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## 11S Globulin Identified as a New Bean Allergen

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Legumes are one of the most frequent causes of food allergy, especially in children [1]. In the Mediterranean and India, lentils and chickpeas are considered the most allergenic legumes. However, beans, also widely consumed in these populations, are less allergenic and usually present cross-reactivity with other legumes, such as lentils, chickpeas, and peas. Numerous studies have demonstrated a high degree of cross-reactivity between legumes [2].

The common bean, *Phaseolus vulgaris*, belongs to the Fabaceae family. Although few studies discuss this legume, some proteins have been identified as allergens. These include the major seed storage protein, phaseolin (Pha v), a vicilin belonging to the 7S globulin family with a molecular weight of 47.5 kDa [3]. Phaseolin has also been described in red and white kidney beans. Moreover, a 32-kDa IgE-binding protein has been identified in green beans as Pha v Chitinase, which is closely related to the major avocado allergen [4], and a 31-kDa major allergen of the red kidney bean (Pha l) was purified and identified as phytohemagglutinin with cross-reactivity to peanut and black gram [5]. Furthermore, profilin (Pha v 5), Bet v 1-like allergen (Pha v 6), and lipid transfer protein (LTP-Pha v 3) have been described in the common bean, with molecular weights of 14.4, 17, and 10 kDa, respectively, and a high degree of cross-reactivity with other vegetables [6,7].

We present the case of a 13-year-old boy with no previous history of atopy or food allergy who attended our clinic because of 2 anaphylactic reactions after eating pinto beans. The episodes took the form of generalized hives, labial angioedema, sneezing, nasal stuffiness, and dyspnea 30-45 minutes after

ingestion. The reaction resolved completely with intramuscular methylprednisolone and dexchlorpheniramine in under 3 hours. The patient had previously tolerated all legumes and, after the episode, he continued eating other legumes (peanuts, lentils, chickpeas, green peas, and green beans) and tree nuts without incidents. However, he did not eat pinto or white beans again. He also reported rhinoconjunctivitis symptoms and morning cough in autumn and spring.

We performed skin prick tests with commercial extracts (Leti Pharma) of soy, peanut, lentil, chickpea, green pea, white bean, green pea, and broad bean. All results were negative. Nevertheless, prick-prick tests with fresh pinto and white beans were positive, eliciting an average wheal diameter of 7 mm and 5 mm, respectively. Besides, skin prick test results with pollen extracts were positive for *Platanus*, *Olea*, *Phleum*, and *Lolium*. We also performed a blood test, which revealed total serum IgE (ImmunoCAP, Thermo Fisher Scientific) of 210 kU<sub>A</sub>/L, and specific IgE antibodies were negative for peach, Pru p 3 (LTP), Pru p 4 (profilin), green peas, white beans, pinto beans, green beans, chickpeas, and lentils (all with IgE <0.06 kU<sub>A</sub>/L).

In order to complete the immunological study, we prepared extracts with cooked white, pinto, red, and black beans. Briefly, 100 g of each type of bean mixed with its cooking water was dissolved in phosphate-buffered saline and kept overnight at 4°C under constant magnetic stirring. Then, the extract was filtered using a double-gauze filtration system. SDS-PAGE run under reducing conditions revealed protein bands ranging between 130 and 10 kDa (Figure, A). In addition, a Western blot with bean extract was performed after incubation with the patient's serum. This revealed an IgE-binding protein weighing approximately 15 kDa in white, pinto, and red bean extracts. Such was not the case for the black bean extract, which did not

