

# **Fermented plant soy protein — allergenicity analysis**

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## KEYWORDS:

Soy  
Allergenicity  
Pet Food  
Protein  
Nutrition  
Fermentation



## Fermented plant soy protein – allergenicity analysis

### Overview

Any protein source can elicit an allergic reaction and more than 200 foods have been demonstrated to be allergenic<sup>1</sup>. Regulatory bodies acknowledge the necessity of refining allergen labeling regulations by focusing on a specific set of priority allergens, previously identified as the ‘Big 8.’ At present, the foods that are subject to mandatory labeling requirements in the United States (milk/dairy, eggs, fish, crustacean shellfish, tree nuts, peanuts, wheat, and soy, with the recent addition of sesame) are recognized as contributing to approximately 90% of food allergy reactions among Americans. However, there is significant variation in the prevalence of allergies to each of the protein sources.

**“ Soy is the least allergenic of the ‘Big 8’ (allergens)”**

Surveys in North America indicate that soy allergy has a lower prevalence compared to the other seven major allergens, with an estimated three adults per 1,000 being allergic to soy<sup>2</sup>. In contrast, the prevalence of milk/dairy allergy is 5–10 times higher than that of soy allergy (Table 1). While soy is included in the Big 14 allergens in Europe, the prevalence of soy allergy among Europeans seems to be lower than for many commonly consumed foods not covered by the Big 14. Consequently, a recent CODEX expert report recommended excluding soy from mandatory allergy labeling requirements<sup>3</sup>.

Self-reported Prevalence of Food Allergy Among US and Canadian Children and Adolescents for the Major Food Allergens (Percent of Population)

| Food                 | US NHANES <sup>12</sup> | US NIAID-Children <sup>3</sup> |         | Canada <sup>14</sup> (SCAAALAR) |
|----------------------|-------------------------|--------------------------------|---------|---------------------------------|
|                      |                         | All Ages                       | 14-17 y |                                 |
| Years data collected | 2007-2010               | 2015-2016                      |         | 2008-2009                       |
| Any food             | 6.53                    | 7.6                            | 7.1     | 7.14                            |
| Peanut               | 1.16                    | 2.2                            | 2.1     | 1.77                            |
| Milk                 | 1.94                    | 1.9                            | 1.1     | 2.23                            |
| Shellfish            | 0.87                    | 1.3                            | 1.5     | 0.55                            |
| Tree nuts            | 0.52                    | 1.2                            | 0.9     | 1.73                            |
| Egg                  | 0.64                    | 0.9                            | 0.5     | 1.23                            |
| Fin fish             | 0.43                    | 0.6                            | 0.6     | 0.18                            |
| Wheat                | 0.29                    | 0.5                            | 0.4     | 0.45                            |
| Soy                  | 0.25                    | 0.5                            | 0.2     | 0.32                            |
| Sesame               | NA                      | 0.2                            | 0.1     | 0.23                            |

Abbreviations: NIAID, National Institute of Allergy and Infectious Disease; NHANES, National Health and Nutrition Examination Survey; SCAAALAR, Surveying Canadians to Assess the Prevalence of Food Allergies and Attitudes Towards Food Labelling and Risk. NUTRITION TODAY

Messina M & Venter C (2020) Recent surveys on food allergy prevalence. Nutr Today 55, 22-29.

- 8 major food allergens account for 90% of the food allergy reactions
- Allergens are assessed by
  - Prevalence
  - Dose/Threshold
  - Severity of reaction
- Soy is the least allergenic of the ‘Big 8’.

<sup>1</sup> Susan L. Hefle, Julie A. Nordlee & Steve L. Taylor (1996) Allergenic foods, Critical Reviews in Food Science and Nutrition, 36:sup001, 69-89, DOI: [10.1080/10408399609527760](https://doi.org/10.1080/10408399609527760)

<sup>2</sup> Messina, Mark PhD, MS; Venter, Carina PhD, RD. Recent Surveys on Food Allergy Prevalence. Nutrition Today 55(1):p 22-29, 1/2 2020. | DOI: [10.1097/NT.0000000000000389](https://doi.org/10.1097/NT.0000000000000389)

<sup>3</sup> FA) and WHO. 2022. Risk Assessment of Food Allergens. Part 1- Review and validation of CODEX Alimentarius priority allergen list through risk assessment. Metting Report. Food Safety and Quality Series No 14. Rome.



