

Friesland Foods Domo



## Health promoting effects of prebiotic galacto-oligosaccharides

IDF symposium "Lactose & its derivatives"  
Margriet Schoterman

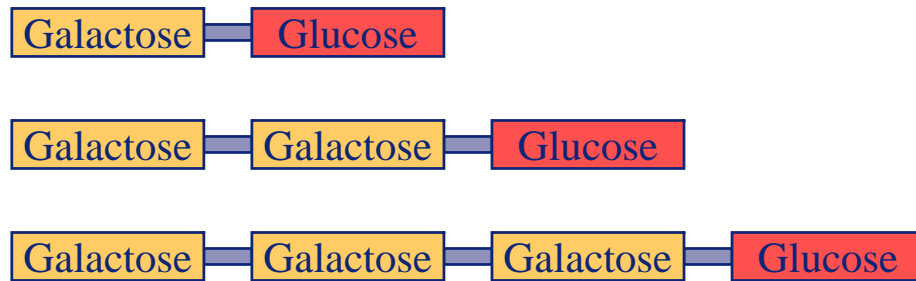
# Contents

- Introduction and properties
- Health promoting effects and scientific research
- Applications

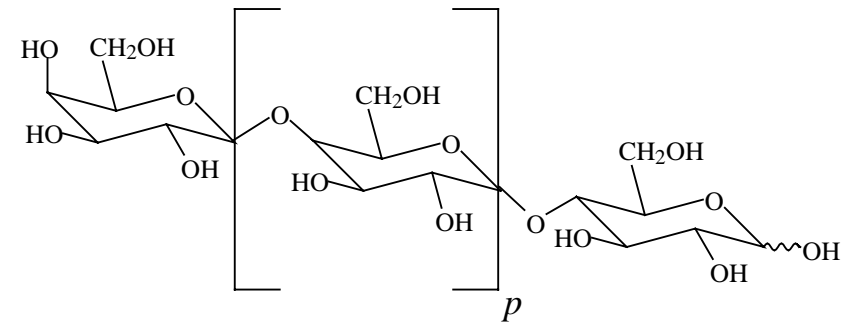
# Introduction and properties

# Introduction and properties

- Non-digestible carbohydrates
- Structure:



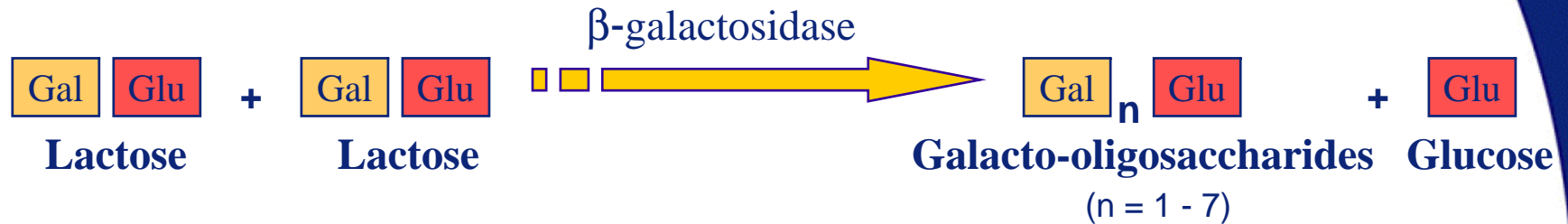
etc.



