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Better treatment of food allergies Risks in your food

Food allergies have been on the increase for years. There is currently only one solution for patients: avoid allergy-triggering products. Fraunhofer researchers are making an important contribution to consumer protection by developing methods to specifically and reliably detect allergenic substances in foods. In addition, they are helping to establish processes that reduce the allergy-triggering properties of food ingredients. Their research work focuses on soy.

Eating is not a pleasurable experience for everyone. After a meal, many people suffer from abdominal pain, itchiness or diarrhea. These complaints are often caused by a food allergy. Particularly peanuts, fish, milk, cereals containing gluten, eggs, celery, crustaceans, edible nuts, mustard, sesame seeds and soy proteins trigger the undesired reactions. Those affected have no other choice but to avoid food with “their” allergen. However, this is no easy task – even the smallest quantities of allergens can get into food unintentionally, for instance when different products are processed in one machine. Since these traces are not an ingredient, they are not always listed on the packaging. The hidden allergens in foods pose a health risk for people with food allergies.

In the LowAllergen project, several Fraunhofer institutes are joining forces to improve the situation of those with food allergies. The four institutes – The Fraunhofer Institute for Cell Therapy and Immunology IZI, for Process Engineering and Packaging IVV, for Molecular Biology and Applied Ecology IME and for Toxicology and Experimental Medicine ITEM – are working together on the development of innovative food allergy analyses, the reliable evaluation of allergens, the reduction of the allergenic potential of foodstuffs and detection methods that exactly determine this. The aim is to identify allergenic proteins and establish technologies to remove these during food production or treat them so that they no longer cause allergies. They are cooperating with Leipzig University Hospital for this purpose.

Hardly any non-allergenic foodstuffs on the shelves

“To date there are no food products, except for baby food, that are hypoallergenic and contain few allergens. The production of such products is very complex. One reason for this is that although the allergenic components of food ingredients can generally be detected, to date, it is not possible to determine their specific allergenicity,” says Dr. Michael Szardenings, group manager at IZI. Yet, taking soy as an example, the re-

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searcher and his team have now succeeded in doing exactly this. “The human body can develop antibodies against all kinds of foreign substances. According to our findings, in the case of soy, this occurs in more places in the allergenic proteins than expected.” Now the scientists have established a method that can be used to identify the allergenic components/regions of proteins recognized by the patient’s antibodies – experts call these epitopes – directly in the antibodies in the blood serum. “Antibodies activated in a person with an allergy are directed against specific molecular sections of the allergens. Patients react to these molecular sections, known as epitopes. We were able to identify 374 allergy-relevant epitopes,” said the subproject manager. To this end, the researchers analyzed 50 blood sera of patients with a soy allergy. During the process, they used a peptide phage display refined at the institute, a method which, among other things, is used for studying proteins and for clarifying antibody interactions.

Soy proteins that trigger fewer allergies

In addition, colleagues at Fraunhofer IVV in Freising showed that soy proteins can be modified so that they are less allergenic. Soy protein isolates were produced and modified using a wide variety of methods. Various heating methods were applied, such as treatment with plasma, pulsed UV light, gamma radiation and high pressure as well as chemical, enzymatic and fermentative processes. Scientists were able to extract soy protein ingredients with especially low immune reactivity, particularly via the combination of enzymatic hydrolysis and a microbial fermentation. “Enzymatic hydrolysis aims to reduce the epitopes, the allergenic components of the proteins. Special epitopes, known as conformational epitopes, can also be eliminated through the folding and unfolding of the protein structure or the amino acid sequence of the proteins is destroyed,” explains Dr. Peter Eisner, a scientist at Fraunhofer IVV and project coordinator. The soy proteins produced in this manner also have improved sensory properties, including better taste. “We have already filed a patent application for the production of hypoallergenic protein preparations,” says Eisner.

