



**In God We Trust**



# Non-dairy probiotic products

**Presenter : Dr. Homayouni**

**Associate Professor, Department of Food Science & Technology, Tabriz University of Medical Sciences**

**[homayounia@tbzmed.ac.ir](mailto:homayounia@tbzmed.ac.ir)**

# Functional foods; definition

“Functional food is a natural or processed food that contains known biologically-active compounds which when in defined quantitative and qualitative amounts provides a clinically documented health benefit, and thus, an important source in the prevention, management and treatment of chronic diseases of the modern age”

---

Danik M. Martirosyan (Ed): Functional Foods and Chronic Diseases: Science and Practice. Food Science Publisher, 2011



# Functional food; classification

Functional food refers to preventative and/or curing effects of food beyond its nutritional value such as probiotic, prebiotic and synbiotic foods as well as foods enriched with antioxidants, isoflavones, phytosterols, anthocyanins and fat-reduced, sugar-reduced or salt-reduced foods.

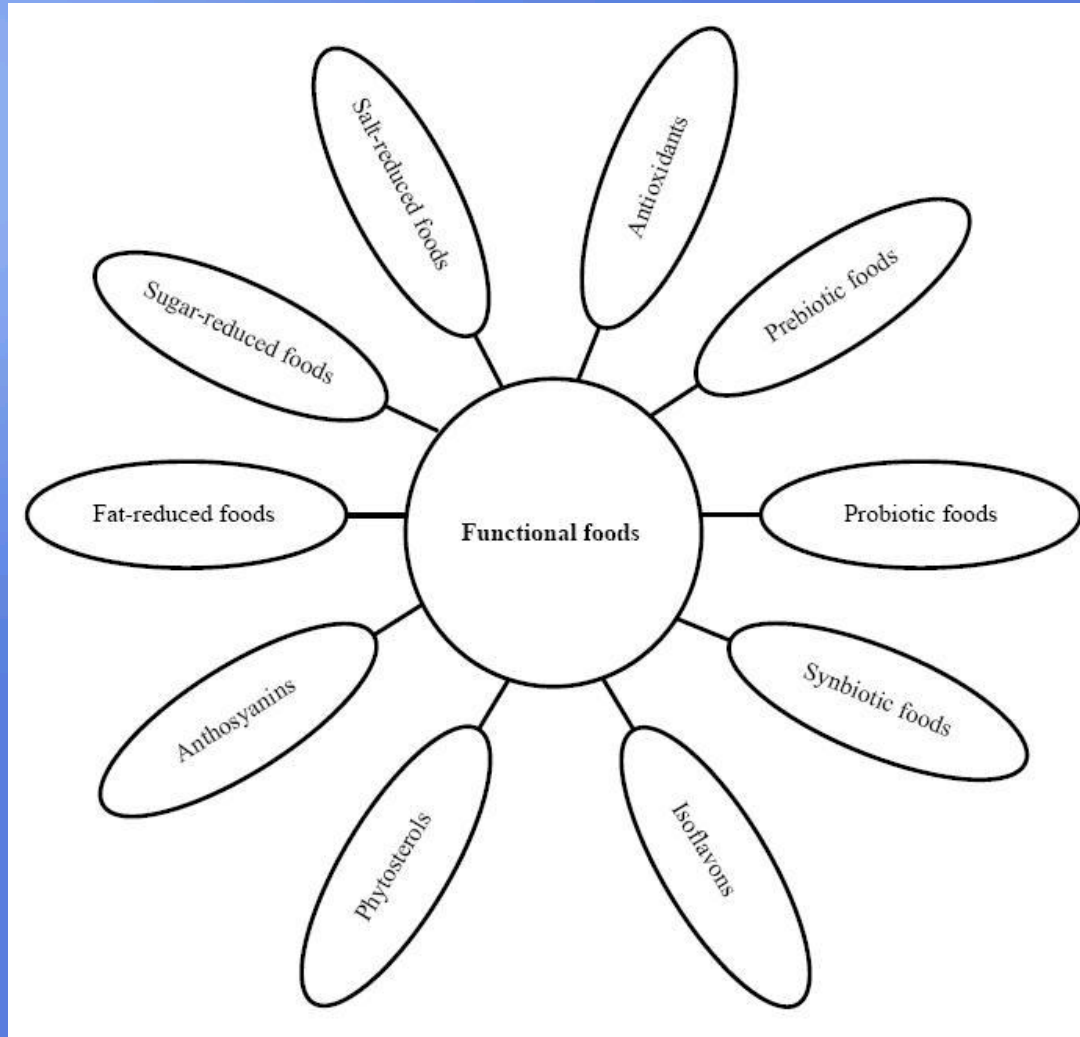
---

Granato et al., 2010, Comprehensive Reviews in Food Science and Food Safety



# Functional food; classification

Aziz Homayouni Rad, Ph.D



# Probiotics; definition

- Probiotics are distinct as live micro organisms, which when administered in sufficient amounts, confer a health benefit to the host.
- *Lactobacillus* and *Bifidobacterium* are the most common probiotic bacteria used in probiotic products.

