

### ALLERGENS IN EGGPLANT (*SOLANUM MELONGENA* L.)

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#### Abstract

Eggplant has some important biological properties such as laxative, analgesic, maturant, cardiogenic, aphrodisiac, anti-inflammatory, stimulant, antipyretic and can improve appetite. To date a number of allergens (immunologic and non-immunologic) have been identified from eggplant. This paper sketches a current scenario on the allergens found in this vegetable. Evidences from the electronic databases such as PubMed, Science direct and google scholar have been included in this review. Eggplant-derived allergens are evident to induce immunoglobulin E (IgE), suggesting the occurrence of IgE-mediated allergic reactions in human and other animals. Anaphylaxis, itching, mild headache, stomach upset, urticaria, hoarseness, unpleasantness, rashes, facial edema and oral allergy are frequently occurring allergic phenomena in human and rodents. In conclusion, adequate precautions should be taken to eating and handling of eggplants, especially in atopy.

**Keywords:** *Solanum melongena*; atopy; food allergens

## Introduction

Eggplant (*Solanum melongena* L.) belongs to the family Solanaceae is a vegetable, cultivated in many countries in the world. Among them, China, India, Iran, Egypt, and Turkey are in a leading position in the production of eggplant. It's the third most important Solanaceae crop after the tomato and potato, particularly in China and India (Ramesh et al., 2016). Eggplant is mainly habituated in North America, Australia, New Zealand, UK, Franch, South Asia and South Africa. This stout herb is composed of 92% water, 6% carbohydrates, 1% protein, and negligible fat. It contains 11% Mnalong with small amounts of essential other nutrients (San José et al., 2014).

To date, a number of chemical substances have been identified in eggplant, such as 4-ethylactechol, trans-caffeic, hydrocafeic, protocatechuic and chlorogenic acids,  $\gamma$ -Hydroxyglutamic acid, lanost-8-en-3 $\beta$ -ol, lanosterol, 24-methylene lanost-8-en-3 $\beta$ -ol, cycloartanol, cycloartenol, 24-methulenecycloartanol, lupeol,  $\beta$ -amyryn, daturaolone, daturadiol, 4 $\alpha$ -methylsterols, vanillin, isoscopeletin, ethyl caffeate, trans-ferulic acid, p-aminobenzaldehyde, 7S vicilin, N-trans-feruloyltyramine, N-trans-p-coumaroyltyramine, N-trans-feruloyloctopamine, N-trans-p-coumaroyloctopamine and solasodin (<http://www.mpbd.info/plants/solanum-melongena.php>; Jain and Salunke, 2015).

The unripe fruit of eggplant is laxative, analgesic, maturant, cardiotoxic and aphrodisiac; improves appetite and lessens inflammation. The seeds are used as a stimulant, while the flower juice is antipyretic (<http://www.mpbd.info/plants/solanum-melongena.php>). In a study, aqueous extract of white eggplant (1 g/kg) was found to inhibit completely compound 48/80-induced anaphylactic reaction coming from the immunoglobulin E (IgE) in rat peritoneal mast cells, suggesting that the eggplant extract may inhibit immunologic and nonimmunologic stimulation-mediated anaphylactic reactions and tumor necrosis factor-alpha (TNF- $\alpha$ ) secretion from the mast cells (Lee et al., 2001). However, the eggplant contains some allergens, that can cause some mild to serious health problems. This review aims to sketch a current scenario on the allergens found in eggplant and

their effects in biological systems, especially in human and rodents.

## Methods

An up to date (December 2017) search was made in the following databases: PubMed, Science direct and google scholar with the key word '*Solanum melongena*' and/or 'Eggplant', which was then paired with 'allergens', and 'allergic reactions'.

## Findings

In total 17 articles were included in this review. Overall search strategy (inclusion and exclusion criteria) has been shown in Figure 1.

Scientific evidence suggests that the evidence on eggplant induced allergic reactions are not sufficient. Still, there is a lack in mechanism of actions of most of the allergens identified in eggplant. Only six studies were seen those have been done on human (clinical), while one in rodent (pre-clinical) and one both in rodents and human (clinical + pre-clinical). Nine non-clinical studies were seen on this allergic plant. The overall findings have been written below.

