Infant Formula 4-1-1

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What this session will cover

Settle in……or run now!!!

- Provide a review of the differences and appropriate use of various infant formulas available to WIC participants
- Discuss the potential benefits of various components added to infant formula (DHA/ARA, nucleotides, prebiotics, etc)
- Provide a basic review of prebiotics and probiotics
- Review the differences in specific human milk components and those used to enhance infant formulas

Product Overview

Standard Formulas

Enfamil Premium Natural Defense

Enfamil Premium Infant “1” new name

- Standard formula
- Intact milk protein base (60:40, whey to casein ratio)
- Blend of 2 prebiotics: GOS and polydextrose
- LC-PUFAs (still in there)

Enfamil Gentlease

- Proteins have been partially broken down
- Reduced levels of lactose (about 1/5 the lactose of a full lactose, routine, milk-based formula)

Enfamil Prosobee

- Soy-protein based
- Lactose-free
- Lowest galactose content in the powder form of the product
- No longer the recommended formula when there is a suspicion of allergy

+

Product Review

Hypo-allergenic Formulas: Casein Hydrolysates

Casein-Hydrolysates

Hypo-allergenic formulas. Extensively hydrolyzed casein. Lactose free.

Indicated for cow milk and soy protein allergy or malabsorption

- Pregestimil
- Alimentum
- Nutramigen

Pregestimil

- 55% of fat from MCT oil
- Designed for infants with absorption issues (CF, GI/liver disease, etc)
- Lactose free and sucrose free. Glucose polymers are the CHO source
- DHA and ARA
- Powder and liquid RTF 20 and 24

Similac Alimentum

Casein-hydrolysate, hypoallergenic

- 33% fat as MCT
- Lactose free
- Sucrose, modified tapioca starch are the CHO sources
- Powder and RTF 20cal/oz

Nutramigen with Enflora LGG

Hypoallergenic, casein-hydrolysate

- Lactose-free. Glucose polymers CHO source
- Probiotic Lactobacillus rhamnosus GG (powder only)
- Enflora LGG is provided at a concentration of 1 x 10^6 CFUs LGG/g of powder formula

Nutramigen LIPIL

- Liquids do not contain the probiotic
- Available in ready to use and concentrate

Elemental formulas

Product Review

Neocate Infant DHA & ARA

Not to be confused with Neocate Jr or Neocate 1+

- Mixes 1 scoop to 1 oz of water
- Infants with SBS or other gastro-intestinal dz
- The recent change….now has 33% MCT
- Hypo-allergenic trial for GER
- Nutricia

Elecare Infant

Abbott

- 100% synthetic amino acids
- For severe milk protein allergy/intolerance or multiple protein allergy
- Contains 33% MCT
- Available with or without DHA/ARA
- 1 scoop to 2oz water

Nutramigen AA

(Mead Johnson)

- Powder only
- Synthetic amino-acids
- For severe milk protein allergy or multiple protein allergy/intolerance
- Mixes 1 scoop: 1oz water

Product Review

Miscellaneous Formulas

Premature Transitional, Enriched or Post-Discharge Formulas

Enfamil Enfacare | Similac Neosure

- 22cal/oz standard dilution
- Not a consensus on how long to use these products and if they should be used
- General Indications: BW<1800gm and approaching discharge
- Slow growth on standard formula