New allergy test – a drop of blood suffices

Through the FoodAllergen project, the scientists want to build on their research results and apply established methods to other food allergies. To continue improving patient diagnostics, Fraunhofer researchers at IVV, IZI and IME are planning to examine the sera of allergy sufferers on a large scale in cooperation with Leipzig University Hospital. One aim is a biobank with more than 500 sera of those affected. “We are working on a test that will enable a broad range of food allergies to be detected with just one drop of the patient’s blood,” according to Szardenings. This would also allow for better detection of cross reactions that typically occur in the skin test– known as the prick test – used in medical practices and that cannot be separated. For example, if someone is allergic to birch pollen, his or her antibodies often react to soy proteins. This means the prick test finding would be positive although the person concerned is not actually

allergic to soy. "With our test, one can precisely determine whether there is a risk of a soy allergy. It could even be evaluated immediately at the medical practice," says Szardenings. Another idea from the researchers is to combine the evaluation with an app in the future. "A person takes a photo of the test with his smartphone. He receives the result shortly after via the app, which is connected with the evaluation software." The FoodAllergen project was launched in the spring of 2016 and runs until March 2019. The Fraunhofer Future Foundation is sponsoring the project with a sum of EUR 6.6 million.

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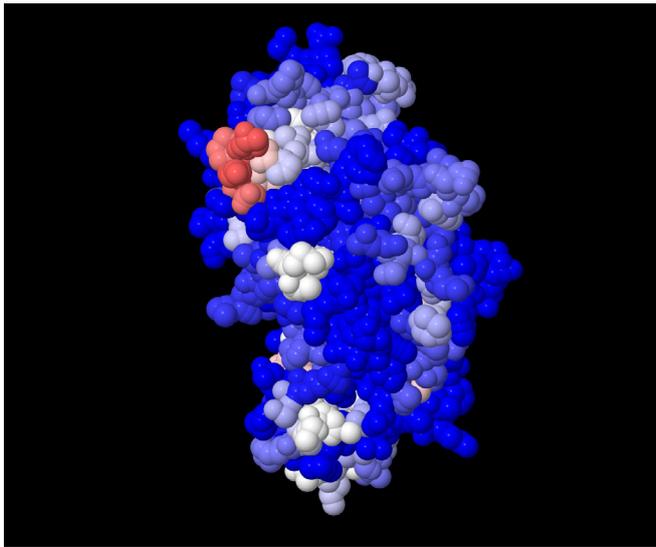
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How an allergy develops

An allergy is a misdirected immune response. A harmless substance is initially perceived to be "foreign" to the body – as an antigen – and antibodies are formed in the process. In most people, the protein/antigen in the foodstuff concerned initiates the formation of antibodies but not an allergic reaction. In the worst case, however, the body forms special IgE antibodies that originally served to ward off parasites. Repeated contact with the allergenic substance triggers the allergic reaction through these already formed IgE antibodies that are bound to certain cells of the immune system – the mast cells. The mast cells then release inflammatory messengers such as histamine that cause the actual, commonly known allergic reactions in the patient's body.

LowAllergen project**Tasks of the Institutes**

- Fraunhofer Institute for Process Engineering and Packaging IVV, Freising: Coordinating the project; producing soy proteins, modifying and characterizing proteins
- Fraunhofer Institute for Cell Therapy and Immunology IZI, Leipzig: Building up a sera bank; identifying and validating allergy-relevant epitopes; producing antibodies against allergenic epitopes and allergen detection assays based on this
- Fraunhofer Institute for Molecular Biology and Applied Ecology IME, Aachen: Producing protein standards (recombined allergens) for allergy and food diagnostics
- Fraunhofer Institute for Toxicology and Experimental Medicine ITEM, Hannover: De novo sequencing of low abundance antibodies using mass spectrometry



3-D space-filling model of a soy antigen. The areas identified most frequently by the antibodies of patient sera are shown in white or even red, unidentified areas are colored in blue. © Fraunhofer IZI | Picture in color and printing quality: www.fraunhofer.de/en/press

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