- Chain length: di- to octasaccharides
- Naturally occurring in human milk

# Introduction and properties

- GOS are produced from lactose

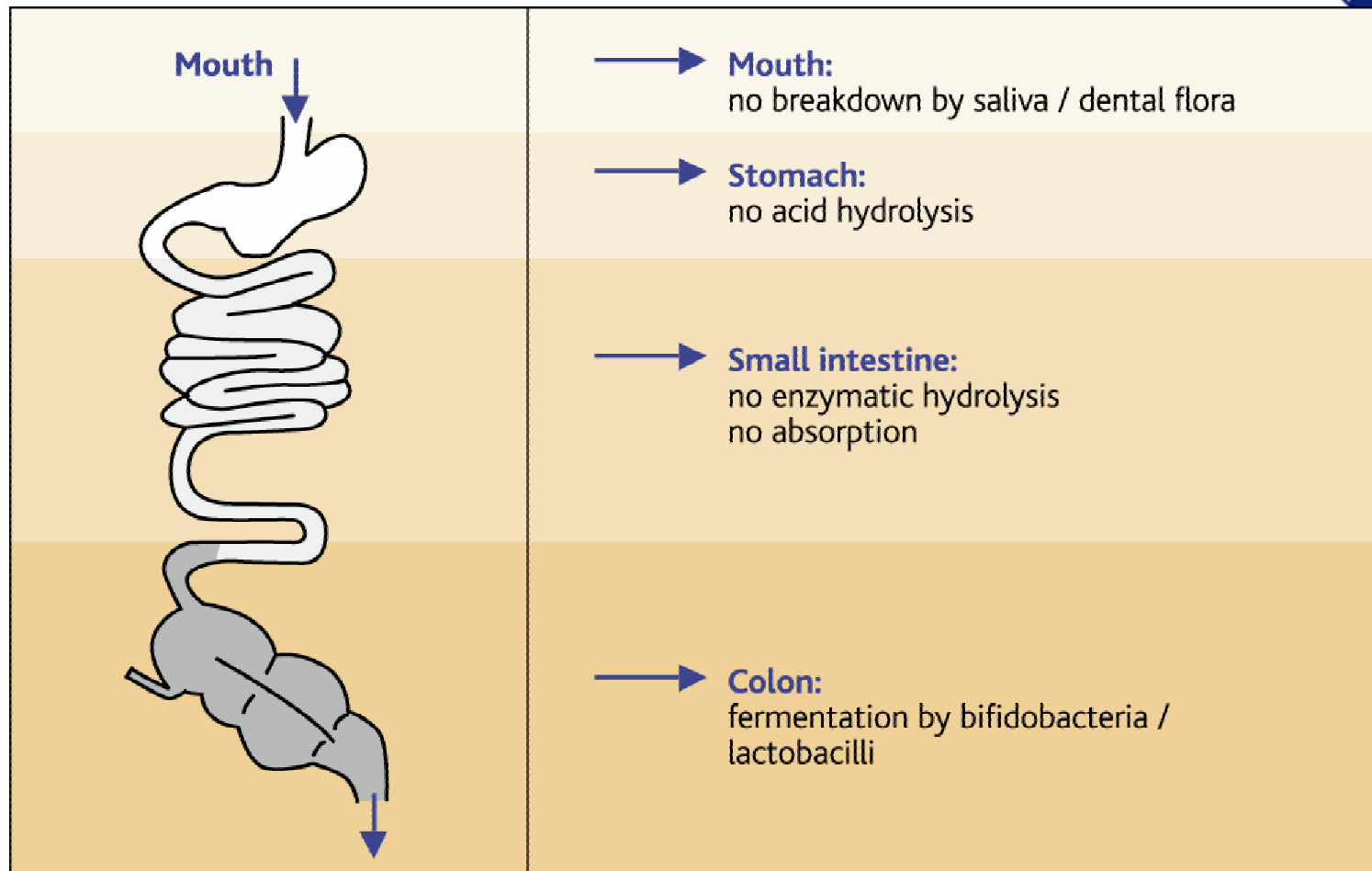


# Introduction and properties

- GOS are identified as prebiotics

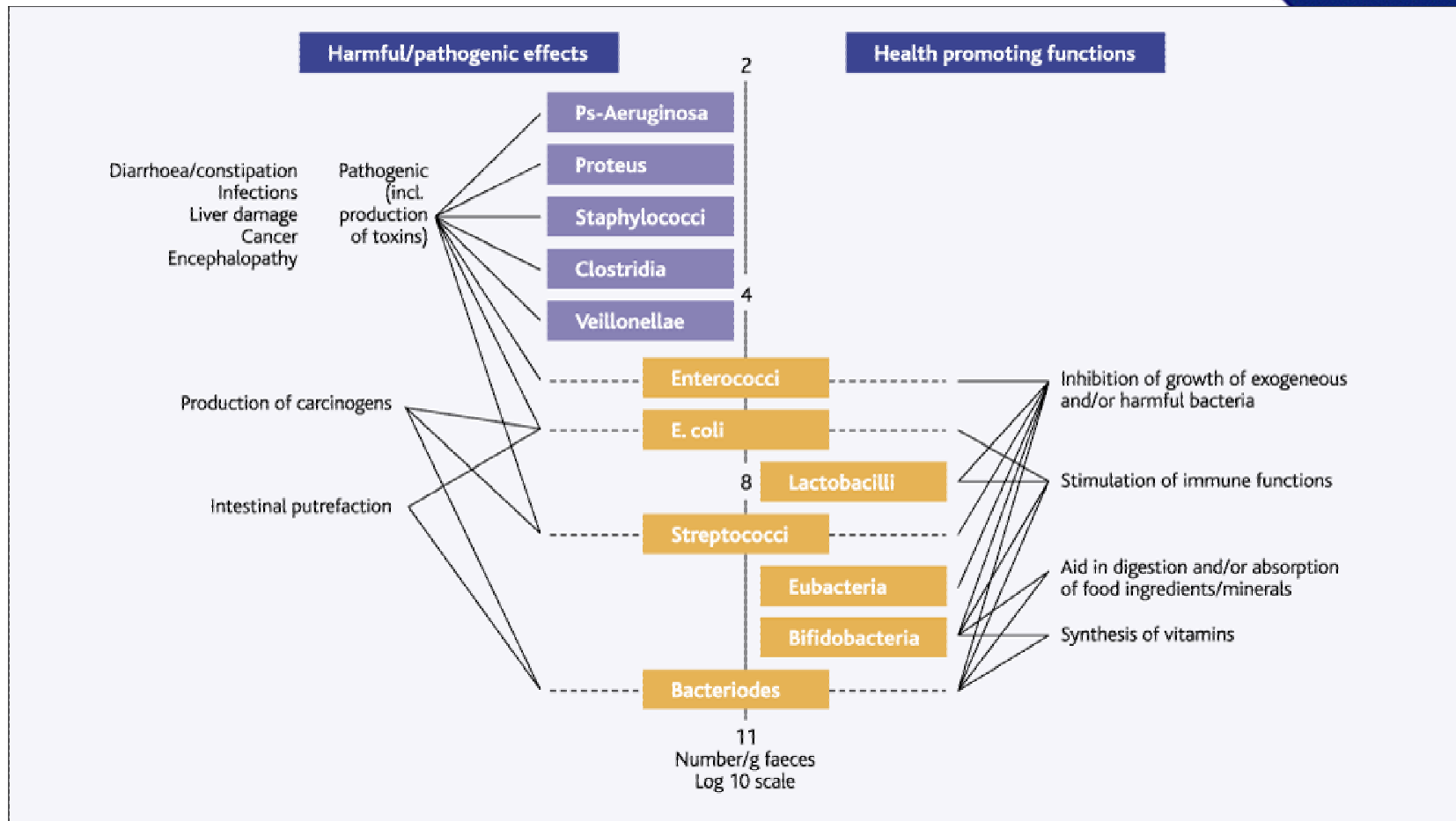
Prebiotics are defined as non-digestible food ingredients that beneficially affect the host, by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon, and thus attempt to improve host health. (Gibson & Roberfroid, 1995)