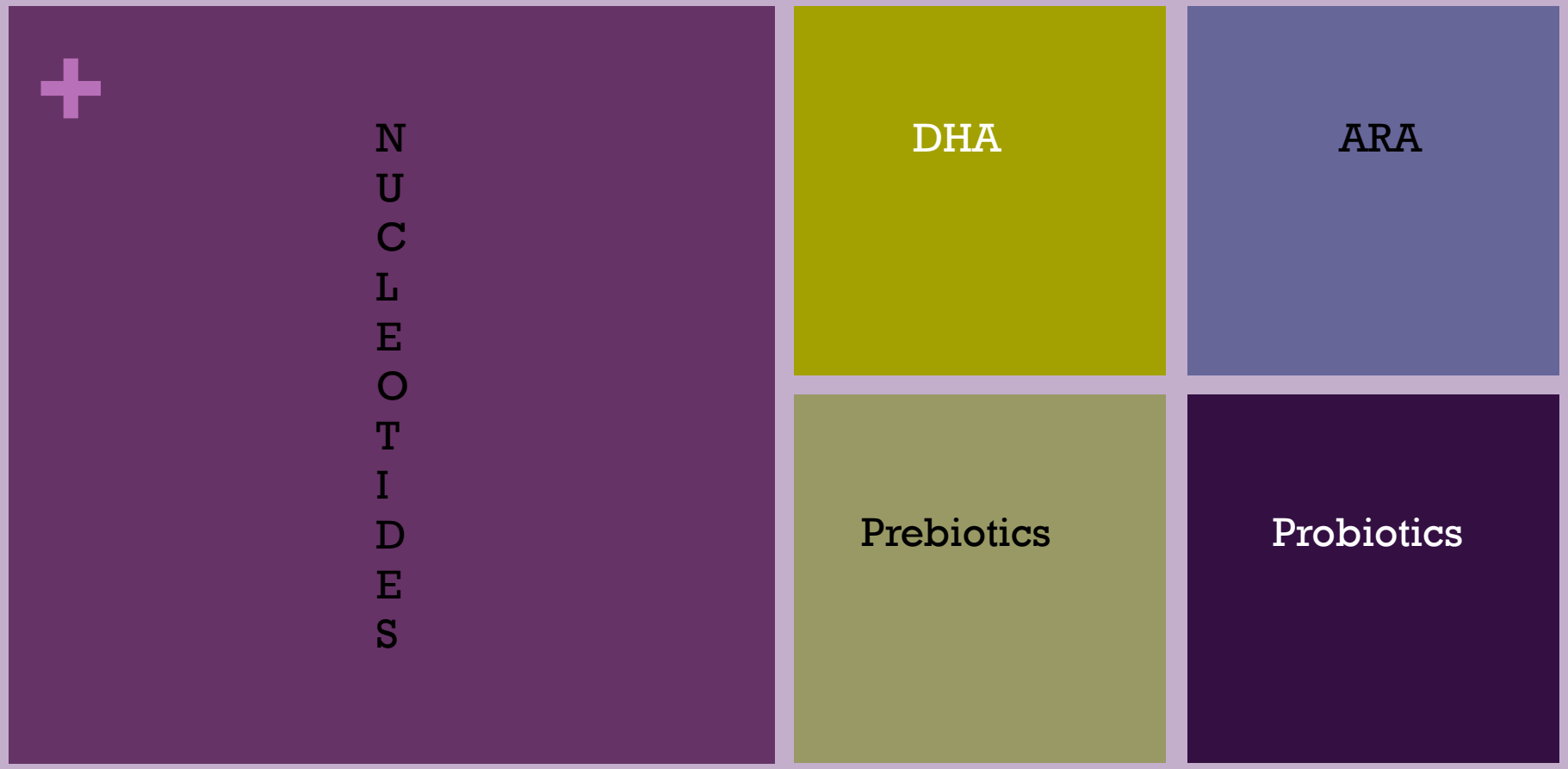
Others of note:

Enfamil AR or Enfamil Restfull

- Added rice starch
- Thickens formula, may be of use with GER not related to milk allergy/intolerance

Enfaport

- Would rarely see this used
- Designed for infants who cannot tolerate significant amounts of LCT or who need more MCT
- Examples: chylothorax, LCHAD



YOU ADDED WHAT?

