Allergy to white kidney beans with cross-reactivity to red kidney beans. Report of two cases in children

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Legumes are dicotyledonous plants belonging to the Fabales order, among which white and red kidney beans *(Phaseolus vulgaris) are* members of the *Fabaceae* family. Legumes are a rich source of proteins, fiber, and minerals consumed worldwide but are also potential triggers of IgE-mediated reactions [1]. Clinical manifestations of legume allergy vary from local symptoms to systemic reactions, although the latter are rarely reported [2]. Rouge and Zacharisen et al. reported two cases of anaphylaxis to kidney beans [3,4]. In Spain, allergy to legumes is the fifth most common cause of food allergy in pediatric population, beans are the third most consumed species of legumes after chickpeas and lentils. Clinical allergy to several legumes is very common, especially in children, due to their well-known high degree of cross-reactivity [5,6]. Ibañez et al. demonstrated white kidney beans are usually well tolerated by children allergic to other legumes, although the exact reason has not been detailed yet [7]. Only a few cases of kidney bean allergy have been described, and the information available concerning the specific allergens involved and their molecular characteristics is scarce.

We present two clinical cases of children with allergy kidney beans with an IgE-mediated immune mechanism and tolerance to other legumes.

The first case is a 5-year-old male, with a past medical history of spontaneously outgrown egg allergy and atopic dermatitis, who reported an immediate appearance of pruritic erythematous wheals distributed through neck, scruff, and face after eating cooked white kidney beans, which were previously tolerated. Symptoms resolved with antihistamines. After this, he tolerated: lentils, chickpeas, green beans and, peas.

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Skin prick tests (SPTs) were negative with commercial legume extracts (Leti Pharma®). Prick by prick with cooked legumes were: white kidney beans (9 mm) and red kidney beans (8 mm). SPTs to other legumes were negative. Total IgE: 2360 UI/ml. Specific IgE (sIgE) against white kidney beans was 0.92 kU/L, pea: 0.25 kU/L, chickpea: 0.46 kU/L, lentil: 0.64 kU/L, soy: 0.62 kU/L and peanut 0.29 kU/L.

The second case is an 8-year-old male with a past medical history of spastic bronchitis after respiratory infections who presented generalized erythematous wheals and abdominal discomfort after intake of white kidney beans and facial angioedema after eating red kidney beans. Both reactions were treated successfully with corticosteroids and antihistamines. After this, he tolerated: lentils, chickpeas, peas, green beans, and soy. Previous tolerance to both beans was reported. SPTs were carried out with commercial legume extracts (Leti Pharma®): beans (3 mm), lentil (4 mm), negative remainder; prick by prick with cooked vegetables: white kidney beans (13 mm), peas (9 mm), chickpeas (5 mm), red kidney beans (10 mm), lentils (7 mm). Total IgE: 219 UI/ml. sIgE against white kidney beans was 10.7 kU /L, green beans 4.02 kU/L, pea: 2.59 kU/L, chickpea: 1.58 kU/L, lentil: 2.26 kU/L, soy: 3.38 kU/L, and peanut: 4.83 kU/L.

In both of these cases, sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) immunoblotting was performed to study the molecular mass of proteins from several legumes (white and red kidney beans, pea, lentils, green beans, peanut and, soy). We found molecular mass ranging from 18 to 68 kDa. Western Blot with legume extracts against the patient's serum was performed. In both cases, we detected bands of approximately 48-50 kDa in the extracts of white and red kidney beans and a band of approximately 28-31 kDa in the extracts of white, red, green bean and, soy. These bands were not recognized in other legumes extracts (Supplementary figures A and B). In the second case, western blot inhibition was carried out with red vs. white kidney beans; all the proteins in the red kidney beans are inhibited by white kidney beans as concentrations are increased (Figure 1).

Allergy to kidney beans with tolerance to other legumes is rare. Some allergens have been purified and characterized from these legumes. Kasperick and Ownby suggested

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that the major allergens of dry beans were in the albumin fraction [8], and Rouge et al. reported that phaseolin and phytohemagglutinin could be the responsible proteins for the allergic reactions [3]. A 31 kDa and 47.5 kDa proteins are considered major allergens of kidney beans, identified as phytohemagglutinin and phaseolin, respectively [9, 10].

In our study, immunoblotting of white and red kidney beans shows chemiluminescence in bands of approximately 47-50 kDa and 28-31-kDa. The first protein could correspond to a phaseolin in white kidney beans, as previously described by Kumar et al. [10] in red kidney beans. Both proteins show homology in western blot inhibition, results expected as there is no fundamental difference in the protein content between dried kidney beans: white (22,9 g each 100 g) and red (24 g each 100 g). The second protein could correspond to a phytohemagglutinin as described by Kasera [9].

We think that culprit proteins of the allergenicity in both cases could be 47-50 kDa, only detected in white kidney bean with cross-reactivity to red kidney beans.

As described in previous publications, in order to avoid unnecessary diet restrictions, we highlight that legume allergy diagnosis should not be based exclusively on specific IgE evaluation. Although serological cross-reactivity among legumes is very common, its clinical relevance remains controversial [7]. This fact has been evidenced by our second patient, whose tests indicate high IgE levels for more legumes even though he tolerated them. On the contrary, in the first patient, although no reaction was reported with red kidney bean, oral challenge was not carried out due to high positivity on SPT and the demonstrated cross-reactivity between white and red kidney bean in this study, and recommendation of avoidance was made.

In conclusion, we present two documented cases of selective allergy to white and red kidney beans in children, demonstrating IgE-mediated sensitivity and that the detection of protein appeared as a band at 47-50 and 28-31 kDa which could correspond to a phaseolin and phytohemagglutinin proteins, respectively. Further studies are needed to isolate and characterize major allergens of kidney beans and

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establish their allergenicity and assess possible cross-reactivity with other legumes and between different bean species.

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Figure 1. WESTERN BLOT INHIBITION OF RED BEAN VS. WHITE BEAN. Lane 1, red bean not inhibited, lane 2: red bean inhibited with 2.90 mg / mL of red bean (homologous), lane 3: red bean inhibited with 0.045 mg / ml of white bean, lane 4: red bean inhibited with 0.18 mg / ml of white bean, lane 5: red bean inhibited with 0.725 mg / ml of white bean, lane 6: red bean inhibited with 2.9 mg / ml of white bean. C-: negative control: white bean with serum from a non-atopic patient.