

Probiotics: The link between health and disease

by Lennart Cedgård, MD

About the author

(Dr Lennart Cedgård is a medical doctor who has conducted research in the field of intestinal microbiology and has developed probiotics in co-operation with universities and biomedical companies.)

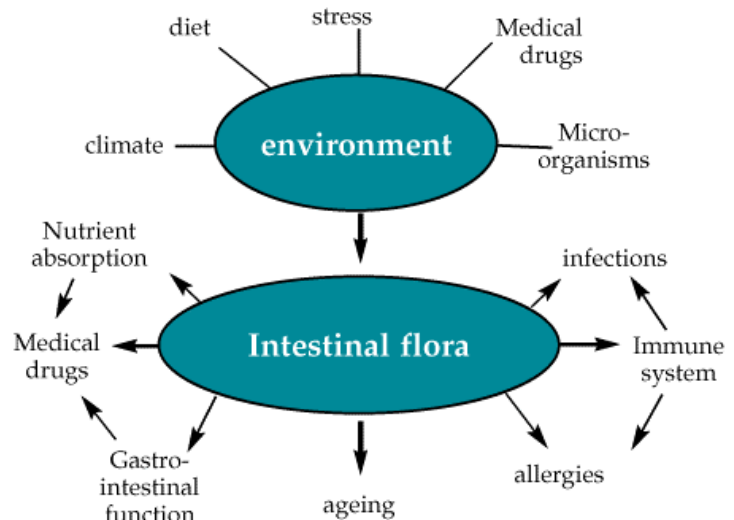
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What is dysbiosis?

Dys means 'faulty' and bios means 'life and growth'. This implies faulty life. In biological terms the phrase 'intestinal dysbiosis' is used for an unbalanced bacterial flora in the intestine. You could say that the microflora is dysbiotic. Normally it is understood that this condition includes harmful metabolic activity of the flora.

How does dysbiosis develop?

There are many factors that influence what type of bacteria or microorganisms will grow or colonize in the gastrointestinal channel. In the mouth there are already quite a number of bacteria. Many of them come from the intake of food. In the ventricle the amount will be reduced. In the small intestine the numbers of bacterial cells increase from the beginning towards the end, i.e. 10^5 to 10^{9-10} /g content. You'll find the highest amount of bacteria in the colon, which has 10^{10-11} /g content.



Stress, food, medical drugs, environmental toxic loading and climate are all factors that stimulate or inhibit different types of micro-organisms, as shown in **Figure 1** (above). A poorly balanced diet will create a dysbiosis.

Intestinal dysbiosis – unbalanced intestinal bacterial flora – may be the link between food and lifestyle and its impact upon health and disease. In the intestine micro-organisms influence our body functions, biochemically and immunologically, hence it is most important to treat the micro flora in an enlightened probiotic direction.

Probiotics, lactic acid producing cultures, are able, together with the host's own flora, to deal with disturbances caused by inadequate food, stress and strain, environmental toxins and different medical drugs such as antibiotics, contra-ceptives, painkillers and so on.

The intestinal flora influence the immune system and regulate the body's ability to cleanse itself of waste products i.e. detoxification. A harmonized and balanced flora will contribute to a better absorption of nutrients, such as minerals, trace elements, vitamins and amino acids.

Different life situations with stress or disharmony are also very influential in creating a dysbiosis. A great number of medical drugs inhibit the beneficial flora from acting normally. Environmental toxins can also provoke an intestinal dysbiosis. Food supplements taken inadequately will disturb the important balance. It should be noted that the climate supports a variety of different bacterial cultures. This is often experienced when traveling; tourists often suffer from diarrhea, for instance.

What conditions or diseases depend on dysbiosis?