Nucleotides

- Nucleotides, nucleosides and nucleobases belong to the nonprotein-nitrogen fraction of human milk
- Dietary nucleotides enhance antibody responses of infants (immune modulation) and are important for optimal metabolic functions

LC PUFAs

- Breastfed infants found to have higher amts of DHA and ARA in plasma than formula fed babies
- Inadequate LCPUFAs were frequently cited explanation for the better cognitive performance of breastfed vs formula fed infants

FA Content Correlates with Maternal Intake

- HM content of LCPUFAs reflects concentrations of LCPUFAs in maternal plasma lipids

- Some infants probably can synthesize additional LCPUFAs from the LA and ALA contents of human milk

DHA

- Docosahexaenoic Acid (22:6n3)
- Long chain polyunsaturated fatty acid Omega 3 fatty acid
- Most abundant in neural, retinal, and heart tissue

ARA

- Arachidonic Acid (C20:4n-6)
- Omega 6 fatty acid
- Precursor to molecules involved in immunity, blood clotting, and other physiologic functions

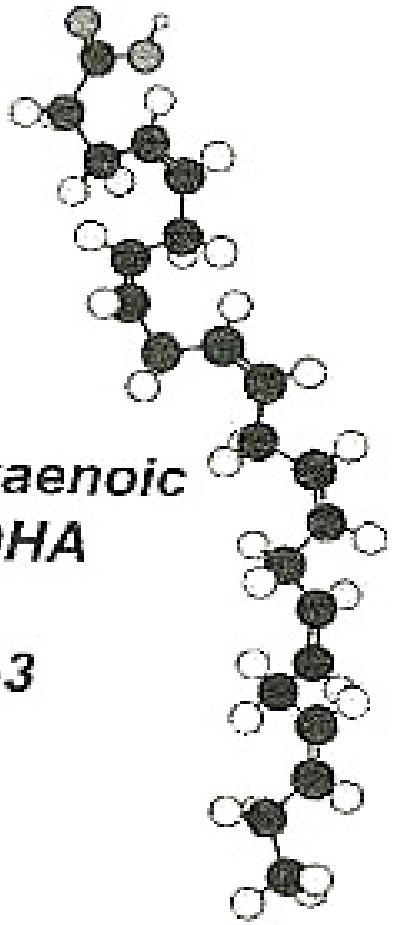
Source of PUFAs in Formula

- Crypthecodinium cohnii oil
- Mortierella alpina oil

Current thoughts on DHA and ARA in Infant Formula

- Studies in both preterm and term infants have not consistently demonstrated efficacy with long-chain polyunsaturated fatty acid supplementation of infant formula

Chemical Structures of DHA and ARA

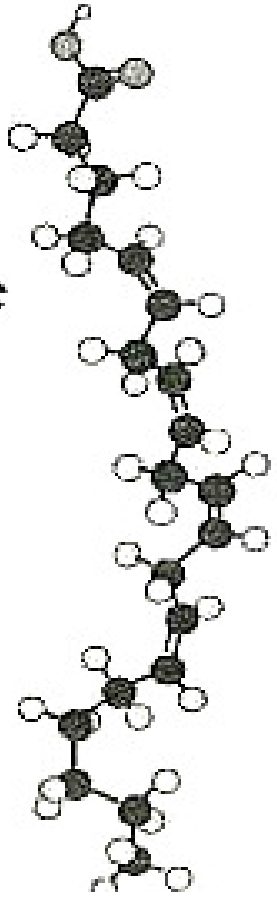


Docosahexaenoic Acid - DHA

22:6 ω3

Arachidonic Acid - ARA

20:4 ω6



Bifidobacteria

Why Pre and Probiotics Matter

Intestinal Microflora and Immunity

GI tract and Immunity

- Intestine is the largest immune organ in the body
- ~80% of all immunoglobulin-producing cells are contained in the GI tract
- Gut associated lymphoid tissue (GALT)
- The mucosa provides the largest area of contact between the human body and its environment

The Intestinal Microflora

- A complex ecosystem comprising over 700 species and 7000 strains of microorganisms
- The microflora has several nutritional and metabolic functions
- Bacterial colonization begins shortly after birth

Why is this Important?

- It is widely believed that microorganisms introduced into the neonatal GI tract have a better chance of becoming established compared to introducing the same microorganisms into the adult GI tract
- Human cells are outnumbered ten-fold by the resident microbiota in the GI tract

Trying to get closer to the gold standard: Human Milk

Differences between breastfed and formula fed infants in Microbiota

- Substantial differences in the microbiota
- The BF infant has a predominance of bifidobacteria in their lower GI tract
- The formula fed infant flora is more diverse, with higher levels of potential pathogens

Why is this important?

