Probiotic based health foods

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History of probiotic foods

- First fermented foods from Neolithic Era (farming, pottery)
- Persian tradition claims that Abraham owed his longevity and fertility to fermented foods
- Metchnikoff: yoghurt is the secret of the longevity of Bulgarian peasants
- In 1917, Alfred Nissle isolated a strain of *E. coli* from enterocolitis-resistant WW I soldier
- In 1930’s, Dr Minoru Shirota introduced a milk drink fermented with specific *Lactobacillus casei*
- In the USA, *L. acidophilus* NCFM was introduced in the 1970’s
Probiotic food market

➤ Rapid expansion over last two decades
  • Growth rate in 2008 between 5-30 % depending on region, product type

➤ Over half of probiotic market is with foods
  • Supplements 30-40%
  • Pharmaceuticals < 10%

➤ Main types of probiotic foods (estimated Worldwide market, $US million)
  • Probiotic yoghurt; 4,000 Mi $US (mainly *Bifidobacterium*, *L. acidophilus*)
  • Probiotic drinks; 2,000 Mi $US (shots, juices, kefirs etc.)

➤ Main health targets and claims:
  • Gut health
  • Immune health
  • General well-being
  • Mainly "soft claims" if any, less claims related to reduction of disease risks
  • Regulation of claims vary between regions
Requirements of probiotic foods

"Live micro-organisms which when administered in adequate amounts confer a health benefit on the host”

FAO/WHO 2002

- Technological properties of probiotic strains
  - Growth in large-scale production
  - Stability of the batch culture
  - Fermentation with starter cultures or probiotics?
  - Stability in the final product

- Safety of the probiotic

- Consumer acceptance
  - Taste
  - Healthy image
  - Price

- Adequate dose not well defined; at least $10^9$ live cells per dose

- Documentation of health benefits? Always strain-specific
Requirements of probiotic foods

→ Stability in foods during storage is a key requirement

→ Stability depends on:
  • Food matrix
  • Storage temperature
  • pH, acidity
  • Oxygen, radicals
  • Antimicrobial compounds
  • Water activity
  • Exposure to light
  • Salt content
  • Other microbes...

→ Labels and claims
  • Strain identity
  • Probiotic level
  • Health claims?

Public health issues arising from microbiological and labelling quality of foods and supplements containing probiotic microorganisms

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Submitted 21 August 1998: Accepted 1 October 1998
Probiotic stability: Viability vs Culturability?

- Probiotic viability normally assessed by traditional culture methods

- Sometimes probiotics may stop growing on plates but remain viable
  - "Viable but nonculturable", VBNC
  - Response to storage stress / injury?
    → Culture-dependent methods may yield incorrect information on true viability

- New methods for assessing viability culture-independently
  For example, fluorescence-based methods (flow cytometry, microscopy)

Improving stability of probiotics

- Encapsulation of viable probiotics
  - Numerous approaches and carriers
    - Extrusion vs. Emulsion
    - Alginate, Carrageenan, Locust bean gum
    - Cellulose acetate phthalate (CAP)
    - Chitosan
    - Gelatin
    - Starches
    - Lipid encapsulation
    - Emulsions of oils, proteins, carbohydrates

- Probiotic straws
  + other ways of avoiding need for cold storage
Examples of probiotic foods: Dairy

- Most common probiotic foods

- Fermented dairy products:
  - Yoghurt (spoonable, drinkable, shots...)
  - Dahi, kefir, others
  - Cheese (long storage)

- Non-fermented dairy drinks (”sweet milk”)

- Probiotic ice cream

- Probiotic margarine
Examples of probiotic foods: Non-dairy

- Fruit and berry juices (non-fermented) around the World
  - pH
  - antimicrobial compounds?

- Fermented vegetable juices and ”yoghurts”
  - Tomato, carrot juice
  - Soy yoghurt, oat yoghurt

- Natto in Japan

- Probiotic olives have been developed in Italy

- Probiotic salami marketed in Germany
  - Long term storage
  - High salt content, low water activity
Examples of probiotic foods: Non-dairy

- Probiotic bread
  - *Lactobacillus* used in traditional sour-dough bread
  - Can probiotics survive baking?

- Probiotic potato chips (Spain)
  - Survival? Healthy food?

- Probiotic muesli

- Nutrition bars

- Probiotic chocolate
  - Coating for probiotics?

- Oat-based probiotic dip
Conclusions

- Probiotic food market and probiotic research growing rapidly
- Probiotic foods dominated by dairy products (yoghurt)
- New products and product types launched continuously
  - Technological feasibility? Including stability of probiotics during storage
  - Consumer acceptance (e.g. price, healthy image of products...)?
- Main requirements for probiotic foods:
  - Stability, dosage, technological feasibility
  - Safety, documented health benefits
  - Consumer acceptance, claims, regulations
- New innovations in:
  - Improvement of probiotic stability during storage
  - Assessment of stability / viability of probiotics in foods
Thank you for your attention!