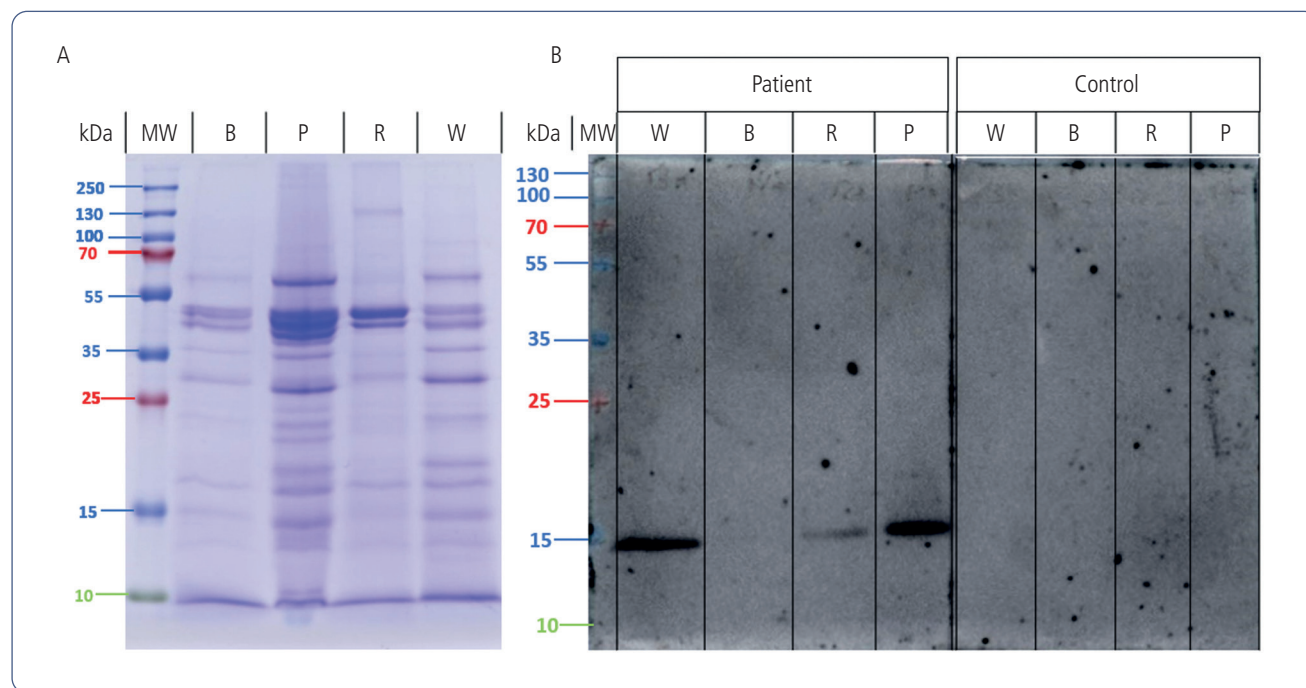
show any bands. Meanwhile, no IgE-binding bands appeared in the negative control (Figure, B).

A protein band with an apparent molecular weight of 15 kDa recognized by the patient's serum was extracted from the gel and identified by mass spectrometry, as previously described [8], as well as by searching a nonredundant protein sequence database (NCBI) using the Mascot program (<http://www.matrixscience.com>) in the Proteomic Service of Complutense University of Madrid, which is a member of the ProteoRed Network. Research conducted with protein databases identified a 15-kDa IgE-binding band as a legumin or 11S globulin.

The patient we report had an exclusive allergy to beans based on both immunological and clinical findings. In Mediterranean countries, the most frequent cause of legume allergy is lentil, and cross-reactivity to chickpea or pea is frequent. Common beans are usually well tolerated, and some patients have allergy to green beans in the context of LTP allergy.

The association between allergy to pollens and legumes has already been addressed elsewhere. In a Spanish study, it was demonstrated through inhibition ELISA and cross-reactivity between peas and white beans and 4 pollens (*Lolium perenne*, *Olea europea*, *Artemisia vulgaris*, and *Betula alba*) [2]. In the present case, the patient's allergy to pollens cannot be due to cross-reactivity to beans, since there are no seed storage proteins in pollens.

7S globulins, or vicilins, are the major allergens of legumes (ie, lentils, chickpea, and pea), and cross-reactivity between them is frequent [9]. The only IgE-binding band recognized by the patient's serum was an 11S globulin or legumin. 11S globulins have been reported to be major allergens in several



**Figure.** A, Protein profile of bean extracts by SDS-PAGE and Coomassie blue staining. B, IgE-immunoblot of bean extract with the patient's serum and the serum of a negative control (nonatopic). W indicates white; B, black; R, red; P, pinto; MW, molecular weight.

seeds, nuts, and legumes and are associated with severe reactions [10]. Although cross-reactivity between different 11S globulins is uncommon, it has been reported (eg, between mustard and nuts) and may depend on the epitopes involved in sensitization. In view of the results, the patient we describe could have been sensitized to the species-specific epitopes of bean 11S globulin.

In conclusion, we present the case of 13-year-old boy with selective severe allergy to beans in which a 15-kDa protein was reported. The allergen was identified as 11S globulin, or legumin, and did not cross-react with other food allergens (ie, seeds, nuts, and legumes). To our knowledge, this is the first time an 11S globulin has been identified in beans. More studies are needed to fully characterize this allergen family.

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#### Conflicts of Interest

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The remaining authors declare that they have no conflicts of interest.

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