- Clinical and epidemiological studies have shown that BF infants have lower rates of GI infections than formula fed infants
- Thought to be in part due to the higher concentration of bifidobacteria, which are known to inhibit pathogens
- Differences in GI microbiota also result in BF infants having softer and more frequent stools

Human milk influence on Neonatal GI Development

- Whey protein: contributes high concentrations of hormones, growth factors and numerous antimicrobial proteins
- Human milk Oligosaccharides: constitute the third-largest component of human milk and offer significant developmental and protective role

Probiotics

"For life"

Probiotics: "For Life"

- FAO/WHO, 2001
- Have been defined as "live microorganisms (bacteria or yeast) which, once ingested in sufficient quantity, have functional and beneficial effects on the health of the host"

Probiotics: Good Little Bugs

- Live, nonpathogenic organisms
- Colonize the host intestine
- Bolster natural host defenses
- Types Include:
  - Lactobacillus
  - Bifidobacterium
  - Streptococcus thermophilus
  - Escherichia coli Species: E.coli Nissle 1917

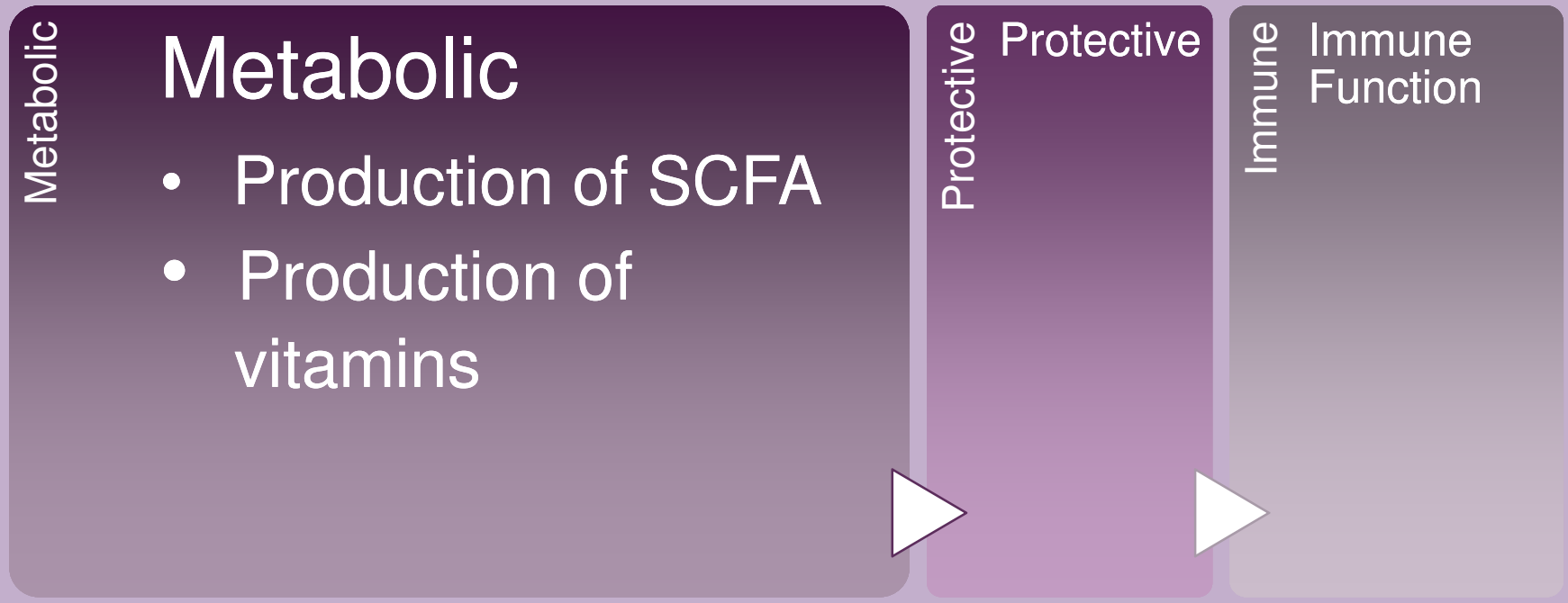
Strains are IMPORTANT:

