CASE REPORT

Anaphylaxis Associated With the Ingestion of Goji Berries (*Lycium barbarum*)

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Abstract

Goji berry (wolfberry), a member of the Solanacea family, has been recently introduced in Western countries and its consumption has increased rapidly. The objectives of the study were to describe the cases of 2 patients who experienced allergic symptoms after Goji berry consumption, to identify the protein profile of the extract, to analyze the allergenic profile of individuals, and to determine cross-reactivity with other members of the Solanaceae family (tomato).

We describe 2 cases of allergic reaction, 1 of which was an anaphylactic reaction, after Goji berry ingestion. A Goji berry extract was manufactured and immunochemically characterized. The patients were skin prick tested with a battery of common aeroallergens including mites, epithelia, and molds. Individuals were also skin prick tested with food allergens, including Goji berries. A positive skin prick test and specific immunoglobulin (Ig) E to Goji berry was detected in both cases. Serum samples recognized a 9-kDa band, probably related to lipid transfer proteins (LTPs). Cross-reactivity with tomato was analyzed by inhibition studies, which showed that the 9-kDa band was totally inhibited by the tomato extract. This study describes the first 2 cases of allergic reaction following Goji berry ingestion. LTPs seem to be involved in allergic sensitization to Goji berries, as evidenced by cross-reactivity with tomato.

Key words: Goji berries. Tomato. Solanaceae. Food allergy. LTP. Anaphylaxis.

Resumen

Las bayas Goji son frutos de la familia Solanaceae. Ha sido recientemente introducida en los países occidentales y su consumo se ha incrementado rápidamente. Los objetivos fueron describir dos casos de pacientes con síntomas alérgicos después del consumo de baya Goji, identificar el perfil proteico del extracto, analizar el perfil alergénico de los dos pacientes y determinar la reactividad cruzada con tomate (Familia Solanaceae).

Se describen dos casos de pacientes, uno con reacción anafiláctica tras la ingesta de bayas Goji. Se preparó un extracto de baya Goji y se caracterizó inmunoquímicamente. A los individuos se les realizaron pruebas diagnósticas cutáneas con la batería estándar de aeroalérgenos estandarizados, incluyendo ácaros, epitelios y hongos, y pruebas a extractos alimentarios, incluyendo baya Goji. En ambos casos se obtuvieron pruebas cutáneas e IgE específica positivas a baya Goji. Los sueros reconocieron una banda de 9 kDa, probablemente relacionada con LTPs. La reactividad cruzada con tomate se analizó mediante inhibición. La banda de 9 kDa se inhibió completamente con el extracto de tomate. Se presentan los dos primeros casos de reacciones alérgicas tras la ingestión de bayas Goji. Las LTPs parecen estar implicadas en la sensibilización como lo demuestra su reactividad cruzada con tomate.

Palabras clave: Bayas Goji. Tomate. Solanaceae. Alergia a alimentos. LTP. Anafilaxia.

Introduction

Goji berry, also known as wolfberry (*Lycium barbarum* and *Lycium chinense*), belongs to the Solanaceae family (Figure 1). It is native to southeastern Europe and Asia and is well known in traditional Chinese medicine. In recent years, interest in Goji berries has increased dramatically, mainly due to their high potential nutrient value (68% of the dry mass exists as carbohydrate, 12% as protein, 10% as fiber, 10% as fat, and there is also a high proportion of antioxidants [1]). Other properties such as health benefits or longevity have been also suggested [2]. These properties have made Goji berries a favorite among healthy lifestyle consumers and individuals wishing to benefit from their claimed weight loss properties. To our knowledge, there are no reports in the literature of allergic sensitization to Goji berries.

The aims of this study were to describe the cases of 2 patients who developed allergic symptoms after Goji berry consumption, to identify the protein profile of the extract, to analyze the allergenic profile of the patients, and to determine cross-reactivity with other members of the Solanaceae family (tomato).

