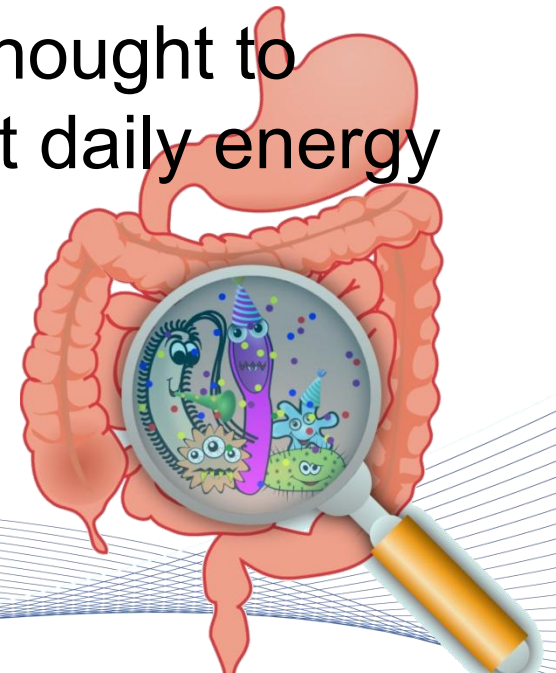


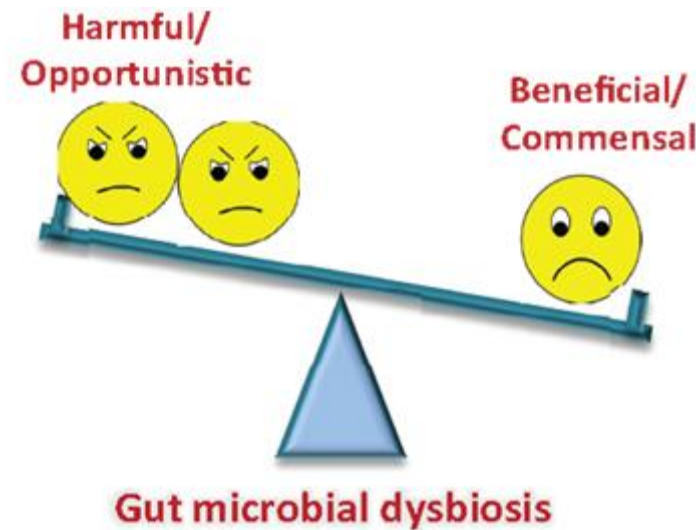


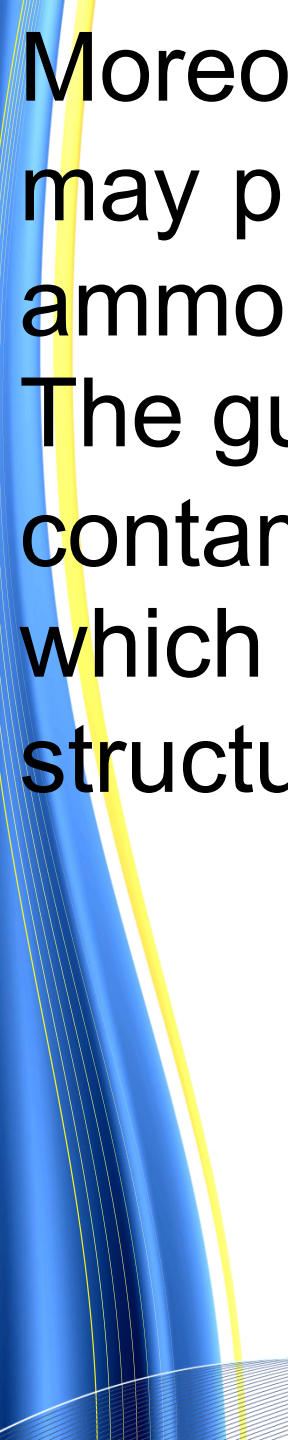
Colonic functional foods

- The microbiota of the human gastrointestinal tract plays a key role in nutrition and health. Through the process of fermentation, gut bacteria metabolise various substrates (principally dietary components) to form end products such as short chain fatty acids and gases
- This anaerobic metabolism is thought to contribute positively towards host daily energy requirements

