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REVIEW

Legumes steam allergy in childhood: Update of the reported cases

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Abstract In the past few decades, the prevalence of allergic diseases has deeply increased, with a key role played by food allergies. Legumes seem to play a major role towards the overall increase in the scenario of food allergy, since they are an appreciated source, consumed worldwide, due to their high protein content, variable amounts of lipids and for the presence of vitamins.

In literature there are numerous descriptions of adverse reactions after ingestion of uncooked and cooked legumes. Nevertheless, cases of allergic reactions induced by inhaling vapours from cooking legumes have rarely been described.

Herein the authors report an update of the literature data on allergic reactions caused by legume steam inhalation, underlying the possible pathogenic mechanism of these atopic events and the knowledge of literature data in paediatric age. The importance of this review is the focus on the clinical aspects concerning legume vapour allergy, referring to literature data in childhood.

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Introduction

In the past few decades, the prevalence of allergic diseases has deeply increased, with a key role played by food allergies.[1,2] Acute reaction to food allergens is a fairly common problem both in childhood and in adulthood, its incidence being especially high in childhood, with a range between 1.4 and 4%.[1,2] Basically, food allergies, defined as adverse reactions to an otherwise harmless food protein, due to an abnormal reaction of the immune system towards these proteins that are recognised as foreign elements. Consequently the immune system triggers a response to neutralise them.[3]

Anaphylaxis consequent to the consumption of an allergenic food affects a significant proportion of the population. In fact its prevalence is about 6–8% in children and 4% in adults.[4–6] Over 90% of food allergies are caused by eight main food groups that are: peanuts, soybeans, cow's milk, hen's egg, fish, crustacean, wheat, and tree nuts. The reaction can be severe in some cases and the severity of food-induced anaphylaxis was described by Wang and

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Sampson,[7] who mentioned that in the U.S.A. about 30,000 persons are treated for food anaphylaxis in the emergency department per year. Peanuts, tree nuts, fish and shellfish were mostly responsible for these anaphylactic reactions.

Legumes seem to play a major role towards the overall increase in the scenario of food allergy, because they are a worldwide-appreciated source due to their high protein content, variable amounts of lipids and vitamins.

Legumes are dicotyledonous plants belonging to the Fabales order, which is composed by four families: Mimosaceae, Caesalpiniaceae, Papillonaceae and Fabaceae. White bean and green bean (*Phaseolus vulgaris*) are members of the Fabaceae family and few cases of systemic reactions in children after their ingestion or vapours inhalation have been reported.[8] Among these legumes, lentils, belonging to the Papillonaceae family, seem to be the most common legumes implicated in paediatric allergic reactions in the Mediterranean area and India.[9–12] In the literature there are numerous descriptions of adverse reactions after ingestion of uncooked and cooked legumes: oropharyngeal symptoms and acute urticaria are the most common symptoms, followed by anaphylaxis.[9–12] Nevertheless, cases of allergic reactions induced by inhaling vapours from cooking legumes have rarely been described, both in adulthood and in childhood.

Herein the authors report an update of the literature data in childhood on allergic reactions caused by legume steam inhalation, underlying the possible pathogenic mechanism. The importance of this review is the focus on the clinical aspects reported in the literature concerning legumes allergy, referring to literature data in paediatric age.

The prevalence of legume allergy in different countries

In a vegetarian diet, legumes are the main source of proteins. However, these crops have been described to be responsible for IgE-mediated reactions in Mediterranean and Asian countries.[3] As far as the prevalence of legume allergies in the Western countries is concerned, peanut allergy is common in the UK, France, Switzerland, and North America, whereas higher prevalence of soybean allergy is found in Japan.[3] Lupine is another legume extensively consumed in Mediterranean countries. The prevalence of sensitisation to this legume varies. In a recent study of 1160 patients in the Mediterranean area, a lupine sensitisation rate of 4.1% was reported among atopic patients.[13] Prevalence of lupine allergy in France and Belgium was reported to present a cross-reactivity sensitisation to peanut,[14] with a rate of 14.5% of adults and 17% of children allergic to peanut and cross-reacting to lupines. In Denmark, sensitisation to lupine was found in 82% of 39 patients allergic to peanut.[15] Chickpea, red gram and mung bean are some of the crops playing a major role for food allergies in the Indian population.[3,16] Lentils and chickpeas have been reported to cause IgE-mediated sensitisations – particularly in paediatric patients.[3]

This variation of allergenic condition from country to country seems to be linked to different cultural and dietary habits, and an increased consumption of a specific crop may lead to sensitisation against that particular crop.[3] However, other factors, as a result of genetic factors and/or exposure to new allergenic proteins early in life may influence the prevalence variation of legume allergy from a country to another one.

The allergic pathophysiology of lentil steam atopy

Although most food atopic reactions occur after ingestion of the responsible food, by IgE-mediated allergic reactions, few cases may occur through the exposure to airborne food allergen particles.[17]

The large legume family (*Fabaceae*) comprises 730 genera with over 19,400 species, including important agricultural crops like peanuts, beans, peas, soy, lentils, chickpeas and lupins. An increasing number of legume proteins have been found to be allergenic. Peanut, soy and lupin are among the major food allergens with relevance for the public health.[18]

The rising prevalence[19] and seriousness of peanut allergy[20] has led to a corresponding increase in studies evaluating the allergenic potentials of the individual peanut proteins, including members of four dominant plant allergen families.[19,20] Peanut profilin (Ara h 5), pathogenesis-related (PR-10) pollen protein (Ara h 8), prolamins (Ara h 2, Ara h 6, Ara h 7, Ara h 9), cupins (Ara h 1, Ara h 3, Ara h 4) and oleosins (Ara h 10, Ara h 11) have been molecularly characterised and immunochemically studied.[21–24]

As far as lentils are concerned, two different types of allergens have been characterised from boiled lentils. The first type consists of three proteins named *len c1* and *len c2* of 16 kD, and a third protein called *len c3* of 12 kD, belonging to the vicillin protein family and having a structural and immunochemical relationship. These proteins represent the main IgE-binding group in boiled lentil extracts. Among them, *len c1* in lentils allergy was first described for its relevance, due to its high percentage of recognition in individual sera of patients affected by lentil allergy (68%). It has also been demonstrated by commercial lentil CAPs that *len c1* has an IgE-binding inhibitory capacity (64%).[17,25–27]

Another mechanism responsible for lentil allergic reactions is referred to the hypersensitivity caused by their steam inhalation, even if in the literature few data are reported on this regard. In 1992, Martin et al.[10] described the case of a 20-year-old man who experienced asthmatic attacks after exposure to the steams from cooking chickpea and lentils. Type I hypersensitivity to the antigens of these legumes was demonstrated by means of immediate skin reactivity, radioallergosorbent test (RAST), RAST inhibition and histamine release tests. The authors[10] identified a protein band with intense specific IgE binding in the homologous boiled legume extracts of lentil, chickpea and pea. They stated that this allergen is thermostable and remains active in cooked legumes. It was also showed that a number of extremely resistant immunoreactive proteins still remained even after autoclaving. Later, in 2000, Sanchez-Monge et al.[28] sought to purify and characterise the relevant IgE-binding proteins from boiled lentil extracts via the sera of patients who had allergic reactions after lentil ingestion. They studied boiled lentils, assuming that they were ingested after having been heated and this probably caused inactivation and/or modification of the putative allergens.

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