# Introduction and properties



# Introduction and properties

## Composition and health effects of human faecal bacteria



Gibson, et al (1998)



# Health promoting effects and scientific research

## Health promoting effects

- Stimulation of growth of bifidobacteria
- Improvement of calcium absorption
- Relief of constipation
- Support of natural defences
- Inhibition of development of colon cancer
- Similarity with human milk oligosaccharides

# Stimulation growth of bifidobacteria

## Human studies - Adults

Subjects	Dose (g GOS/day)	Duration (days)	Results
- 8 healthy adults <sup>1</sup>	10	7; 14; 21	↑ bifidobacteria
- 12 healthy men <sup>2</sup>	10	7	↑ bifidobacteria and lactobac
- 12 healthy men <sup>3</sup>	2.5	7; 14; 21	↑ bifidobacteria
- 20 healthy adults <sup>4</sup>	2.5; 10	21	↑ bifidobacteria
- 11 healthy men <sup>5</sup>	2.0	10; 20	↑ bifidobacteria
- 5 healthy adults <sup>6</sup>	3.0; 10	14	↑ bifidobacteria and lactobacilli
- 12 healthy adults <sup>7</sup>	15	6	↑ bifidobacteria
- 8 healthy men <sup>8</sup>	1.0; 3.0	21	↑ bifidobacteria
- 12 healthy men <sup>9</sup>	10	7	↑ bifidobacteria