Cases Descriptions

We report the cases of 2 individuals who reported allergic symptoms after Goji berry ingestion. Both were skin prick tested with a battery of aeroallergens consisting of grasses, *Salsola kali*, *Chenopodium album*, *Cupressus arizonica*, *Parietaria judaica*, *Ambrosia elatior* and *Platanus hybrida*, mites (*Dermatophagoides*), epithelia (cat and dog) and mold (*Alternaria alternata*) (Laboratorios LETI S.L., Madrid, Spain). The patients also underwent skin prick testing with food extracts, including peach, tomato, apricot, kiwi, nuts (almond, peanut, hazelnut, and chestnut) and rice; patient 1 was also skin prick tested with green pepper (Laboratorios LETI S.L.).

Finally, the patients were skin prick tested with lipid transfer protein (LTP) from peach and profilin from date palm pollen (ALK Abello, Madrid, Spain). Serum samples from both patients were obtained after oral consent.

Patient 1

A 27-year-old woman who developed grade II anaphylaxis after eating Goji berries (latency, <1 hour), accompanied by acute generalized urticaria on the hands, palms, and soles, lip edema, dyspnea, and acute rhinitis. She attended the emergency department, where her symptoms disappeared within an hour of treatment with adrenaline. She had previously experienced anaphylaxis after eating a salad containing lettuce, tomato, chicken, and tuna. She had also experienced immediate rhinoconjunctivitis and pruritus after handling raw rice but showed no clinical manifestations after eating rice. She also develops rhinoconjunctivitis due to sensitization to grasses, *S kali* and *P judaica*, and follows regular treatment with antihistamines. The skin prick tests were positive for Goji berries, peach, LTP, tomato, and green pepper and negative for profilin, other pollens (*C album*, *C arizonica*, *A elatior*, and *P hybrida*) and foods (apricot, kiwi, nuts, and rice), mold, epithelia, and mites. Specific IgE was measured by ImmunoCap (Phadia, Uppsala, Sweden), with values of 1.27 kUI/L to tomato, 7.4 kUI/L to peach, and 1.38 kUI/L to Goji berry.

Figure 1. Goji berry or wolfberry (*Lycium barbarum*).

Patient 2

A 13-year-old girl who reported generalized urticaria, severe pruritus and skin lesions (hives), angioedema, and dysphagia after Goji berry consumption. She also reported problems after eating almonds and handling rice and oral allergy syndrome after eating tomato, green pepper, peach, and apricot. The skin prick tests were positive for *C album*, *A elatior, P hybrida*, and *C arizonica* and the following foods: Goji berry, peach, kiwi, almond, peanut, hazelnut, chestnut, rice, tomato, and LTP. The tests were negative for profilin, grasses, *S kali*, *P judaica*, mites, mold, and epithelia. She had positive specific IgE to tomato (18.4 kUI/L) and Goji berry (16.9 kUI/L).

The Goji berry extract was manufactured (Laboratorios LETI S.L, Madrid, Spain) following a previously described methodology [3]. After homogenization and extraction in buffer solution (PBS/PVPP 0.01 M), the extract was centrifuged and the supernatant collected, dialyzed, filtered, and freeze-dried. The protein content was 482 μg/mg freeze-dried material. A skin prick test, at 5 mg/mL, was prepared.

The protein profile was analyzed by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) (80 μg). Several bands within a molecular weight range of 9 and 100 kDa were visualized, the most prominent of which were at 9, 25, 66, and 100 kDa approximately (Figure 2A). Electrophoretically separated bands were electrotransferred to an Immobilon-P membrane (Millipore, Bedford, Massachusetts, USA) and the allergenic profile of both patients was studied. A 9-kDa band was clearly visible in patient 2 and less so in patient 1 (Figure 2B). The molecular weight of the band and the clinical profile of both individuals suggested a possible relationship between this protein and LTPs.

