Indigenous Plants as Prebiotic Sources in Asia

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Prebiotic

- A substrate that is selectively utilized by host microorganisms conferring a health benefit (Gibson et al., 2017)
- Selectivity is the key!
- Current prebiotic source – chicory root, Jerusalem artichoke, dandelion green – all of western origin

Gibson et al., 2017

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Potential Asian Plant as Prebiotic

- Starch Crops
- Legumes
- Fruits & Vege
- Herbs, Shrubs & Spices
- Seaweeds
Starch Crops

- Potential crops as prebiotic – cassava, rice & sago
- Resistant Starch – the sum of starch and the product of starch digestion that resists digestion in the small intestine of a normal human being (Englyst et al., 1992).
- 4 types:
  - RS1: In legumes, and seeds
  - RS2: In some raw foods, such as green bananas and raw potato (or special breeding *i.e.* Hi-Maize®)
  - RS3: Obtained through retrogradation *i.e.* cooking and cooling rich-starch foods (potatoes, rice, and pasta) (*e.g.* Novalose®)
  - RS4: Chemically modified starch to make it non-digestible (*e.g.* Fibersym®)
Sago

- Mainly cultivated for their starch obtained from its trunk
- Consumed in Asia before rice become staple (3350 BC, Southern Subtropical China)
- Among important commodity in Malaysia – Sarawak is the world’s largest exporter
- Starch yield per unit is 3X higher than rice, corn, wheat & cassava
- However, only 3 % share in world starch market; inferior to corn, potato and tapioca
Sago Starch

• Proven to be less digestible compared to other starches – resistance up to 55 %, even after 72 hours digestion (Srichuwrong et al., 2005) – Prebiotic potential???

• *In vivo* mouse (BALB/C) study (Sarbini & Zaman, unpublished):
  – Native sago: contain 69% resistant starch
  – Modified starch (crosslinking & acetylation) increase amylose content
  – Native sago shows weight reduction & decreasing food intake, indicating satiety
  – Increase lactate and propionate content
India is the world's largest producer and the largest consumer of legumes

- Global legumes market – 60 million tonnes
- High in fibre
- Provide Protein, Vitamin B & Iron
- Low glycemic index – modulate blood sugar, aid weight loss
- Excellent source of resistant starch!
Lentils

- ‘Prebiotic’ content of lentils per 100 g (Johnson et al., 2013): 13 g
  - Resistant starch: 7500 mg
  - Raffinose-family oligosaccharides: 4071 mg
  - Sugar alcohols: 1.423 mg
  - Fructo-oligosaccharides: 0.062 mg

- Prebiotic enhancement strategy:
  1. Selection of more nutritious lentil
  2. Improve lentil nutritional quality through breeding and food processing
  3. Understanding environmental and genetic factors affecting prebiotic carbohydrates, allowing selection for mass production
Fruits & Vege
(Supriya et al., 2016; Wichienchot et al., 2011)

- Pomegranate
- Papaya
- Red Date
- Jackfruit
- Spinach
- Okra
- Dragon Fruit
- Fiddlehead Fern
Herbs, Shrubs & Spices

- Prebiotic ability due to phytochemicals i.e. flavonoids & alkaloids and/or dietary fiber
  - Black Pepper
    - Enhance *L. reuteri*; Inhibit *E. coli* (Sutherland et al., 2009)
    - Suppresses *Staphylococcus*; Inhibit *E. coli* & *Salmonella paratyphi* in broilers (Bishnu et al., 2009)
    - Increase bifidobacteria; Increase acetate concentration (Nashri et al., unpublished)
  - Cinnamons
    - Enhance growth of *Bifidobacterium* spp. & *Lactobacillus* spp. (Lu et al., 2017)
    - Inhibit *Fusobacterium* spp. and *Clostridium* spp. (Lu et al., 2017)
  - Turmeric & Ginger
    - Inhibit *Clostridium* spp. (Lu et al., 2017)
  - Green & Black Tea
    - Tea phenolic compounds (catechin) may suppress growth of pathogenic bacteria, but less affecting *Bifidobacterium* & *Lactobacillus* (Lee et al., 2006)
Seaweeds

- Contain 75% dietary fibre (mostly soluble)
- Cultivated for its hydrocolloids *i.e.* alginates, agar & carrageenan – thickening and gelling agents
- World’s largest producer: China > Rep. of Korea > Japan > SEA
- *Laminaria japonica, Undaria pinnatifida* & *Porphyra* sp.
Develop LMWPs from seaweed hydrocolloids as prebiotic, using acetic acid and hydrogen peroxide (Ramnani et al., 2011):

1. Gelidium seaweed (MW 64.64 kDa) showed increase in bifidobacterial, from log 8.06 (0 h) to log 8.55 (24 h)
2. Significant increases in total SCFA production i.e. acetate and propionate

Red seaweed (Kappaphycus alvarezii) cultivated from Malaysia, were digested using in vitro mouth, gastric and duodenal model, further colon model (Bajury et al., 2017):

1. Increase Bifidobacterium sp.; from log 7.96 (0 h) to log 8.72 at (24 h), no significant difference when compared to inulin
2. Significant increases in total SCFA production i.e. acetate and propionate
Issues & Challenges

• Variety of people & diverse diet, thus microbiota
• Challenge of consumer – Eating habit? Knowledge?
• Limited relationship between scientists and industries (maybe at least in SEA)
• Some still working with ‘obsolete’ technique i.e. culture dependent, single culture evaluation – not tested in vitro
• Limited clinical study conducted – cannot confirm prebiotic status
Evaluation of potential prebiotics: a review

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Bajury et al., 2017
The way forward

• Classification of plant-based prebiotic of Asian origin – start with the potential past findings, current research & trend

• Enhance network between scientists, manufacturers, regulators & consumers – Investment?

• Incorporation strategy – Whole food? Extraction for supplement?
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