1. Bouhnik Y, et al. (1997)  
 2. Ito M, et al. (1990)  
 3. Ito M, et al. (1993)  
 4. Ishikawa F, et al. (1995)

5. Tamai S, et al. (1992)  
 6. Tanaka R, et al. (1983)  
 7. Ito M, et al. (1993)

8. Tamai S, et al. (1994)  
 9. Bouhnik, Y, et al (2004)

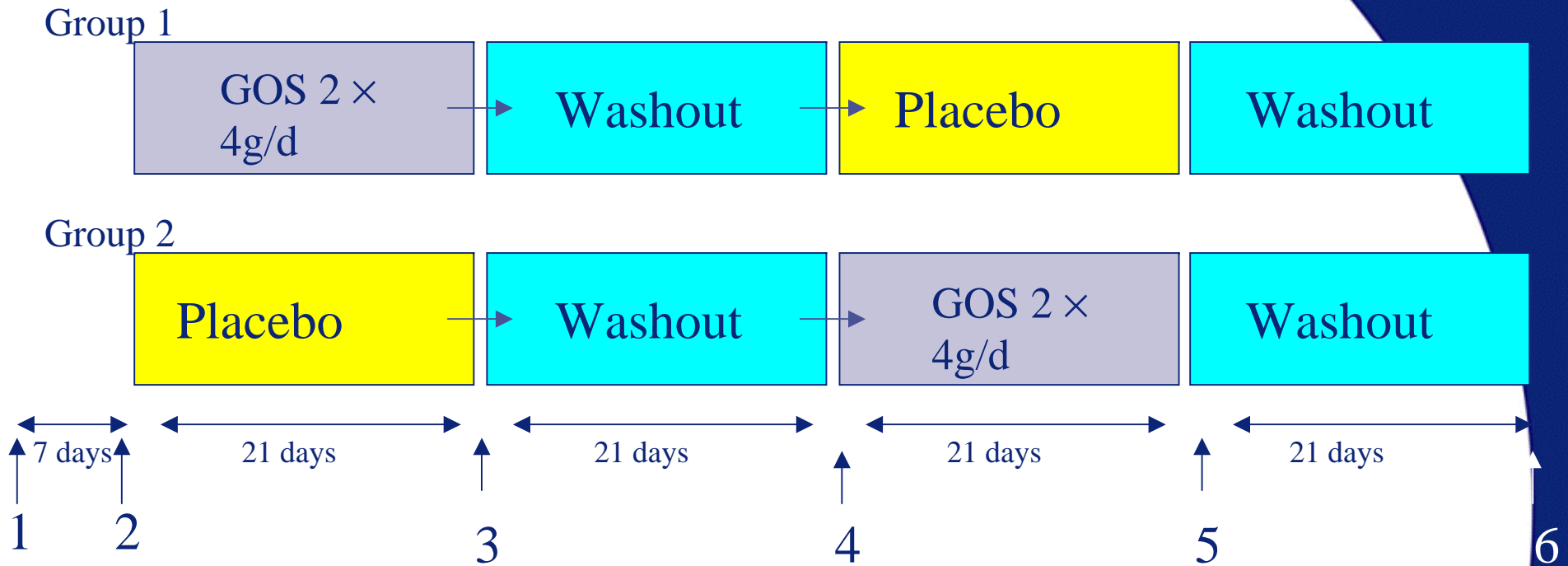
# Stimulation growth of bifidobacteria

## Human study

- Objective
  - Study the effect of GOS (Vivinal GOS) on the gut microflora in the elderly
- Methods
  - 39 Elderly volunteers (>50 years old)
  - 2x4 g GOS/day via orange juice
  - q-PCR for quantifying bacteria
  - Double blind placebo controlled

