus, the safety and optimal quality of life of consumers living with food allergies can only be successful with cooperation, transparent and harmonised legislation, proper scientific support, and allergen management conscious food production alongside the education of affected consumers and healthcare providers on allergen information, which makes trustworthy labelling both a goal to achieve and a tool to apply.

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