



Nutritional Enhancement via Animal Biotechnology

Gene adding and gene editing

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Enhancing nutritional value

Altering the nutritional profile

- Adding benefit
 - By introducing new protein*
 - By adjusting metabolism
- Removing harm
 - Allergens



Muscle mass

- AquAdvantage™ salmon by AquaBounty
 - *chinook salmon growth hormone* (1989)
 - Quicker more efficient muscle growth
- Regional Fish Institute
 - Editing myostatin (red sea bream)
 - Editing leptin (tiger puffer fish)
 - Increased muscle, fillet size and feed conversion efficiency
- But not really nutritional enhancement – just more protein not new protein



Fish bred by Regional Fish

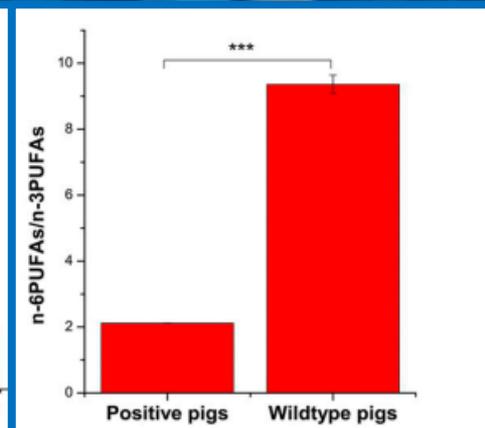
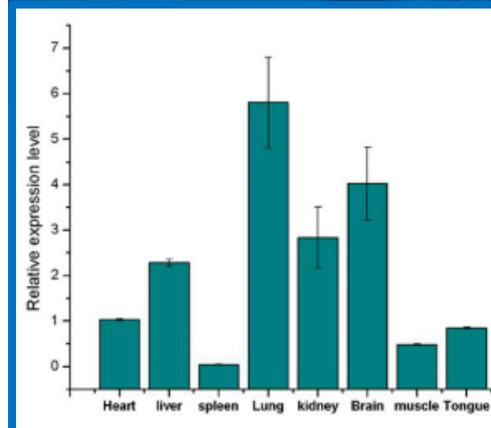
Conventionally bred fish





PUFA pigs

- Lowering the $\omega 6/\omega 3$ fatty acid ratio
- Health benefits to animals and potentially to human consumers of the animal product
- Adding *C.elegans fat1*
 - Lai et al (2006)
 - Wu et al (2013)
- CRISPR HDR into pRosa26





Allergens in animal food products

- Meat
 - Pork-cat syndrome
 - Fish-chicken syndrome
 - α -Gal syndrome (AGS)
- Milk
 - Bovine β -lactoglobulin
- Eggs
 - Egg-white & yolk allergens





GalSafe™ pigs

- Alpha-Gal Syndrome (AGS)
 - Food
 - Transplantation
- glycoprotein galactosyltransferase α - 1,3 gene (*GGTA1*) *KO* removes α -Gal from animal tissues (meat)
- *Neo^r* plasmid insertion into *GGTA1* gene
- FDA reviewed transgenic and approved
 - No significant impact of IGA





Dairy allergen KO cow safer milk

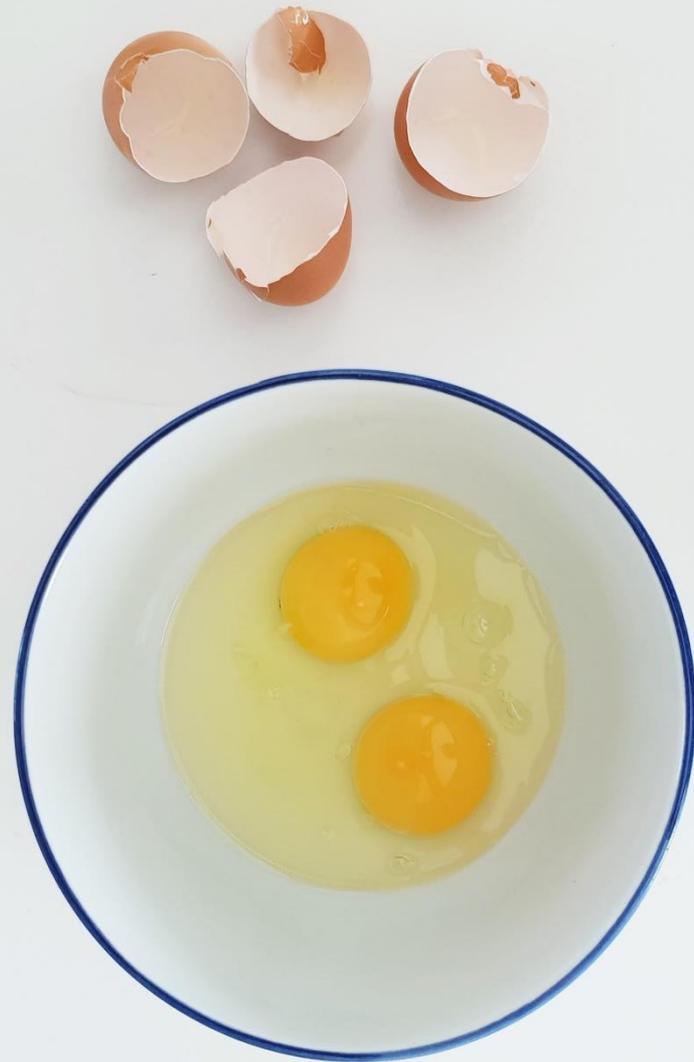
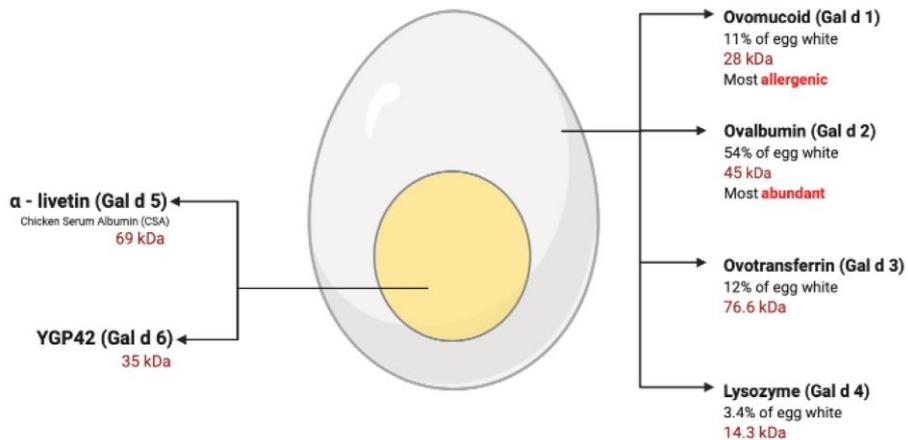
- Milk
 - Bovine β -lactoglobulin
- First by targeted miRNA inhibition
- Wei et al (2018) *Scientific Reports*
 - Goetz Liable & Recombinetics
 - Homozygous deletion using TALENs
- Yielding milk free of BLG