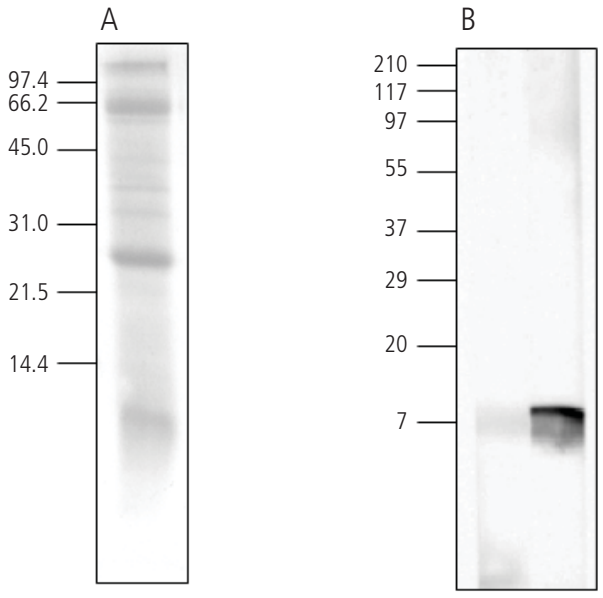

Figure 2. Protein and allergenic profile. A, Sodium dodecyl sulfate polyacrylamide gel electrophoresis. Protein profile of Goji berry extract (80 µg of protein). B, Individual immunoblot. Solid phase, Goji berry extract (80 µg). Lane 1, serum sample from patient 1; Lane 2, serum sample from patient 2. Serum samples were diluted 2:3.

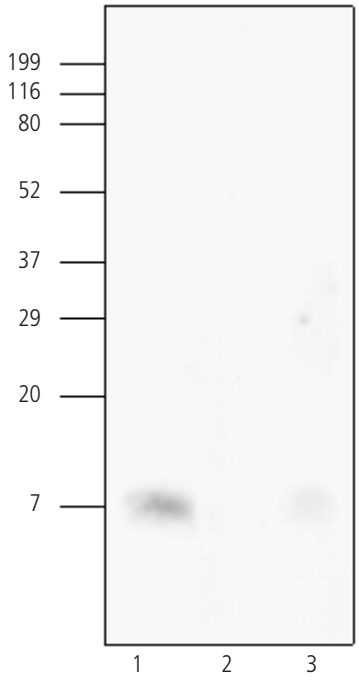

Figure 3. Immunoblot inhibition. Goji berry extract (80 µg of protein). Pool of sera prepared with serum samples from 2 individuals. Lane 1, no inhibition; lane 2: inhibited with 800 µg of Goji berry extract; lane 3, inhibited with 800 µg of tomato extract.

Cross-reactivity with tomato extract (Solanacea family) was investigated. Tomato extract was used for immunoblot inhibition experiments. Briefly, Goji berry extract was coated in solid phase (80 µg). A pool of sera was prepared with an aliquot from each serum sample and preincubated with Goji berry (800 µg) and tomato extract (800 µg) for 2 hours. Results showed a positive inhibition of the 9-kDa band with tomato extract, demonstrating a high degree of cross-reactivity. Tomato LTP, previously identified by mass spectrometry [4] is an important tomato allergen and could be responsible for the Goji berry inhibition observed (Figure 3). Total inhibition was detected when Goji berry was self-inhibited.

Discussion

Despite the increasing consumption of Goji berries in Western countries, sensitization or allergy to this fruit has not been previously reported. We have described the first 2 cases of allergy following Goji berry consumption, one of which was associated with severe symptoms and anaphylaxis, demonstrating the high allergenicity of this fruit. A skin prick test with Goji berry extract as well as specific IgE to this fruit confirmed the specific nature of the sensitization.

On the other hand, results obtained through in vitro experiments, performed following an analysis of the allergenic profile of the 2 patients, showed a 9-kDa band, suggesting that the corresponding protein might be related to LTPs. Since Goji berries and tomato belong to the same botanical family, and since in both cases the patients were sensitized to tomato, we decided to analyze cross-reactivity between Goji berry and tomato peel extracts. The results demonstrated a high degree of cross-reactivity, as evidenced by immunoblot inhibition. The tomato peel extract inhibited the 9-kDa band in Goji berries, suggesting that it might correspond to an LTP [4]. This would also demonstrate a high level of homology between LTPs from tomato and Goji berries confirming, once again, the homology between LTPs from different food species [5].

In conclusion, similarly to the situation with other fruits in Mediterranean countries [6], LTPs seem to play a significant role in Goji berry sensitization. Further studies are necessary to describe and identify the allergens involved and the allergenic profile of sensitized individuals.

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