Insects as a Potential Food Allergens

Phil Johnson
Overview

► Food Allergy
► Cross-reactivity
► Current evidence for cross-reactivity
► Opinions on handling food insects as allergens
► Gaps in our knowledge
► Cross-reactivity: a growing issue with novel foods?
FARRP

• Food Allergy Research and Resource Program
• Department of Food Science and Technology at UNL
• Industrial consortium (approx. 90 member companies)
• Provide advice, guidance and analysis to food industry
• Basic and applied research on food allergens

• Involvement in assessment of novel foods (both GMO and non-GMO) including preparation of GRAS submissions
Insects do not pose a unique or in any way unsurmountable allergy risk

- The assessment of potential allergy risk is a requirement of novel food evaluations (e.g. GRAS)
- The primary purpose of these evaluations is to provide information to those likely affected and allow the mitigation of any identified risk
Food Allergy

- Reaction to **protein** in a food
- Symptoms range in severity
- Higher in West (3-4%) than East (often poor data) – correlated with wealth
- No standardized cure
- Avoidance only control
- Labeling in most Western economies, increasingly prevalent elsewhere
Cross-reactivity

In practical terms: **the ability of a food to cause a reaction in someone allergic to another food**

Cross-reactivity to the following foods are by far the most significant issue:
Arthropods we eat

The more related two organisms are:
• The more likely it is that the proteins they contain will be the same
• The more likely that a cross-reaction will occur
Introducing a new food to the Western population

In the West

• Traditionally eat crustacea
• Do not eat insects

• Has shellfish allergy
• Has a higher rate of food allergy

We are introducing a novel food similar to a known allergen to a potentially sensitive population
Is there evidence for cross-reactivity?

For most techniques we use either blood from shellfish allergics or the patients themselves.

- **Serological testing** provides evidence that antibody in the patients blood can bind one/more proteins in the food.
- **DBPCFC** considered the ‘gold standard’ of allergy diagnosis, and proof of allergenicity.
- Researchers favor less difficult techniques which give molecular information.

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Serological and homology studies across insects

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Cross-reactivity with shellfish allergens is a key concern with insect consumption

Western blotting is a type of serological testing

We can see individual proteins from a food which bind IgE from the blood of allergic patients

We looked at:
- Cricket
- Mealworm
- Superworm
- Waxworm
- Shrimp
- Black soldier fly
- Madagascar cockroach
- House dust mite
- German cockroach
- Cochineal*
Cross-reactivity with shellfish allergens is a key concern with insect consumption

Most shellfish allergic sera:
• Reacted to insect proteins
• Reacted to tropomyosin: a ubiquitous muscle protein
• Showed less reactivity to waxworm, superworm and mealworm than to other insects
Tropomyosin is an especially problematic allergen

- Tropomyosin from shrimp is similar to that from a range of insects
- Importantly, the parts of the protein to which human IgE binds are mostly identical or similar
- We do not have full length tropomyosin sequences from cricket, but cDNA cloning and mass spectrometry experiments confirm the cricket tropomyosin is unlikely to be significantly different
Cricket tropomyosin is likely to be difficult to digest

• Tropomyosin from cricket is also resistant to digestion by pepsin, the major protease in the human stomach; and trypsin and chymotrypsin, major proteases in the duodenum

• Protease resistance is used as an indicator for potential allergenicity in the GM risk assessment process
Clinical studies on mealworm

- Protein homology
- Serological testing (e.g. ISAC)
- Skin-prick test
- Open challenge
- DBPCFC

Computer
Lab (blood)
Clinic
Clinic
Clinic
DBPCFC of shellfish allergics with mealworm

- Confirmed mealworm allergy in **13 out of the 15** subjects
- **Symptoms were typical** of those we would expect from shrimp consumption
- Although a limited set of individuals was studied, it was concluded that shellfish allergics react to roughly the same amount of mealworm as they do shrimp
- It is likely that **insects do not pose more of a risk than does shrimp**

- The levels of shrimp required to cause a reaction are typically far higher than other allergens
How should manufacturers of insect foods handle the allergy problem? (my take)
Labeling and consumer information

Insects are in no way a unique cross-reactive allergen issue. With more protein-rich novel foods entering the market, the issue is likely to grow.

Problem: the food poses a risk to people who are allergic to another food

• We cannot label the food as containing the other food
• We should also consider the wellbeing of consumers

Regulators have not provided advice to manufacturers regarding cross-reactivity. BUT the following solution has not been challenged (as yet):

Label the food as ‘May not be suitable for shellfish allergics’ or similar.
Existing labels

**PEOPLE WHO HAVE AN ALLERGIC REACTION TO SHELLFISH CAN HAVE A SIMILAR REACTION WHEN EATING INSECTS.**

**Indications:** contains tree nuts and crickets. If you have a Crustacean shellfish allergy, you may be allergic to this product.

**Ingredients:** Crickets (Acheta Domesticus) (Crustaceans) 88% (Freeze-Dried, Un-Seasoned), Hot Chilli Marinade 12% (Soy Sauce, Fresh Chillies, Paprika, Sesame Seeds).

**Allergy Advice:** For allergens including cereals containing gluten, see ingredients in **Bold.** May contain traces of Wheat.

**Individuals with a crustacean shellfish allergy, may be allergic to crickets.**

**Contains Nuts. If you have a Shellfish Crustacean allergy, you may be allergic to this product.**

**ALLERGEN INFORMATION:** If you have a Crustacean shellfish allergy, then you may be allergic to this product due to the crickets.
Cross contact during production

• As a likely food allergen, I would advise that insects are handled as such in a production environment
• This would mean taking steps to preventing insect materials ending up in products which are not meant to contain insects
• Likely a growing issue if (as appears likely) insect products expand into larger facilities handling many different types of food

This means an allergen control plan
http://farrp.unl.edu/allergen-control-food-industry
Occupational exposure

• Insects and related arthropods are known to both sensitize and elicit reactions through airway and skin contact

• Respiratory and contact protection should be provided to those working in environments where insects and handled and processed

• Care should be taken in exposing shellfish and dustmite allergics to an insect-containing food facility
How should consumers handle the allergy problem? (my take)

- Shellfish allergic individuals should not consume insect-based products. There is a likelihood of reaction.
- Shellfish allergics should familiarize themselves with the labeling of insect-containing foods.
- Dust mite allergics should also be cautious.
Key Takeaways

► Food insects examined so far have proven to be likely or certain food allergy risks in the Western population particularly to shellfish allergics

► The extent of this risk compared to other known allergens is unknown

► Labeling most often consists of a ‘may pose a risk to shellfish allergics’ or similar language. I would consider this best practice

► Insects should be controlled as allergens in a manufacturing environment and employee contact minimized.
Insects do not pose a unique or in any way unsurmountable allergy risk
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