# Stimulation growth of bifidobacteria

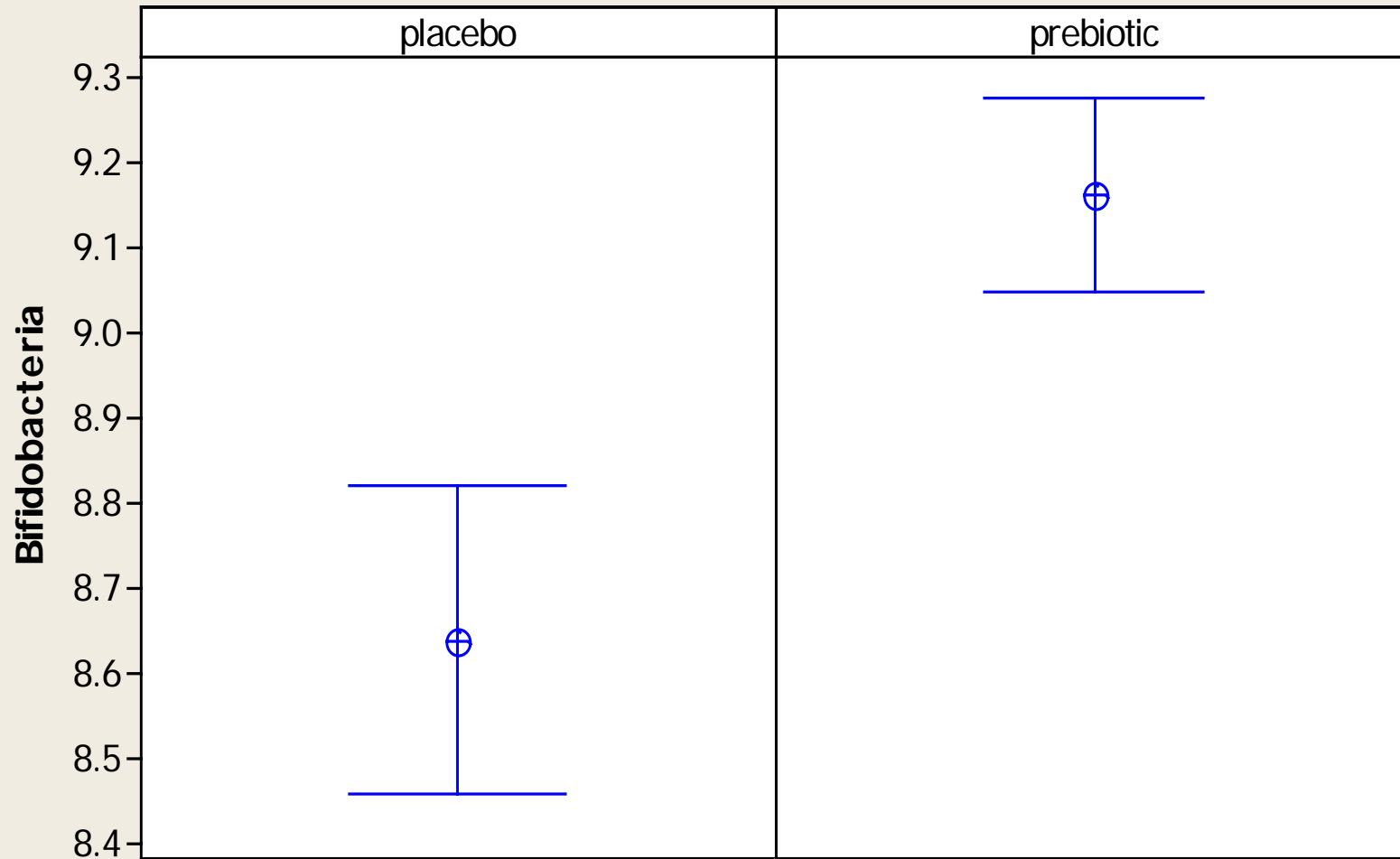
## Study design



Samples 1-6 taken for e.g.:  
Bacterial characterisation

### Interval Plot of Bifidobacteria

Bars are One Standard Error from the Mean



Panel variable: Treatment

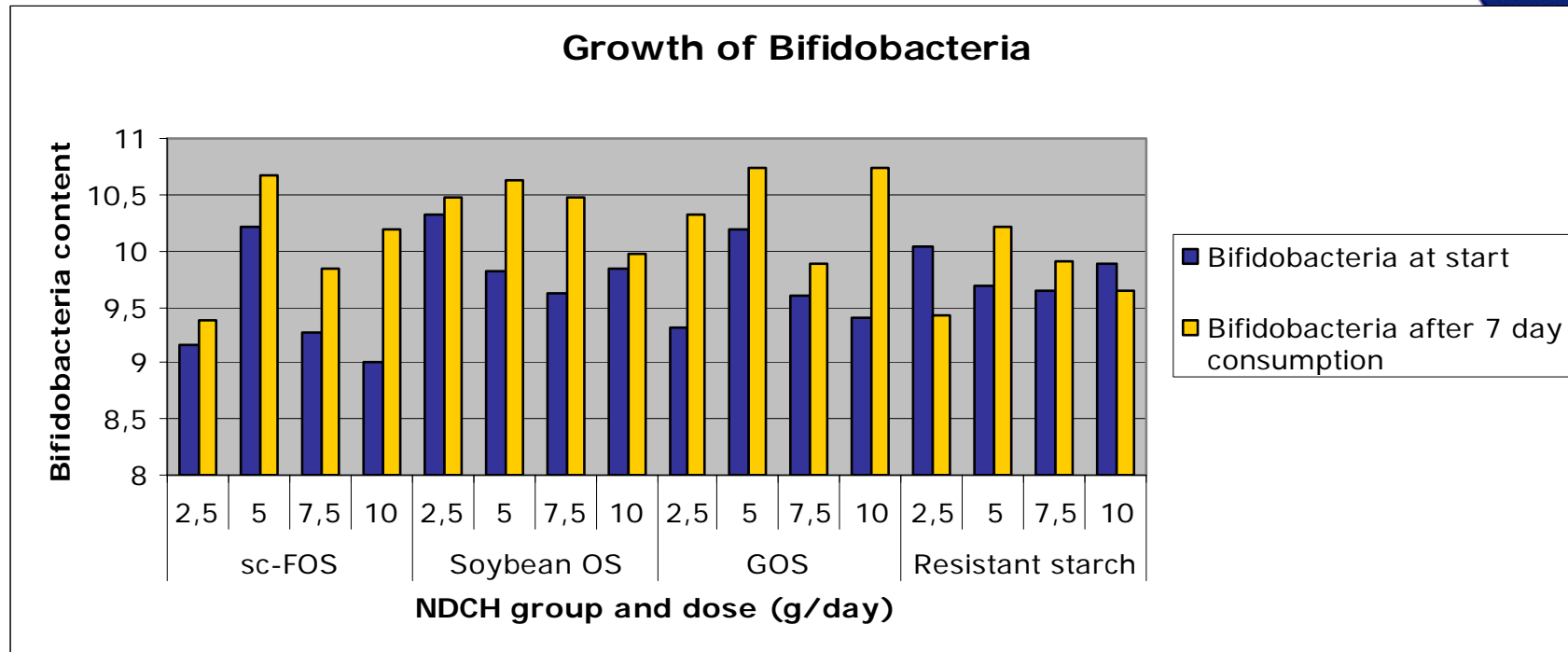
# Stimulation growth of bifidobacteria

## Conclusion

- This study demonstrated the selective nature of GOS to increase the number of Bifidobacteria

# Stimulation growth of bifidobacteria

Human study



Bouhnik, et al (2004)