Dysbiosis will often show as functional disturbances in the ventricle or the intestine. Symptoms such as dyspepsia, constipation or loose stools are conditions that will later develop into gastritis and chronic inflammation of the intestine. Ulcers in the ventricle or the intestine could result if the dysbiosis is not properly regulated. Gallbladder problems and constipation or diarrhea are often related to intestinal dysbiosis. Dysbiosis is most often seen in the dysfunction of the immune system i.e. food intolerance. Atopies or allergies, such as eczema and urticaria, are of similar origin. Chronic inflammatory diseases, such as arthritis are also developed in the context of dysbiosis. Certain types of migraine, where food and diet are significant in the outbreak, could be symptoms of intestinal dysbiosis.

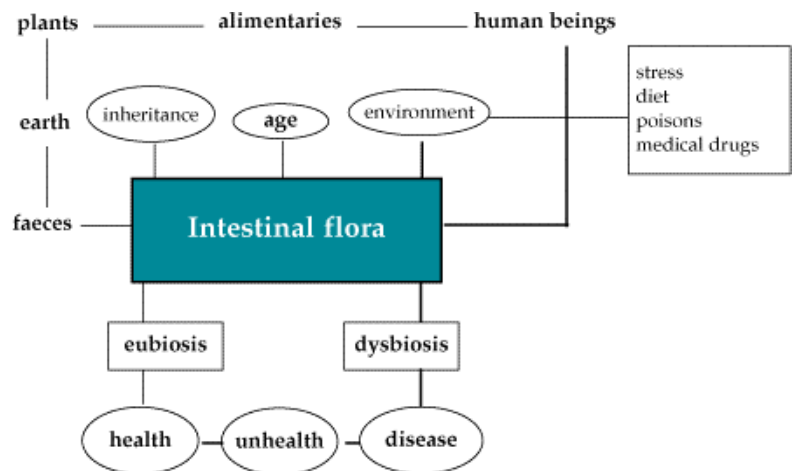
How will dysbiosis be inhibited?

The stimulation of beneficial bacteria in the intestine will reduce the degree of dysbiosis, thus optimizing the food intake and avoiding detrimental stress. Harmful medical drugs, environmental toxins and microorganisms can disrupt mental and physical welfare. (See **Figure 2** below) There are not many of us that can live in total harmony. This would be a utopia. To be successful in this, you must learn what is beneficial and what is harmful for the intestinal flora in general and in specific cases.

Eubiosis and Probiosis

What are probiotics?

Lactic acid bacterial cultures, so-called probiotics, stimulate colonization of the so-called human autochthonous flora in a beneficial direction. Probios means 'for life'. A condition without any dysbiosis is called eubiosis. It is more likely to be a utopia. Reducing the degree of dysbiosis is called probiosis. That is why the cultures are called probiotics. As a therapist you, of course, advise your patient to optimize all the factors mentioned above.



A well-balanced diet and life pattern is the best insurance for being healthy. In most cases probiotics could be an important, if not crucial, complement.

Bifidobacterias and bacteroides

What bacteria are there in the stomach and the intestine?

When fasting you only find small quantities in the stomach. Together with the intake of food the amount of bacteria will increase to 10^5 cfu (colony-forming units) /ml liquid. There often are streptococci, bifidobacteria, enterobacteria and bacteroides, some of them emanating from the mouth and the food itself. These will be reduced when the stomach starts producing acid and the pH is reduced. Further down in the small intestine the numbers of cells increase again: 10^{5-7} cfu/ml content.

In the colon the numbers increase dramatically. The two dominating types of cultures are bacteroides and bifidobacteria.

There are about 10^{10-11} cfu/g faeces. The weight is 0.5-1 kg. The total amount is 10^{14} . This is related to the total amount of human body cells that is 10^{13} . This implies there are tenfold more microorganisms than body cells! This is of great importance, especially when referring to the immune system. The Peyer's patches in the small intestine play the most important role in the control and balance of the immune system and its relation to the micro flora. There is a micro-eco-intesto-immuno-endocrino-neuro-psycho linkage. This explains many of the syndromes described, where you find both physical and psychiatric disorders closely related to each other.