## Fermented plant soy protein — allergenicity analysis

### Pet food analysis

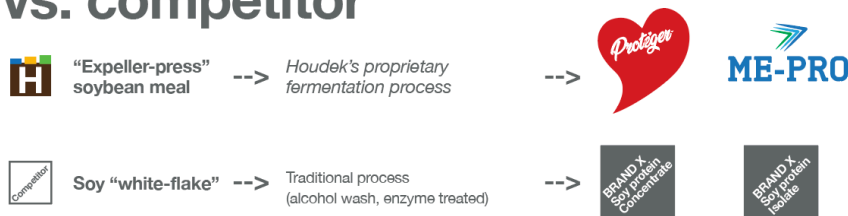
The primary sources of food allergens for dogs include beef (34%), chicken (17%), milk and dairy products (15%), lamb (15%), and wheat (14%). In the case of cats, significant food sources triggering Adverse Food Reactions (AFR) include beef, chicken, and fish. For horses, anecdotal evidence suggests that foods associated with AFR may include potatoes, malt, beet pulp, buckwheat, fish meal, wheat, alfalfa, red and white clover, St. John's wort, chicory, barley, and oats<sup>4</sup>.

The epitopes of the  $\beta$ -subunit of soybean seed storage protein  $\beta$ -conglycinin is a known allergen in humans and has also been found to be antigenic (though not allergenic) in pigs, dogs, rabbits, and fish<sup>5</sup>. Notably, soy is a common ingredient in many pet foods and is recognized as a known food allergen in dogs.

***“(Houdek is developing products that have significant reductions in proteins identified to have potential to be allergens).”***

Houdek is actively pursuing the development and commercialization of fermented soy protein ingredients that display significant reductions in the proteins that have previously been identified as having potential to be allergens in both humans and companion animals. In particular, Soy Trypsin Inhibitor (STI) and Glycinin proteins have been used in the development of commercial test kits by multiple vendors for the detection of these known soy allergenic proteins. In collaboration with the Food Allergy Research and Resource Program (FARRP) at the Univ of Nebraska-Lincoln (UNL), Houdek conducts surveys of the soy allergen content of both its fermented plant protein ingredients (i.e. ME-PRO® and Protéger™) and those of other soy protein ingredients used in companion animal diets, ranging from unrefined, expeller meals and High Protein Dispersibility Index (PDI) soyflour, to more highly refined soy protein concentrate (SPC) and hydrolyzed soy protein isolate (SPI-H), as described in the Figure below.