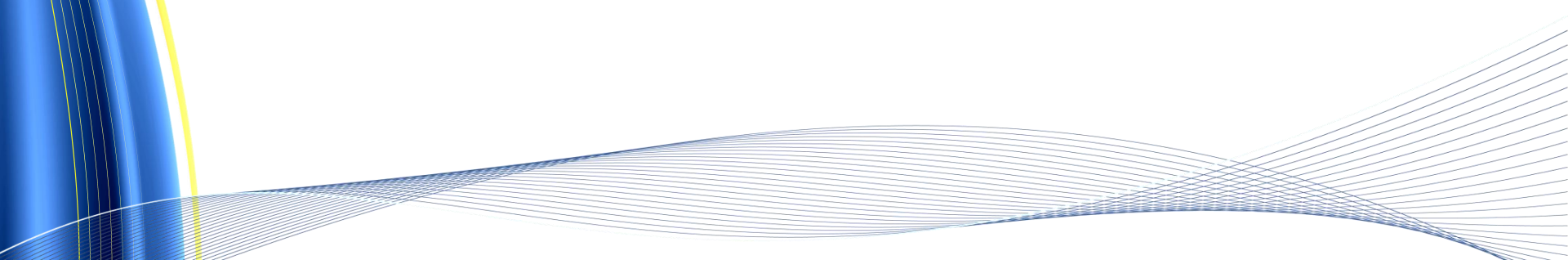


Usually, the human host lives in harmony with the complex gut microbiota. However, under certain circumstances like antimicrobial intake, stress, poor diet and living conditions, the microflora balance' m be upset

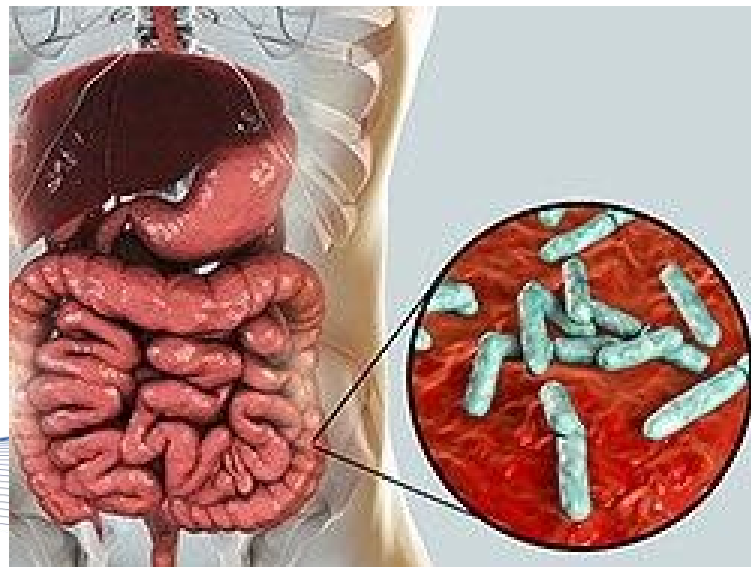




Moreover, the normal fermentative process may produce undesirable metabolites like ammonia, phenolic compounds, toxins, etc. The gut flora is also susceptible to contamination from transient pathogens, which further upset the normal community structure.



It is clear that the colonic microbiota is susceptible to manipulation through dietary mechanisms that target specific bacterial groups.³ There is current interest in the use of dietary components that help to maintain, or even improve, the normal gut microflora composition and activities



Prebiotics serve a similar purpose to **probiotics** in that they aim to improve the gut microflora community structure.

A **prebiotic** is a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon, that may improve the host health