Upon handling or eating of eggplant is evident to cause itchy skin or mouth, mild headache, and stomach upset in human. The leaves of this plant are evident to cause contact dermatitis (Kabashima and Miyachi, 2004), while flower pollen allergy in human (Gerth van Wijk et al., 1989). A study conducted with 741 Indian people suggests that commonly consumption of eggplant induced allergic symptoms nearly in 10% people, with 1.4% showing symptoms within two hours (Harish Babu et al., 2008). It may be due to eggplant contains high amount of histamines or it may stimulate mast cells for the secretion of histamines in atopic patients. Some proteins and secondary metabolites have been identified as potential allergens in eggplant (Pramod and Venkatesh, 2008), that may show IgE reactivity (Hoseini-Alfatemi et al., 2015).

Babu and Venkatesh (2009) demonstrated that the eggplants are multiallergenic vegetables as peel, pulp, raw, and cooked eggplant extracts can sensitize positive skin prick. The raw eggplant contains some glycoproteins (allergens) that are heat-stable and are capable to cause retention of IgE during simulated gastric fluid digestion.

Different species of eggplant contains different amounts of histamines, among them the green round eggplant by 0.241 and 0.207 mg/kg in its fresh weight in raw and cooked extracts, respectively. Histamine, a stable to heat-processing, since only 11-14% loss is occurring upon cooking and it can cause some allergic phenomena on the skin of human and other animals (Kumar et al., 2009). Not only histamine but also other, non-protein components present in eggplant may also show allergic type pharmacological effects in human. However, IgE-mediated allergies are more frequent in females than the males (Harish Babu et al., 2008).

A number of allergens (protein band between 22 and 36 kDa, a band near 36 kDa, and a band between 36 and 50 kDa) have been identified as IgE-binding proteins in eggplant in a case of anaphylaxis with cross-reactivity to latex (Lee et al., 2004). Ingestion of eggplant (4 varieties) in an atopic subject resulted urticaria, itching of the throat, and hoarseness (Pramod and Venkatesh, 2008). The authors also suggested that nonprotein allergenic compounds found in eggplant, such as pigments (cyanidin, delphinidin, lycoxanthin, and nasunin), alkaloids (solamargine, solanidine, solanine, solasodine, solasonine, and trigonelline), and phytosterols might induce those phenomena.

Eggplant is also evident to cause unpleasantness, rashes, facial edema, oral allergy, itching between the fingers, itching in the throat, and general urticaria in human (Pramod and Venkatesh, 2004). In a recent study, the 64 and 71 kDa allergens as polyphenol oxidase (PPO) based food allergens have been identified (Harish Babu et al., 2017). The main function of PPOs in the plant is defense (Mishra and Gautam, 2016).

### Discussion

IgE, a type of antibody (or immunoglobulin), synthesized by the plasma cells found in mammals, has an essential role in type I hypersensitivity (Gould et al., 2003). IgE plays an important role in responses to allergens, including food allergens. IgE after specifically recognizing an allergen, capable to induce inflammatory reactions by releasing chemicals like histamine, leukotrienes, and some interleukins. These chemicals cause many allergic symptoms, such as allergic asthma, eczema, increased mucus secretion, sinusitis, allergic rhinitis,

chronic urticaria and atopic dermatitis. Atopic individuals having more than 10 times IgE levels than non-atopic individuals (Takhar et al., 2005). IgE is also known to elevate various autoimmune disorders such as lupus, rheumatoid arthritis and psoriasis (Elkayam et al., 1995).

The eggplant contains a very low level of protein (1% of fresh weight). However, to date, a number of IgE-binding proteins with varying in molecular mass have been identified in this vegetable (Harish Babu and Venkatesh, 2009), among them only the 6 kDa protease inhibitor has been studied broadly (Richardson, 1979), while others partially or incompletely such as PPO (56 kDa) (Mishra et al., 2012); lipoxygenase (97 kDa) (Pérez-Gilabert et al., 2001), and linoleate hydroperoxide iso-merase (298 kDa, three 97 kDa subunits) (Grosman et al., 1983). Recently, two heat-stable allergens of 15 and 35 kDa have been detected in eggplant causing allergy in human (Hoseini-Alfatemi et al., 2015). Therefore, precautions are necessary to eat and handle eggplants, especially the green eggplants. More precautions are suggested to atopic patients, who are suspected to have a hereditary component developing certain allergic hypersensitivity immediately in contact to many allergens, including the food allergens.

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### Conflict of Interest

None declared.

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**Figure 1.** Search strategy, and inclusion and exclusion criteria