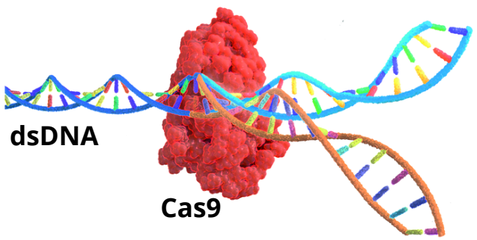
CRISPR/Cas9 Against Major Food Allergens



1. Food allergy prevalence is increasing worldwide, with **5 out of 9 common allergens** derived from **plants**.

2. **CRISPR** technology is able to **delete allergen genes** precisely.

Self-reported food allergy (% population)

	🇺🇸	🇨🇦	🇪🇺
Wheat	0.7	0.9	3.6
Tree nuts	1.2	1.8	1.3
Peanut	1.9	1.4	0.4
Soybean	0.6	0.5	1.5
Sesame	0.2	0.3	0.1

Data sources: FARE; Goverment of Canada; EFSA


Wheat

- Target: **α-gliadins**

CRISPR/Cas9 targets immunodominant epitope 33-mer peptide in **bread** and **durum wheat** cultivars. **Gluten content and immune reaction reduced by 85%**.[1]

- Target: ATI subunits **WTAI-CM3** & **16**

*ATI: α-amylase/trypsin inhibitors

CRISPR/Cas9 transgene free-plants in **durum wheat**. Next, test whether the lines are more **susceptible to pathogen infections**.[2]


Peanut

- Target: **Ara h1**, **2**, **3** & **6**

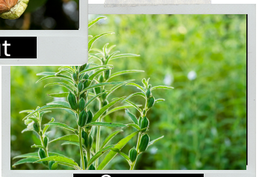
RNAi crops with up to **25% of the seeds not expressing Ara h 2**, major immunodominant allergen in peanut. In progress, CRISPR/Cas9 quadruple knockout for the four Ara genes.[3,4]


Soybean

- Target: **Gly m Bd 28k** & **Gly mBd 30k**

CRISPR/Cas9 transgene free-plants in **Enrei and Kariyutaka** Japanese varieties. **First step** to produce **hypoallergenic soybean** plants.[5]


Walnut


Sesame

CRISPR/Cas9 editing has been **successfully implemented in sesame and walnut** (tree nut with the highest allergy incidence), opening doors to allergen deletion.[6,7]

CRISPR: Clustered Regularly Interspaced Short Palindromic Repeats; RNAi: Ribonucleic Acid interference

Ref. (1) Sanchez-Leon, S., et al. (2018). Low-gluten, nontransgenic wheat engineered with CRISPR/Cas9. Plant Bio J 16, 902-910. (2) Camerlengo, F., et al. (2020). CRISPR-Cas9 multiplex editing of the α-amylase/trypsin inhibitor genes to reduce allergen proteins in durum wheat. Front in Sust Food Syst 4, 104. (3) Dodo, HW., et al. (2008). Alleviating peanut allergy using genetic engineering: the silencing of the immunodominant allergen Ara h 2 leads to its significant reduction and a decrease in peanut allergenicity. Plant Bio J 6, 135-145. (4) Dodo, HW. (2021). SBIR Phase II: Development of an Allergen-Free Peanut Using Genome Editing Technology. SBIR-STTR. (5) Sugano, S., et al. (2020). Simultaneous induction of mutant alleles of two allergenic genes in soybean by using site-directed mutagenesis. BMC plant biol 20, 1-15. (6) You, J., et al. (2022). CRISPR/Cas9-Mediated Efficient Targeted Mutagenesis in Sesame (Sesamum indicum L.). Front in Plant Sci 13. (7) Chang, Y., et al. (2022). Robust CRISPR/Cas9 mediated gene editing of JrWOX11 manipulated adventitious rooting and vegetative growth in a nut tree species of walnut. Scientia Hort 303, 111199.