# Stimulation growth of bifidobacteria

## Human studies - infants

Dose g/dl	Duration	Results
1.0*	28 days	↑ bifidobacteria <sup>1</sup>
0.4; 0.8*	28 days	↑ bifidobacteria and lactobacilli <sup>2</sup>
0.4*	25; 45; 68 days	↑ bifidobacteria <sup>3</sup>
0.8*	6 weeks	↑ bifidobacteria <sup>4</sup>
0.8*	6 weeks	↑ bifidobacteria <sup>5</sup>
0.7%**	21 days	↑ bifidobacteria <sup>6</sup>
0.24**	3; 6 months	↑ bifidobacteria and lactobacilli <sup>7</sup>
0.5**	6 weeks	↑ bifidobacteria <sup>8</sup>

\* 90% GOS + 10% FOS

\*\* 100% GOS

1. Boehm G, et al. (2002)

2. Moro G, et al. (2002)

3. Rigo J, et al (2001)

7. Ben XM, et al (2004)

4. Schmelze H, et al (2003)

5. Knol J, et al (2001)

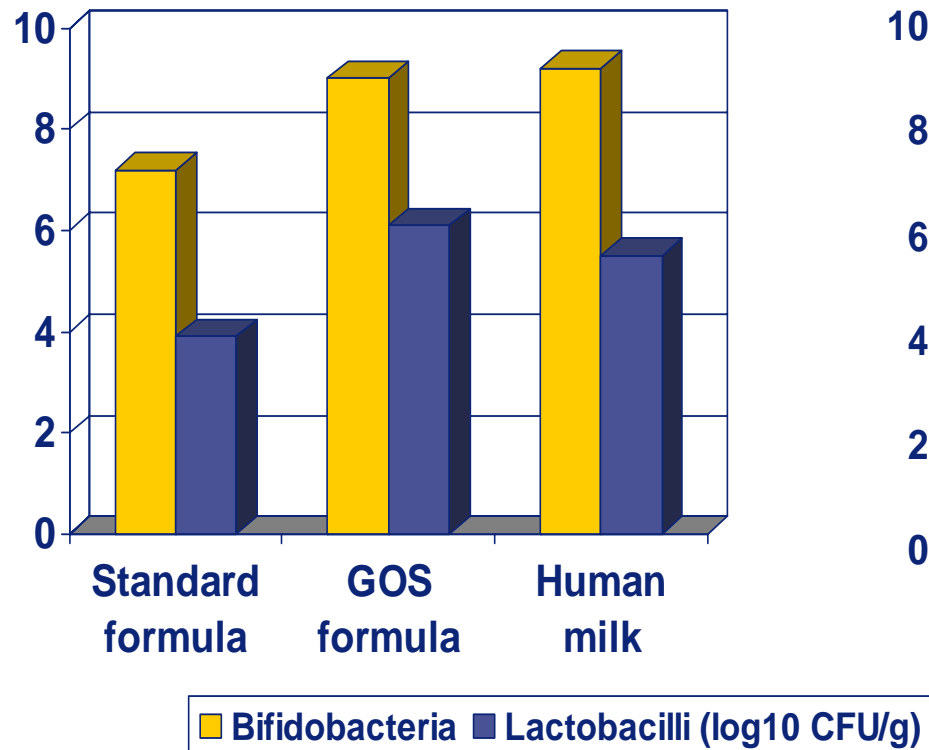
6. Napoli JE, et al (2003)

8. Sawatzki G, et al (2005)

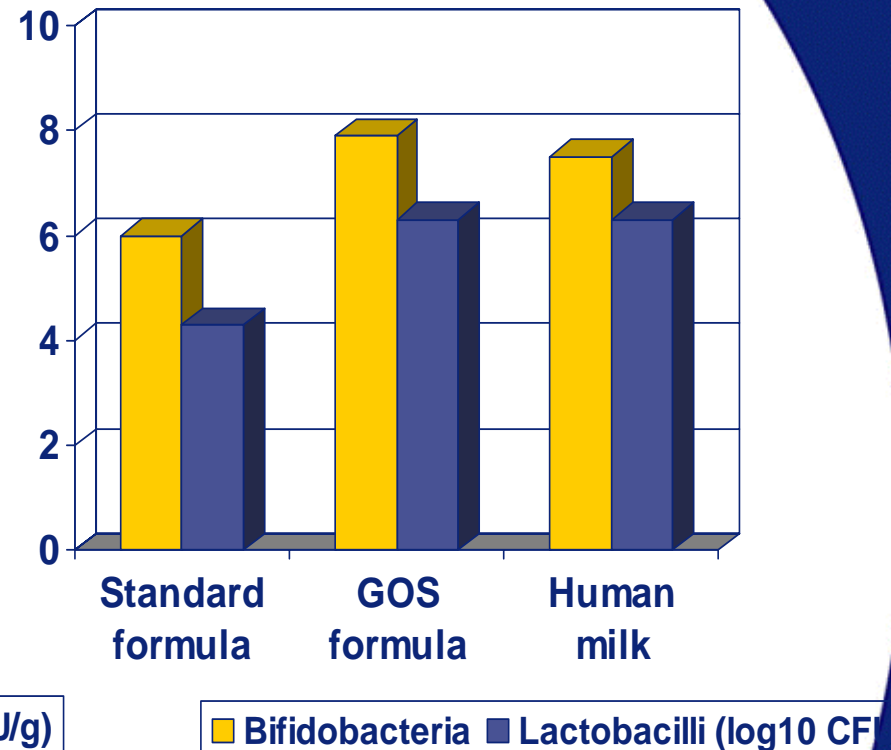
# Stimulation growth of bifidobacteria

Infant study

Results after 3 months



Results after 6 months



Ben, et al (2004)