Fermentation and putrefaction

Simplified, you could classify the Bifidobacteria as the good ones and the bacteroides as the evil ones. Bifidobacterias split the food by fermentation. Lactic acid, acetic acid and butyric acid are produced. These will create a more acid environment in the intestine. The bacteroides will digest the food by putrefaction. It will then produce nitrogen waste products. These are harmful for the human body and they will be absorbed in the intestine reaching all the different body tissues. Streptococci, enterococci, enterobacteria i.e. colibacteria are found in minor quantities. In adolescents the quantity of bifidobacteria is lower.

What sort of diet promotes a healthy flora?

Food rich in complex carbohydrates with a low glycaemic index will promote healthy flora. These are broken down relatively slowly and will provide you with a steady blood sugar level. Vegetables of different types, rice and pasta provide adequate roughage. A high intake of protein and animal saturated fatty acids stimulate the activity of bacteroides towards putrefaction. In Western society we strain our bodies with the intake of too much protein and saturated fatty acids. The WHO standard protein requirement is approximately 0.8g per day per kg of body weight. A high intake of fiber improves the motility of the intestine. This promotes the bifidobacteria. A vegetarian diet contains many different food fibres such as cellulose, hemicellulose and pectin. An intake of fiber should always be followed by an intake of water. The term 'throw water' is adequate. It indicates enough hydration.

The immune system and lymphoid tissue

The intestinal flora communicates with the immune system through the lymphoid tissue. This tissue is found in crypts in the small intestinal mucosa, so-called the Peyer's plaque. Deeper in the intestinal tissue there is the lamina propria with lymphoid tissue. All this is connected together with lymphatic vessels directed towards the lymph nodes. These are located in the mesenteric fibrous tissue that lines the small intestine. This is related to the other parts of the immune system. The intestinal related immune system is, in this manner, able to read and translate or react to the biochemical activities in the intestine.

The immune system is stimulated or inhibited by different bacterial cultures or food items. Dysbiosis creates a disharmony in this complicated relationship. The human being is born with a genetic memory that decides what sort of food will be accepted or not. If we introduce new unknown food items into the body, there is a risk that the immune system will react. Certain probiotics can induce an immunogen effect. It means B and T lymphocytes are stimulated and the concentration of immunoglobulins is increased. Probiotics are transitory. They do not normally colonize on the intestinal mucosa.

Nitrogen waste products

What happens in the intestine biochemically and immunologically during probiotic therapy?

Microorganisms in the stomach and the intestine influence enzymes, and the body uses these enzymes for digesting food, directly or indirectly. This is called enzyme induction or inhibition. Certain compounds that are produced in the digestion of the food are toxic and cause harm in different tissues. When there is intestinal dysbiosis these compounds are found in high quantities. Probiotics will reduce the dysbiosis and thereby the accumulation of toxic waste products. When protein is digested through the action of these harmful intestinal microorganisms, directly or indirectly, a variety of nitrogen waste products will be produced, such as ammonia, urea, indols, phenols, nitrites and nitrosamines. These toxic items could in a later sequence influence the outcome of different unhealthy conditions, such as chronic diseases where the immune system is seriously involved. They also promote the development of polyarthritis and skin diseases. Normally the liver is able to detoxify all these toxins. However, if the load is heavy and prolonged, the liver will not be able to cleanse completely.

Detoxification and retoxification

Certain beneficial bacteria are able to neutralize toxic metabolites. This is called detoxification. The opposite is retoxification. It is conversion of non-harmful products to harmful ones. Probiotics reduce the pH in the intestine causing the activity of the coliform putrefactive bacteria, such as bacteroides and clostridia to be inhibited. The production of their metabolites will then be reduced. Additionally the absorption of these is impaired, resulting in them being excreted in the feces.