JERUSALEM ARTICHOKES



LEEKS



ASPARAGUS



BERRIES



MUSHROOMS



GARLIC



ONION



CITRUS FRUITS



DANDELION GREENS



CHICORY ROOT




JICAMA

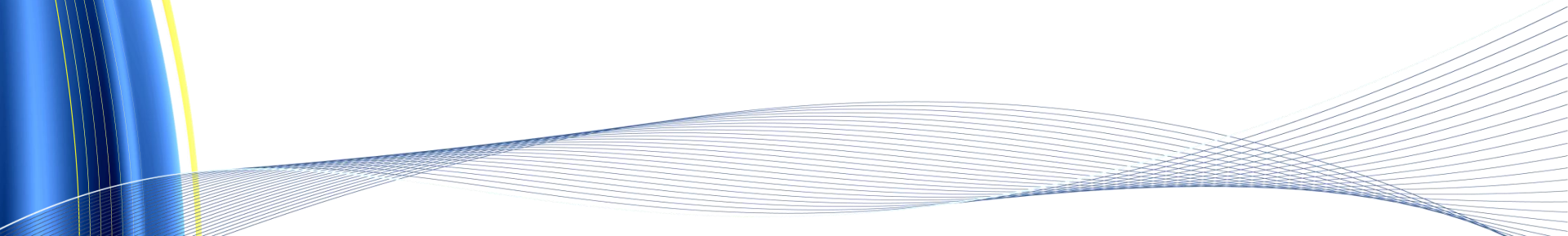


YACON ROOT





A complex, resident gastrointestinal microflora is present in humans. While the transit of residual foodstuffs through the stomach and **small intestine is probably too rapid** for the microflora to exert a significant impact, this slows markedly in the colon



As such, colonic micro-organisms have ample opportunity **to degrade available substrates**, of which **around 70g/d may be** derived from the diet. These can be recognised **as 'colonic foods'**, metabolism of which occurs through the anaerobic metabolic process known as fermentation



Type of substrates available for bacterial growth in the human large intestine

<i>Substrate</i>	<i>Estimated quantity (g/d)</i>
Resistant starch	8–40
Non-starch polysaccharides	8–18
Unabsorbed sugars	2–10
Oligosaccharides	2–8
Dietary protein	3–9

HOW ARE COLONIC FOODS METABOLISED?

- Bacteria resident in the large gut depend upon a supply of fermentable substrate for their growth and activities.
- Principally, this is provided by the **diet**, (any food that resists digestion) although there is also a contribution from endogenous sources like **mucins** and **chondroitin** sulphate

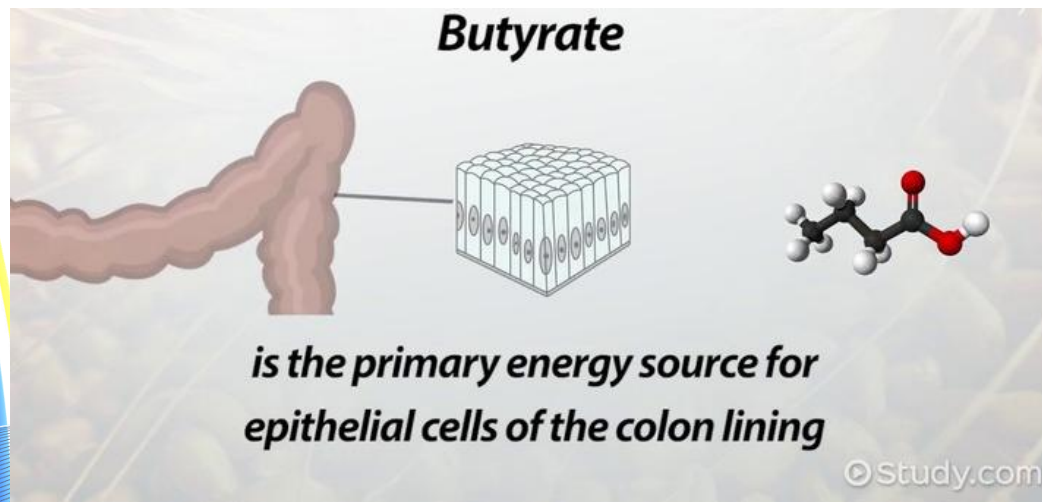
- Any foodstuff that resists digestion in the upper gastrointestinal tract (stomach, small intestine) can serve as a colonic food in that it feeds the resident microbiota

Major **SCFA** produced are acetate, propionate and butyrate. It is thought that acetate is cleared

in peripheral tissues such as muscle.