- Escherichia : Genus
- coli: species
- Nissle 1917: strain
- E coli Nissle 1917 is a probiotic, while E coli 0157:H7 is a pathogen

Desirable Properties of a Probiotic Strain

- Human origin
- Resistant to acid and bile
- Attachment to human epithelial cells
- Colonization of the human intestine
- Production of antimicrobial substances
- Antagonism against pathogenic bacteria
- Safety in food and clinical use
- Clinically validated and documented beneficial effects

The Work of Probiotics



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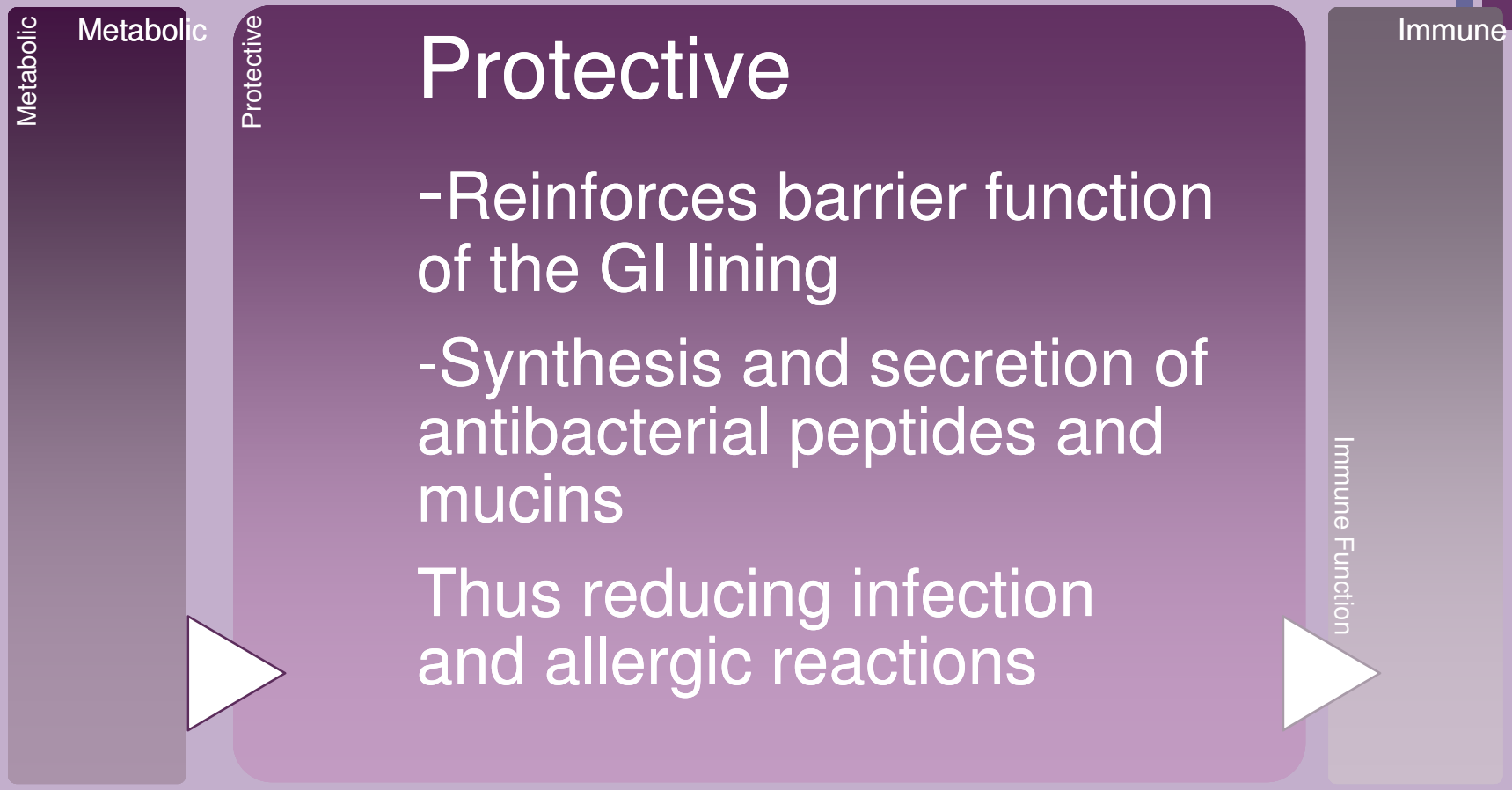
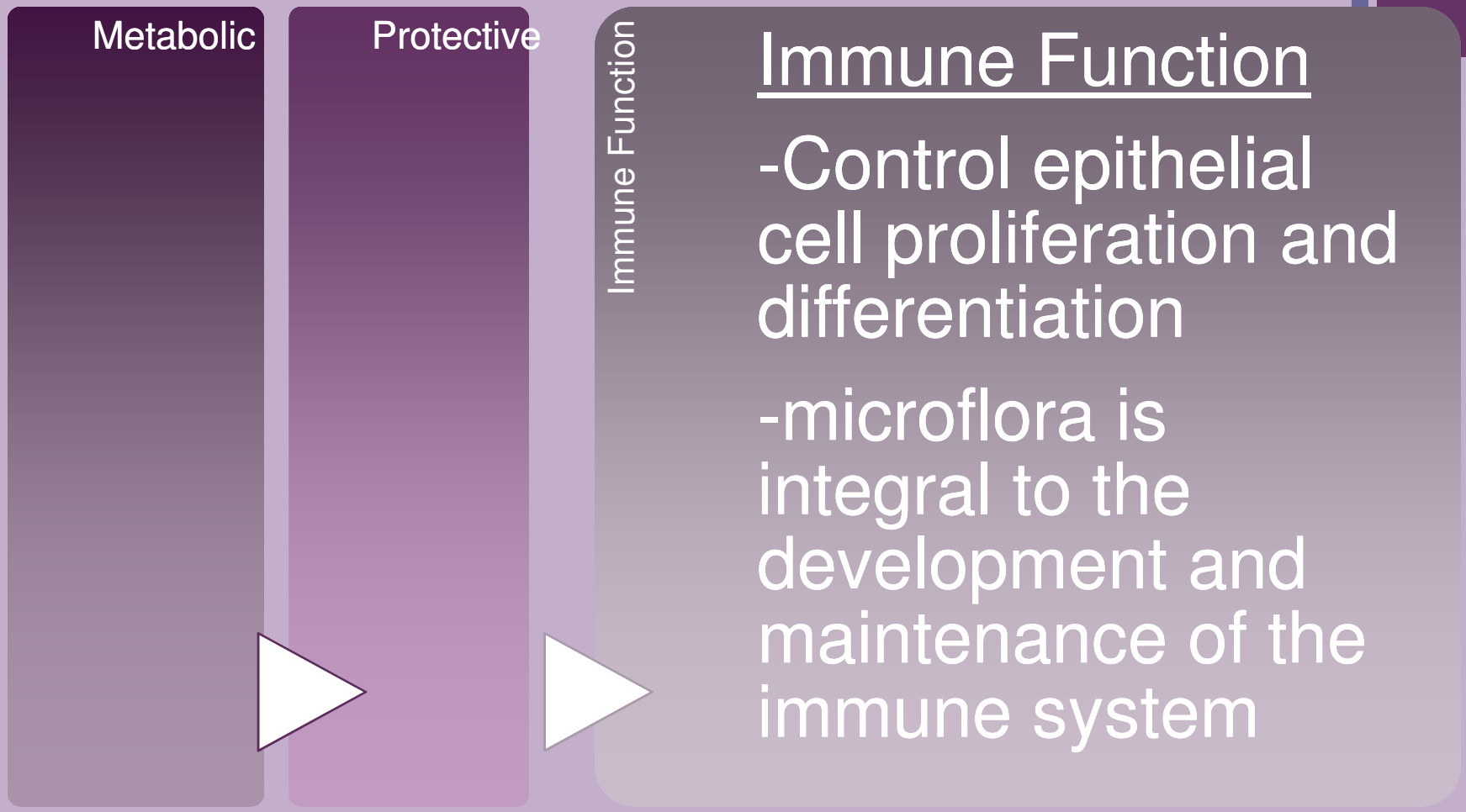


