Innovations in Agriculture and Food and Implications for Nutrition and Precision Health

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Australia’s innovation catalyst

• Australia’s national science agency we’ve been solving issues and pushing the edge of what’s possible for almost a century.

• CSIRO plays a crucial role in the Australian Innovation System.

• Largest producer of research relevant to Australia’s Strategic Priorities and the Industry Growth Centres.
We are a global research organisation

At the CSIRO, we:
- Have over 5000 Research Scientists
- Have 58 sites globally
- Research activities in 80 Countries
- A $1 Billion Annual budget
- Are in the Top 1% Of Global research agencies.
## The changing global landscape

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<th>More from less</th>
<th>Chronic burden</th>
<th>Less predictable planet</th>
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<td>Going, going, gone?</td>
<td>Global biosecurity</td>
<td>One World</td>
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<td>The silk highway</td>
<td>Developing markets</td>
<td>Health on the mind</td>
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<td>Forever young</td>
<td>Chronic burden</td>
<td>Smarter food chains</td>
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<td>Digital immersion</td>
<td>Precision healthcare, Integrated care</td>
<td>Choosy customers</td>
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<td>Great expectations</td>
<td>Consumer control</td>
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<td>Porous boundaries</td>
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<td>Digital evolution</td>
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What does this mean for the future of food, health and nutrition?

- Foods for health
- Sustainable diets
- Nutritious foods using less resources
- Foods for emerging markets
- Innovations to improve health benefits
- Precision health & nutrition
- Safe food in a global food network
Obesity
Diabetes
Cardiovascular disease
Cancer
Dementia
Gut health
Cognitive performance
Reduce inflammation
Strong immune system
Foods for health... health by stealth
Grains
Resistant starch barley
BARLEYmax
BARLEYmax™

Breakfast cereal

Muesli bars

Wraps and bread

US launch April 2017
High amylose wheat: making the diet healthier without changing it
Kebari™ barley

for coeliacs and gluten intolerance
Hulled (malting)    Naked (food)

...next Gluten Free barley foods

FLAKES    ROLLED    EXTRUDED
Teff: ancient grain new again
Teff: new gluten free products
Sustainable diets

- Low environment impact
- Optimise human & natural resources
- Healthy life - present and future
- Available
- Accessible
- Utilisation
- Stable food system

*Adapted from Johnstone et al Adv Nutr 418-429: 2014
FAO Sustainable diets & biodiversity: directions & solutions for policy, research & action, 2012
Plant Oils
Genes for synthesis of omega 3 can be transferred to plants.
Innovations in food for precision health

Food Loss

Food Waste
Processing food waste for value adding

Separation Technologies

Food Stabilisation & Transformation Technologies

Food Fermentation

Bioactives, Food Ingredients, Foods & Beverage Products, Feed
Functional powder ingredients
Broccoli Latte!
Apple fibre cookies
Foods for emerging markets

Growing middle class
Urbanisation

Demand for protein
Demand for fruit & veg

Health and ageing
Plant proteins
Innovations in food for precision health

Precise nutrition measures
- Nutritional quality & physiology, digestion
- Nutrigenomics & nutri-epigenomics

Precise energy expenditure measures
- Resting
- Thermic effect of food
- Physical activity – occupational & leisure time

Individual generated data
- Behaviours – food, physical activity & sleep
- Age, gender, ethnicity, culture

Multi-omics
- Microbiome
- Genome, epigenome, gene expression profiles
- Transcriptome & proteome
- Metabolome – lipids, AA, nucleotides, sugars

Clinical information & phenotype
- Clinical measures
- Body composition, adiposity

Better disease risk prediction
More precise interventions for better health outcomes
Diet and epigenetic effects
Integrated approach to nutrition of infants

Maternal nutrition
- Over/undernutrition
- Vitamin D status
- Dietary methyl donors
- LCPUFA intakes
- Food pollutants

Neonatal and infant nutrition
- Human milk
- Formula milk
- Prebiotics/probiotics

Microbiome
- Maternal microbiota
- Mode of delivery
- Maternal and infant diet
- Antenatal and post-natal antibiotic exposure
- Urban/rural environment

Epigenome
- Human genome
- Environmental factors

First 1000 days of life

Encapsulation: success with Omega-3 oils

MicroMAX® (a patented technology) is available for the encapsulation of other ingredients.
Gut health and microbiome
Numerous factors are influencing the complex gearing:
- Lifestyle
- Food
- Immune priming
- Host metabolic signalling
Food, gut and aging

Physical changes
- Sensory Alterations
- Oral Health
- Reduced appetite/early satiety
- Chronic & acute diseases

Environmental changes
- Living environment
- Medications
- Finances
- Physical Activity & diet

Changes in elderly gut
- Lower bacterial diversity
- Reduced butyrogenic species
- Decreased SCFA concentration
- Increased transit time
- Increased leaky gut

Health Impacts
- Immunosenescence & inflamm-aging

Gut-brain axis
Gut microbiome dysbiosis
In summary

FOOD MARKET TRENDS

- Foods for health
- Sustainable diets
- Nutritious foods with less resources
- Foods for emerging markets
- Innovations for health benefits
- Precisions health and nutrition

EXAMPLES OF A RESPONSE

- Foods for health by stealth through innovation – grains, plant oils, waste
- Alternative protein sources
- Gut health and microbiome
- Infant nutrition
- Precision nutrition

UNDERPINNED BY SAFE FOOD IN A GLOBAL NETWORK