Propionate is largely broken down in the liver.

whereas butyrate acts as the primary source of fuel for colonocytes. The systemic metabolism of SCFA in the liver is thought to contribute about 7–8% of host daily energy requirements which in itself confirms the significant role of gut microorganisms in human nutritional processes



Gases are also derived by bacterial action in the large intestine. Principally, these are **hydrogen**, **carbon dioxide**, **methane** and **hydrogen sulphide**. While gas formation is usually considered to be the terminal stage of food digestion, it remains an enigmatic process through the 'balance' of H₂ generation/ metabolism




A number of possible fates occur for intestinal H₂ in that it may be excreted or further metabolised by gut bacteria. In the latter case, sulphate reducers (producing H₂S), methanogens (excreting CH₄) and acetogens (excreting acetate) may all be involved



Medically, H₂ and its fate have been, at least tenuously but usually scientifically, linked with pneumatosis cystoides intestinalis, ulcerative colitis and bowel cancer

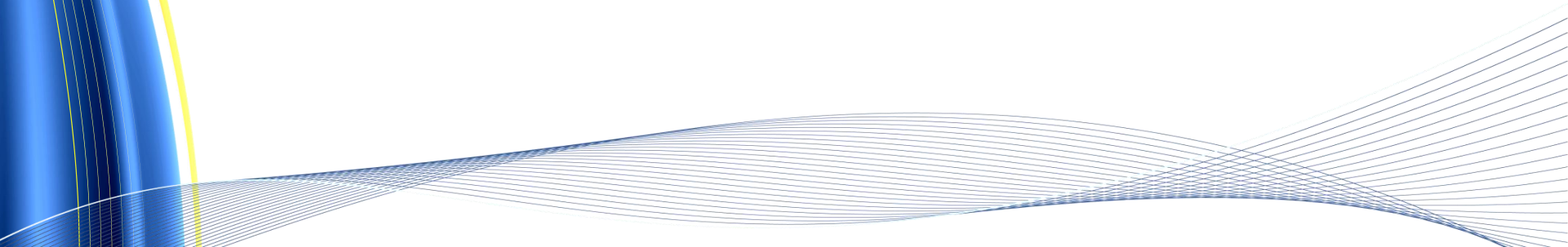
Factors affecting colonisation and growth of bacteria in the gut

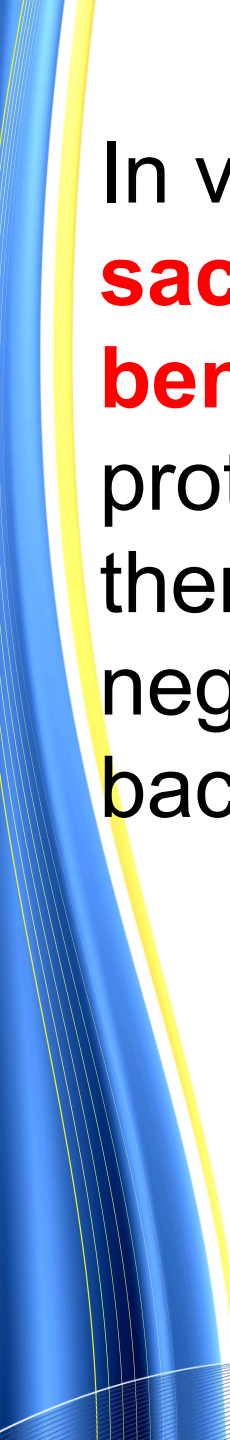
<i>Physicochemical</i>	<i>Microbial</i>
Amount and type of substrate	Competition between species for colonisation sites and nutrients
pH of gut contents	Inhibition through metabolic end products, e.g. acids, peroxides
Redox potential	Specific inhibitory substances, e.g. bacteriocins Bile salts Immunological events



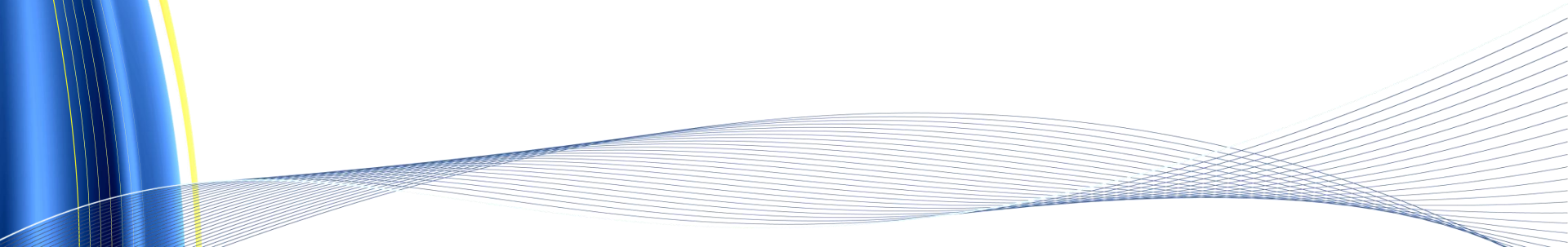
Predominant end products of protein fermentation are **SCFA**, including branched chain forms, as well as **phenolic compounds**, **ammonia** and some amines