---

[http://www.who.int/safety/publications/fs\\_management/probiotics2/en](http://www.who.int/safety/publications/fs_management/probiotics2/en)



# Factors affecting survival and growth of probiotics

Aziz Homayouni Rad, Ph.D

- Heating or freezing
- Air incorporation
- Packaging

Manufacturing processes



- Food environment
  - pH
  - TS
  - Osmotic pressure
  - Water activity
  - Nutrients
- Preserving environment
  - Temperature
  - Moisture

Storage conditions



- Gastric acid
- Bile
- Gut enzymes
- Adherence to the mucosa

Gastrointestinal conditions



Ranadheera et al., 2010, Food Res Int; Sleator et al., 2008, Lett Appl Microbiol; Kailasapathy et al., 2000, Immunol Cell Biol; Kolida et al., 2000, BNF Nutr Bull; Homayouni et al., 2008(a), J Appl Sci; Homayouni et al., 2008(b), Food Chemistry; Homayouni et al., 2012, Int. J. Dairy Sci.



# Probiotic Delivery Vehicles

## ➤ Foods

- Dairy products
  - Ice-cream
  - Cheese
  - Yogurt

## ➤ Nondairy products

- Chocolate
- Beverages
- Cereals
- Vegetables

## ➤ Supplements

- Capsules
- Powder
- Tablets

Why?

1. Lactose intolerance
2. Unfavorable cholesterol content of dairy products
3. Vegetarian probiotic products

Ranadheera et al., 2010, Food Res Int



# Foods vs. supplements as delivery vehicles

Foods may be better carriers for probiotic delivery to consumers

- 1) Foods help to buffer the bacteria through the stomach
- 2) Foods provide nutrients for bacterial activity thus increased efficacy
- 3) Some food contents (prebiotics) can act synergistically with probiotics
- 4) Foods carrying probiotics don't scare consumers

Homayouni et al., 2012, Nutrition





# Probiotic non-dairy foods

## ➤ Chocolate

- chocolates offered superior protection (91% and 80% survival in milk chocolate for *L. helveticus* and *B. longum*, respectively compared to 20% and 31% found in milk).
- Long term administration led to proper colonization (using Simulator of the Human Intestinal Microbial Ecosystem (SHIME)).
- naturally contains a higher content of ingredients with protective properties.

---

Possemiers et al., 2010, Int J Food Microbiol



# Probiotic non-dairy foods

## ➤ Beverages

- Sucrose protected probiotics exhibited higher survival rate than skim milk protected cells in fruit juice.
- The same probiotics showed better stability in skim milk during 2 weeks of refrigeration compared to orange, grape or passion fruit juices.
- Acid and bile tolerance were better in skim milk than juices (buffering and protective effects of milk).

---

Saarela et al., 2006, Int Dairy J



# Probiotic non-dairy foods

## ➤ Cereals

- Lower viability of probiotics was obtained during fermentation and storage in water based cereals than milk based cereals.
- Water based puddings obtained significantly lower pH and faster reduction in pH during storage which adversely affected growth and viability of probiotics.

---

Helland et al., 2004, Int Dairy J



# Probiotic non-dairy foods

## ❖ Cereals

- ❖ Malt increased bile tolerance of probiotics to a greater extent than barely and wheat.
- ❖ Malt may be a better medium due to its favorable chemical composition and availability of maltose, sucrose, glucose, fructose and free amino nitrogen.
- ❖ Immobilization of probiotic bacteria within malt and barely fiber increases gastrointestinal tolerance.

---

Michida et al., 2006, Biochem Engin J; Patel et al., 2004, Food Microb;  
Charalampopoulos et al., 2002, JAM



# Probiotic nondairy foods

## ➤ Vegetable products

➤ Probiotic survival has been reported to be high in table olive and artichoke (during storage and through gut) which is comparable and even higher than milk based products.

- Micro-architecture of these vegetables
- Roughness which protects against acid
- Prebiotic substances

---

Lavermicocca et al., 2005, AEM; Lavermicocca et al., 2006, Digest Liver Dis; Valerio et al., 2006, AEM



# Probiotic nondairy foods

## ➤ Vegetable products

- More lactic acid was produced in carrot juice than beetroot juice, when fermented with probiotics.
- Number of probiotics showed greater increase in beetroot than carrot juice when fermented.
- Some probiotics lost their viability in cabbage juice during storage, maybe due to chemical constituents of cabbage.

---

Rakin et al., 2007, Food Chemistry; Yoon et al., 2006, Bioresource Technol



# Prebiotics or Probiotic?

- Prebiotics may be of greater potential to invest in
  - Prebiotics precede the probiotics
  - Gut microbiota of each person is unique to him
  - Prebiotics are not as vulnerable as probiotics
  - Prebiotics are cheaper
  - Consumer attitude favors prebiotics
  - Prebiotics may be used in various foods
  - Prebiotics may have fat replacing and texture improving properties.

