Healthy food ingredients to reduce susceptibility to experimental food allergy

Dr Liz Forbes-Blom
Functional food ingredients extracted from New Zealand’s Greenshell™ mussel and micro-algae species to create hypoallergenic, anti-allergenic and anti-inflammatory foods
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MBIE CAWX1318
Food allergy is no longer an oddity, the burden of an unlucky few. It affects millions of children worldwide. Le Gros dubs them “Generation A” – A for allergy, of course.

Food or Foe? Stacy Anyan, North and South; March 2013

Food allergy ‘generation’

When I started my practice 18 years ago, I’d get one peanut allergy referral every six to 12 months. Now it’s four a week.

Dr. Vincent St Aubyn Crump, Allergist; Auckland Allergy Clinic.
9 COMMON ALLERGENS:

- Wheat
- Soy
- Fish
- Milk
- Crustacean
- Egg
- Tree Nut
- Peanut
- Other

5 of 100 affected by crustacean allergy

TOP 3 ALLERGENS:

- 150 million have food allergies
- 50 million have peanut allergy

3 allergens that cause deadly reaction called anaphylaxis

- Crustacean:
  - Lobster
  - Crab
  - Prawn

- Tree Nut:
  - Walnut
  - Cashew Nut
  - Pistachio
  - Almond
  - Brazil Nut
Sensitisation

Allergen → Dendritic cell → Allergen-specific T cell → Th2 cell → B cell → Allergen-specific IgE → Mast cell

IL-4, IL-13 → FceRI

Allergic reaction

Local symptoms
- Swelling
- Itching
- Nausea
- Vomiting
- Diarrhoea

Systemic symptoms
- Airway obstruction
- Hives
- Blood pressure drop
- Arhythmia

Histamine, Leukotrienes, Cytokines, Prostaglandins, PAF

Mast cell degranulation
Eicosapentaenoic acid (EPA)

• An omega-3 fatty acid, which are long chain polyunsaturated fatty acid (PUFA)

• Body converts the essential fatty acid ALA found in seeds, nuts and vegetable oils to EPA.

• Majority of EPA is from the diet e.g. oily fish, edible seaweed and phytoplankton

• EPA suppresses symptoms in food allergic mice
  van den Elsen L et al J. Nutr 2014

• EPA is present in breast milk
  van Elten TM et al Allergy 2015
EPA and DHA can suppress food-induced allergic responses in mice

van den Elsen et al., J Nutr 2014 114:1970
Experimental food allergy

Brandt et al., 2003 JCI 112:1666

i.p. 50 µg OVA /1 mg Alum

intragastric challenge saline alone or 50 mg OVA/250 µl saline

Diarhea occurrence (%)

Number of allergen challenges

Diarhea occurrence (%)

Number of challenges

OVA (J1.2)

OVA (ACK2)

Brandt et al., 2003 JCI 112:1666
IL-9 plays a role in the development of experimental food allergy

Osterfeld H et al., 2010 JACI 124 (2): 469

i.p. 50µg OVA /1 mg Alum

Diarrhea Occurrence (%)

Serum mcp-1 (µg/ml)

No. i.g. Challenges

Diarrhea Occurrence: 0/23, 2/23, 0/29, 5/29, 1/10, 2/10, 3/10

Serum mcp-1: WT Veh, WT, IL9R−/−, IL9−/−
Targeting IL-4 and IL-13 alleviates experimental food allergy

Brandt et al., 2009 JACI 123: 53
Loss of IL-3 ameliorates experimental food allergy

Poyntz H et al. submitted
Photonz EPA high oil inhibits the development of experimental food allergy

Photonz algal EPA high oil composition:
- Fatty acid ethyl esters
- ~80% EPA
- Other FAs including DHA
- Many minor algal components including non-lipid moieties
Photonz EPA high oil has subtle effects on mast cell responses and IgE.

- Photonz microalgal EPA high oil
- Fish EPA high oil
- Fish EPA high oil
- Corn Oil

**Graphs:**
- Mean Number of Mast Cells/HPF
- mMCP1 ng/ml
- OD450; OVA-specific IgE

**Legend:**
- Photonz microalgal EPA high oil
- Fish EPA high oil
- Fish EPA high oil
- Corn Oil
Photonz EPA high oil reduced IL4 and IL13 expression

IL13

Fold change

0 20 40 60 80

Naïve  Fish EPA high oil  photonz microalgal EPA high oil  Corn oil

IL4

Fold change

0 1.0 2.0 3.0 4.0 5.0

Naïve  Fish EPA high oil  photonz microalgal EPA high oil  Corn oil
Summary and current research focus

- Photonz EPA high oil protects against experimental food allergy as efficiently as cytokine deficient mice, or neutralization of cytokines by antibody administration.
- Photonz EPA high oil outperforms the other EPA high oils in preventing the development of experimental food allergy. These data suggest a synergistic effect of the components of the oil; and ongoing investigations will attempt to address this.
- We are currently examining the effects of EPA high oils on mast cell cultures *in vitro* and will perform RNA seq on intestinal tissue for an untargeted transcriptomics approach to identify candidate molecules the Photonz EPA high oil may be acting on.