These metabolites have been associated with various clinical states such as tumourigenesis, schizophrenia, migraine





In very general terms, the metabolites of a **saccharolytic metabolism** in the gut are **benign**, whereas those that arise from proteolysis can be **detrimental**. As such, there can be positive or negative outcomes associated with gut bacterial fermentation.



PROBIOTICS

- The first records of ingestion of live bacteria by humans are over hundred years ago. However, at the beginning of this century probiotics were first put onto a scientific basis by the work of Metchnikoff at the Pasteur Institute in Paris.

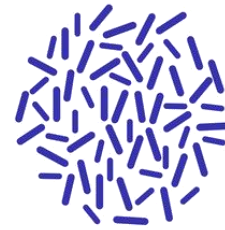
Metchnikoff hypothesised that the normal gut microflora could exert adverse effects on the host and that consumption of 'soured milks' reversed this effect.

Metchnikoff refined the treatment by using pure cultures of what is now called *Lactobacillus delbrueckii subsp. bulgaricus* which, with *Streptococcus salivarius subsp. thermophilus*, is used to ferment milk in the production of traditional yoghurt

PROBIOTIC DEFINITIONS



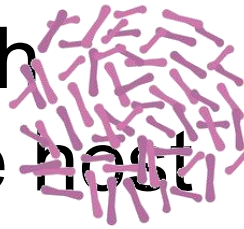
bulgaricus



propionibacterium



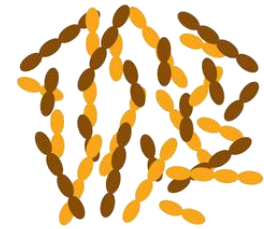
streptococcus thermophilus



bifidobacterium



lactobacillus



lactococcus

➤ A formal probiotic definition is a live microbial feed supplement which beneficially affects the host animal by improving its intestinal microbial balance

Over the years, many species of micro-organisms have been used. They consist not only of lactic acid bacteria (**lactobacilli, streptococci, enterococci, lactococci, bifidobacteria**) but also *Bacillus spp.* and **fungi** such as *Saccharomyces spp.* and *Aspergillus*

BENEFITS OF PROBIOTICS

Main positive effects associated with probiotics include

- cholesterol and/or triglyceride reduction, Anti-tumour properties.
- protection against gastroenteritis,
- improved lactose tolerance
- stimulation of the immune system through non pathogenic means

PREBIOTICS



- Prebiotics allow the **selective growth** of certain indigenous gut bacteria. Thus, the prebiotic approach involves administration of a non-viable food component and considers that many potentially health-promoting micro-organisms such as **bifidobacteria** and **lactobacilli** are already resident in the human colon

TO BE AN EFFECTIVE PREBIOTIC A COLONIC FOOD MUST

- Neither be hydrolysed nor absorbed in the upper part of the gastrointestinal tract;
- Have a selective fermentation such that the composition of the large intestinal microbiota is altered towards a healthier composition

COMMERCIALY AVAILABLE

fructose-containing oligosaccharides

(FOSs) banana, onions, legumes, Jerusalem artichoke.....

Galacto-oligosaccharides (GOSs) are

another class of prebiotics that are manufactured and marketed in Europe as well as Japan. dairy products Legumes, Cashews and pistachios, soya milk or soya drink and Oat milk.

Xylo-oligosaccharides (XOSs) are also used

as prebiotics in Japan. Sources: bamboo shoots, fruits, vegetables, milk, and honey



SYNBIOTICS

- A synbiotic is a marriage of the concepts of probiotics and prebiotics. A synbiotic consists of a live microbial food additive together with a prebiotic oligosaccharide. They can deliver the benefits of probiotics and prebiotics.