Safer low allergen egg?

- CSIRO has a focus on poultry molecular genetics and genome engineering





Safer low allergen egg

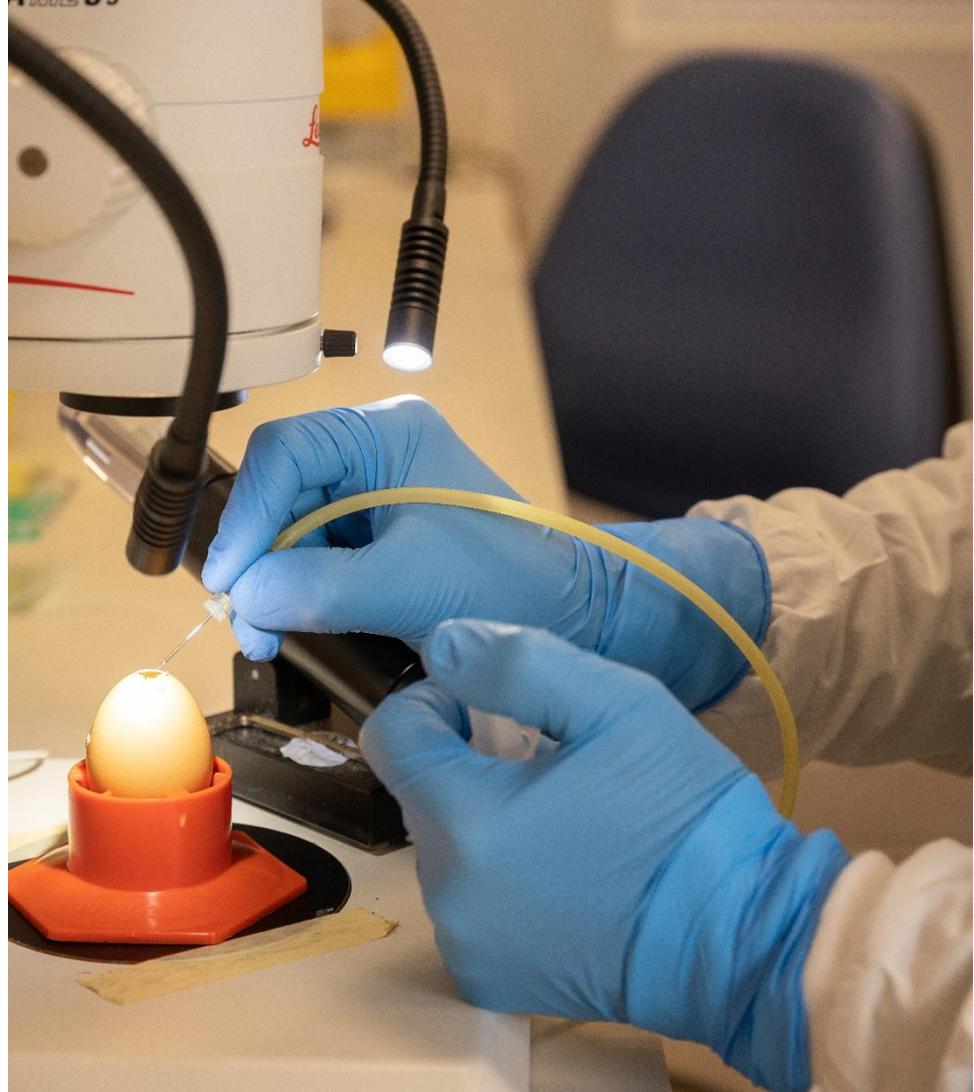
- Egg allergy is a significant food safety problem → → →
- Of the four key allergens in egg white, one survives heat treatment (cooking) and food processing.





Safer low allergen egg

- CSIRO's goal is to create the first gene edited animal food product on the Australian market
- The capability assembled comprises
 - Genome engineering
 - Food processing
 - Allergy clinical studies
- A complete team to develop and test the egg product





Thank you

CSIRO Health & Biosecurity

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