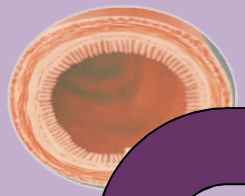
The Work of Probiotics



Benefits Associated with Probiotics

- A reduction in the length of acute diarrhea and a decrease in the incidence of acute rotavirus and antibiotic associated diarrhea
- Decreasing severity of atopic disease, and early intervention may decrease atopic sensitization
- Possible benefits for decreasing the incidence of NEC and ameloriating inflammatory bowel disease (UC)

Pathophysiology of GI Disease



- Damage to the GI barrier through disruption of the microflora

Damage

- Increased intestinal permeability leading to bacterial translocation

Bacterial Translocation

- Unregulated contact between luminal contents and intestinal tissue

Contact

Many GI diseases lead to disruption of the GI barrier and many systemic diseases result in damage to the GI barrier, adding further insult to an already vulnerable system.

Probiotics, questions we have:

- Dose response—what is the best dose
- Appropiate Species to use
- Determine the difference of live probiotic bacteria, heat-killed probiotic bacteria, bacterial products
- Identify potential long-term effects….good or bad
- How long should therapy be continued
- Delivered with prebiotics

Safety of Probiotics

- No cases of infection from commercial products with Bifidobacteria have been documented
- There have been more than 70 clinical studies involving more than 4000 children and infants consuming foods or formulas with microbial ingredients
- HAVE been reports of adverse events with immune compromised patients

Cautious Use for certain groups:

- Immune compromised individuals (major risk factor)
- Central venous catheter
- Adminstration of probiotic via jejunostomy\
- Administration of broad spectrum antibiotics to which probiotic is resistant
- Cardiac valve disease

Prebiotics

Prebiotics Defined

Natural food ingredients found in a healthy diet that stimulate the growth of beneficial bacteria in the colon and are generally recognized as safe

(Gibson and Roberfroid, 1995)

Prebiotics

- Non-digestible, food ingredients
- Fermented in the GI tract by colonic bacteria
- Stimulate growth of beneficial fecal microflora
- Act as fuel for probiotics
- Examples include:
  - Inulin
  - Oligosaccharides in human milk
    - Have a bifidogenic effect
    - Inhibit intestinal attachment of pathogenic bacteria

Human milk oligosaccharides (HMOS)

- HMOS are a mixture of oligosaccharides that differ in molecular wt and structure, current analysis methods have found more than 130 different structures
- It is not possible to replicate the HMOS content or composition of human milk in infant formula
- GOS and FOS are polymers of galactose and fructose

HMOS

- HMOS are resistant to digestion by enzymes in the stomach and small intestine
- They can be absorbed into the circulatory stystem and transported to other sites, such as the urinary tract

Prebiotics in Infant Formula

- Softer, more frequent stools
- An increase amt of friendly bacteria
- Reduced allergy and infection rate????
- Need more studies, especially with preterm infants

Ben XM et al. Chin Med J 2004; 117 (6); 927-931

High risk atopic disease. Hydrolysate formula with GOS&FOS, Intervention Birth to 6 months, follow-up to 2 years. Arslanglu S, et al. J Nutr 2008; 138: 1091-1095.

Osborn DA, Sinn JK, Prebiotics in infants for prevention of allergic disease and food hypersensitivity. Cochrane Database of Systemic Reviews 2007, Issue 4.

Prebiotics in Infant Formula

- Several food grade oligosaccharides have been evaluated for use as prebiotics infant formula
  - Galactooligosaccharides (GOS)
  - Polydextrose (PDX)
  - Lactulose (LOS)
  - Inulin
  - Fructooligosaccharides (FOS)

Prebiotics that are used in WIC products:

- Polydextrose
- Galacto-oligosaccharides

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Questions?