---

Homayouni et al., 2012, Nutrition



# Conclusions

- Non-dairy probiotic foods are a necessary field to pay attention to.
- Cereals and chocolate have been shown to be better matrices for probiotic delivery than fruit juices and vegetable products.
- Prebiotic foods may be a better option to invest in, when it comes to improving public health.





# References

- Anonymous. Guidelines for evaluation of probiotics in foods. Accessed at: [http://www.who.int/safety/publications/fs\\_management/probiotics2/en](http://www.who.int/safety/publications/fs_management/probiotics2/en)
- Charalampopoulos D, Pandiella SS, Webb C. Growth studies of potentially probiotic lactic acid bacteria in cereal-based substrates. *Journal of Applied Microbiology* 2002; 92(5): 851-859.
- Danik M. Martirosyan (Ed): *Functional Foods and Chronic Diseases: Science and Practice*. Food Science Publisher, 2011
- Granato D, Branco GF, Nazzaro F, Cruz AG, Faria JAF. Functional foods and nondairy probiotic food development: trends, concepts and products. *Comprehensive Reviews In Food Science And Food Safety* 2010; 2: 292-302.
- Helland MH, Wicklund T, Narvhus JA. Growth and metabolism of selected strains of probiotic bacteria in milk- and water- based cereal puddings. *International Dairy Journal* 2004; 14(11): 957-965.



# References

- Homayouni A, Akbarzadeh F, Vaghef Mehrabany E. Which are more important: Prebiotics or probiotics? *Nutrition* 2012; 28: 1196-1197.
- Homayouni A, Azizi A, Ehsani MR, Razavi SH, Yarmand MS. Effect of microencapsulation and resistant starch on the probiotic survival and sensory properties of synbiotic ice cream. *Food Chemistry* 2008(b); 111: 50-55.
- Homayouni A, Ehsani MR, Azizi A, Razavi SH, Yarmand MS. Growth and survival of some probiotic strains in simulated ice cream conditions. *Journal of Applied Sciences* 2008(a); 8(2): 379-382.
- Homayouni A, Vaghef Mehrabany E, Alipoor B, Vaghef Mehrabany L, Javadi M. Do probiotics act more efficiently in foods than in supplement? *Nutrition* 2012; 28: 733-736.



# References

- Kailasapathy K, Chin J. Survival and therapeutic potential of probiotic organisms with reference to lactobacillus acidophilus and bifidobacterium spp. Immunology and Cell Biology 2000; 78: 80-88.
- Kolida S, Tuohy K, Gibson G.R. The human gut flora in nutrition and approaches for its dietary modulation. British Nutrition foundation Nutrition Bulletin 2000; 25: 223-231.
- Lavermicocca P. Highlights on new food research. Digestive and Liver Disease 2006; 38(suppl. 2): S295-S299.
- Lavermicocca P, Valerio F, Lonigro SL, de Angelis M, Morelli L, Callegari ML et al. Study of adhesion and survival of Lactobacilli and Bifidobacteria on table olives with the aim of formulating a new probiotic food. Applied and Environmental Microbiology 2005; 71(8): 4233-4240.



# References

- Michida H, Tamalampudi S, Pandiella SS, Webb C, Fukuda H, Kondo A. Effect of cereal extracts and cereal fiber on viability of *Lactobacillus plantarum* under gastrointestinal tract conditions. *Biochemical Engineering Journal* 2006; 28(1): 73-78.
- Patel HM, Pandiella SS, Wang RH, Webb C. Influence of malt, wheat, and barley extracts on the bile tolerance of selected strains of lactobacilli. *Food Microbiology* 2004; 21(1): 83-89.
- Possemiers S, Marzorati M, Verstraete W, de Wiele TV. Bacteria and chocolate: a successful combination for probiotic delivery. *International Journal of Food Microbiology* 2010; 141: 97-103
- Rakin M, Vukasinovic M, Siler-Marinkovic S, Maksimovic M. Contribution of lactic acid fermentation to improved nutritive quality vegetable juices enriched with brewer's yeast autolysate. *Food Chemistry* 2007; 100(2): 599-602.



# References

- Ranadheera RDCS, Baines SK, Adams MC. Importance of food in probiotic efficacy. *Food Research International* 2010; 43: 1-7.
- Saarela M, Virkajavri I, Alakomi HL, Sigvart-Mattila P, Matto J. Stability and functionality of freeze dried probiotic *Bifidobacterium* cells during storage in juice and milk. *International Dairy Journal* 2006; 16(12): 1477-1482.
- Sleator RD, Hill C. New frontiers in probiotic research. *Letters in applied microbiology* 2008; 46: 143-147.
- Valerio F, De Bellis P, Lonigro SL, Morelli L, Visconti A, Lavermicocca P. In vitro and in vivo survival and transit tolerance of potentially probiotic strains carried by artichokes in the gastrointestinal tract. *Applied and Environmental Microbiology* 2006; 72: 3042-3045.
- Yoon KY, Woodams EE, Hang YD. Production of probiotic cabbage juice by lactic acid bacteria. *Bioresource Technology* 2006; 97(12): 1427-1430.





*Thanks for your attention*

Wednesday  
12 Dec 2012