# Improvement of calcium absorption

## Animal studies

Animals	Dose (% GOS)	Duration (days)	Results
- 36 female rats <sup>1</sup>	5	8-10; 18-20	↑ Ca absorption + bone ash weight and tibia Ca content (p < 0.05)
- 36 male rats <sup>2</sup>	5; 10	8-10	↑ Ca absorption (p < 0.05)
- 32 male rats <sup>3</sup>	10	8-10; 18-20	↑ Ca absorption + femur bone ash weight and Ca content (p < 0.05)
- 56 male rats <sup>4</sup>	5	7; 14	↑ Ca (and Mg) absorption (p < 0.05)
- 20 male rats <sup>5</sup>	5	7	↑ Ca (and Mg) absorption (p < 0.05)

1. Chonan, O. et al. (1995)

2. Chonan, O. & Watanuki M. (1995)

3. Chonan, O. & Watanuki M. (1996)

4. Yanahira, S et al. (1997)

5. Chonan, O et al. (2001)

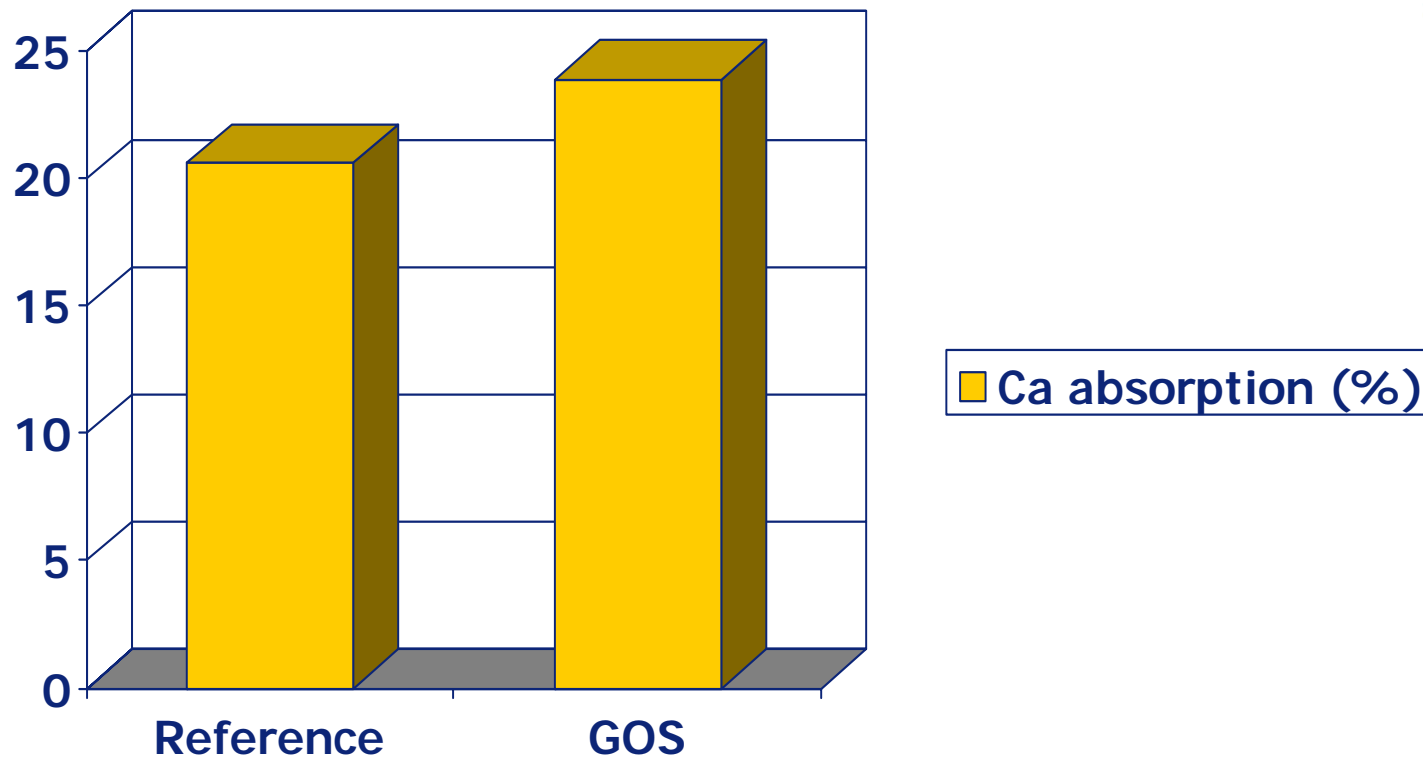
# Improvement of calcium absorption

## Human study

- Objective      Investigate effect of GOS (Vivinal GOS) on true calcium absorption in postmenopausal women
- Subjects        12 postmenopausal women
- Treatments     2 x 10 g GOS vs reference sucrose during 9 days
- Ca absorption   Dual stable isotope technique in 36 h urine

