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Probiotic based health foods

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History of probiotic foods

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- 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

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- 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

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"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

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- 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

JMT Hamilton-Miller[1,*], S Shah[1] and JT Winkler[2]
[1]Department of Medical Microbiology, Royal Free and University College Medical School, London NW3, UK: [2]Food and Health Research, 28 St Paul Street, London N1, UK

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Probiotic stability: Viability vs Culturability?

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- 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)

Lahtinen et al (2006) Appl Environ Microbiol 72(7): 5132-5134

Lahtinen et al (2005) Appl Environ Microbiol 71(3): 1662-1663

Improving stability of probiotics

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- 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

Stand-alone HOWARU™ Straw

On-pack HOWARU™ Straw

Examples of probiotic foods: Dairy

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- 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

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- 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

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- 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

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- 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

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Thank you for your attention!