## Houdek fermentation process vs. competitor



All samples tested with four commercial soy ELISA kits

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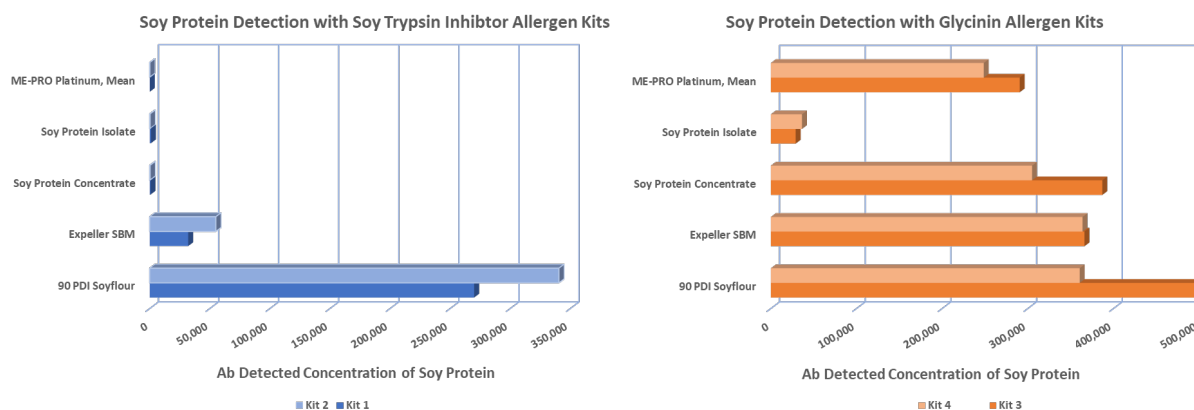
<sup>4</sup> I. Pali-Schöll, M. De Lucia, H. Jackson, J. Janda, R. S. Mueller, E. Jensen-Jarolim. Eur Journal of Allergy and Clinical Immunology. Comparing immediate-type food allergy in humans and companion animals—revealing unmet needs. 72(11): p. 1643-1656, 2017. DOI: <https://doi.org/10.1111/all.13179>

<sup>5</sup> Jeffers JG, Meyer EK, Sosis EJ. Responses of dogs with food allergies to single-ingredient dietary provocation. J Am Vet Med Assoc. 1996; 209: 608-611.

## Fermented plant soy protein – allergenicity analysis

### Pet food analysis, cont.

The four commercially available kits utilized detect and quantify distinct soy target proteins including trypsin inhibitor (STI), soy glycinin proteins (11S) and the soy globulins (7S) abundant in soy. The relative results from the comparative processed protein ingredients are shown below (Figure). The results for the source material are not pictured due to the significantly higher allergen response seen with two types of minimally processed soybean meal, namely expeller soybean meal where shear, pressure and heat, rather than hot hexane is used to remove much of the oil from the soybean, and so-called High Protein Dispersibility Index (PDI) soyflour or “white flakes” where hot hexane, but only indirect steam treatment is used to remove essentially all of the crude oil from the soybean. Commercial lots of ME-PRO Platinum™ both demonstrated dramatically lower STI allergen content and substantially lower glycinin/b-conglycinin allergen content than that seen in both of the minimally processed expeller soybean meal or High PDI soyflour.



The current process of production of ME-PRO Platinum results in a dramatic reduction of specific soy allergens (STI), compared to the ISP and SPC ingredients currently used in market applications (Kits 1 & 2, [pictured on left](#))<sup>6</sup>. Differences were less pronounced in glycinin detecting kits (Kits 3 & 4, [pictured on right](#)), where ME-PRO Platinum demonstrates slight improvement over SPC but not the commercially available ISP in use in certain therapeutic petfood applications.

Our efforts to date confirm that Houdek’s plant-based fermentation process does not result in an increase in known soy allergens in the ME-PRO Platinum products surveyed. In fact, Houdek’s plant based fermentation process results in a profound reduction in the soy proteins that are detected by kits that primarily detect STI allergens. The reduction in STI allergens is comparable to or better than that seen with SPC and even hydrolyzed SPI that is commonly used in hypoallergenic diets used for companion animals. The reduction in Glycinin allergens while not as profound as that seen to date with STI allergens is nonetheless incrementally better than that found in expeller meal and High PDI soyflour

## Fermented plant protein Protéger™ — allergenicity analysis

### Pet food analysis, cont.

fermented plant protein Proteger, and SPC. Innovation programs are actively underway at Houdek to improve this important quality attribute and these improvements will be brought to the petfood industry and our customers as they are robustly validated at our commercial production facility and in collaboration with UNL FARRP. These benefits will build upon the significant nutrition, animal health, and sustainability benefits already seen to date from Houdek's plant-based fermentation platform.

Susan L. Hefle, Julie A. Nordlee & Steve L. Taylor (1996) Allergenic foods, *Critical Reviews in Food Science and Nutrition*, 36:sup001, 69-89, DOI: [10.1080/10408399609527760](https://doi.org/10.1080/10408399609527760)

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