# Improvement of calcium absorption

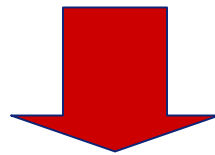
Galacto-oligosaccharides increase true calcium absorption ( $p < 0.05$ )



# Improvement of calcium absorption

## Conclusion

- Consumption of GOS increases calcium absorption in postmenopausal women
- The increase of calcium absorption was not accompanied by increased urinary calcium excretion



- GOS may increase the uptake of calcium by the bones and/or inhibit bone resorption

# Relief of constipation

Subjects	Dose (g GOS/day)	Duration (days)	Results
128 adults <sup>*1</sup>	5; 10	7	↑ defecation frequency + softer faeces (p<0.05)
14 female Elderly <sup>*2</sup>	9	14	↑ defecation frequency + easier defecation (p=0.07)

\* With constipation or constipation tendency

1. Deguchi Y et al. (1997)
2. Teuri U & Korpela R (1998)

# Support of natural defences

Examples of in-vitro and in-vivo studies

## In-vitro

- Effects GOS on adherence of E. Coli (Shoaf et al, 2006)
  - Inhibition adherence of E. Coli to tissue culture cells (antiadhesive activity)

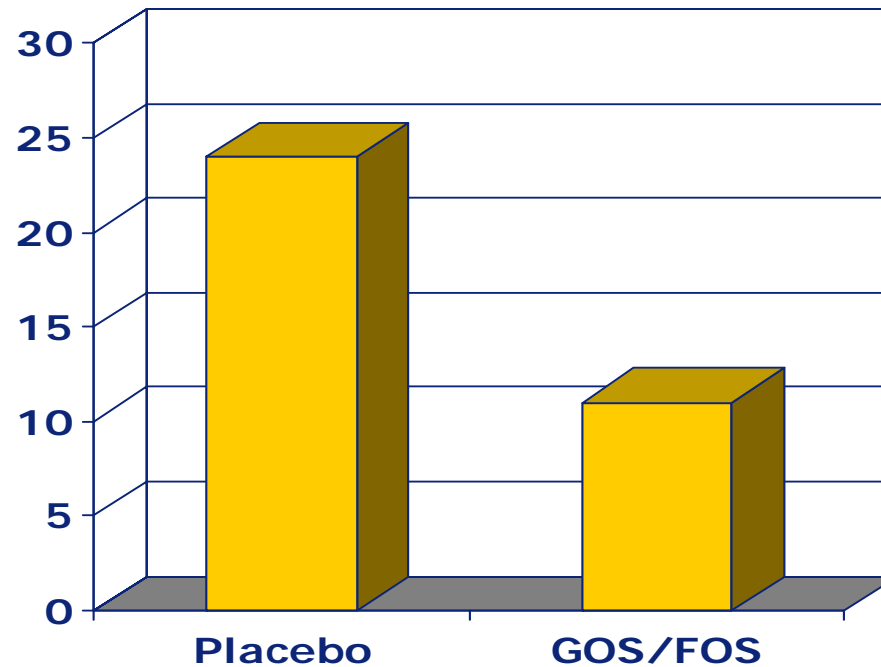
## Infant studies

- Effects of 0,8 g GOS-FOS/100 ml in infants (Knol et al, 2005)
  - Reduction of clinically relevant pathogen germs
- Effect 0,6 g GOS-FOS/100 ml in infants (Bakker et al, 2006)
  - Trend towards higher faecal SIgA levels
- Effects 0,8 g GOS-FOS/100ml in infants (Moro et al, 2006)
  - Reduction of incidence of atopic dermatitis



# Support of natural defences

Reduction of incidence of atopic dermatitis in infants at risk of developing an allergy ( $p < 0.05$ )



■ Cumulative incidence at 6 months (%)

Moro, et al (2006)

# Applications

# Applications

## Traditional products (functional foods)

- Dairy products
- Beverages
- Bakery products

## Products for special target groups

- Infant nutrition
- Clinical nutrition
- Products for children or adolescents
- Geriatric nutrition

# Applications

## Infant nutrition

- **↑** Bifidobacteria
- **↓** Risk on allergy
- Similarities human milk oligosaccharides



## Geriatric nutrition

- **↑** Bifidobacteria
- **↓** Constipation
- **↑** Calcium absorption



**Thank you for your attention!**