Conjugation and deconjugation

One of the methods the liver uses is to neutralize toxins by conjugating them with glucuronic acid, thereby creating glucuronides. This process is called conjugation. When these are excreted from the gallbladder out into the intestine, it is given the capability to get rid of toxins. When there is a dysbiotic condition in the intestine, certain bacteria improve their ability to digest these conjugates. This is called deconjugation. The toxins are reabsorbed into the blood. The result is retoxification. Some of the enzymes that deconjugate and retoxify toxic waste products are betaglucuronidase, azoreductase and nitroreductase. The outcome of their action is an increased accumulation of toxic metabolites. By probiosis this will be reduced. Glycosides from different green plants such as rutin may be converted by the action of *Streptococcus faecium* to quercetin. This molecule is mutagenous. It will cause injuries on the body cell's genetic code. This can develop to malignant conditions such as cancer. *Streptococcus faecalis* is responsible for another sort of retoxification. It converts the amino acid tyrosine to tyrosamine. An increased amount of tyrosamine is thought to trigger attacks of migraine. In a latter phase this amine is converted to phenol, which is mutagenous.

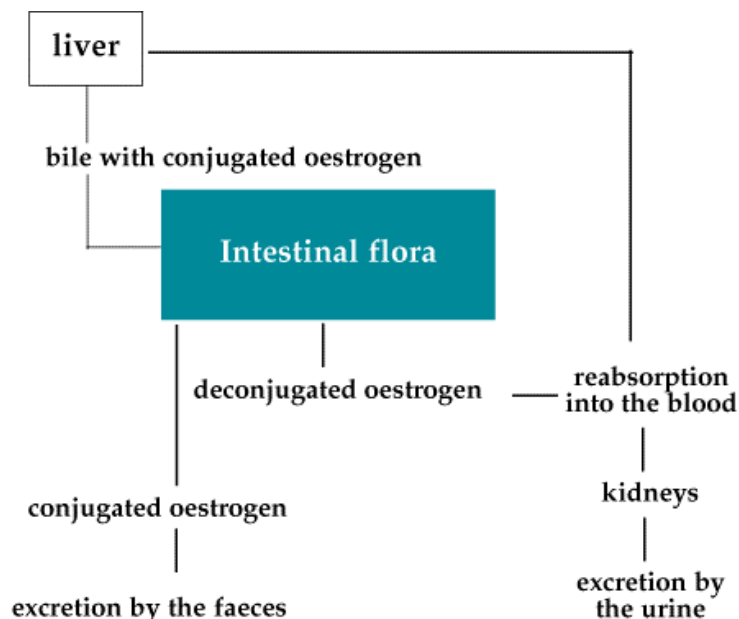
Oestrogen

Bile acids, cholesterol and a variety of sex hormones are exposed by the same mechanisms: conjugation and deconjugation. They are excreted by the bile into the intestine. (See **Figure 3** below) Further down in the intestinal channel they are reabsorbed. A certain amount is lost in the feces. Volatile bile acids and, to a certain degree, cholesterol are lost in the same manner which could be favorable. It is not desirable for the sex hormones to be lost in the feces. Both female and male hormones can be lost in this manner. This happens when there is an intestinal dysbiosis. A reduced concentration of oestrogen can cause bleeding disturbances, increased sensitivity to genital infections such as vaginitis and cystitis in the bladder, impaired fertility and osteoporosis with pain syndrome. You may experience similar mechanisms when taking contraceptives and antibiotics at the same time.

Carcinogens and insulin

Deconjugated bile acids and cholesterol are to be converted further on in a later phase. The harmful bacteria stimulate the production of an increased amount of volatile secondary bile acids and coprostanol, which is a digested product of cholesterol.

These are carcinogenic including the above-mentioned enzymes and the nitrosamines. They promote the initiation of different types of cancer such as breast cancer. An unbalanced intake of short and speedy carbohydrates i.e. glucose intensifies the development of dysbiosis. Notice the glucaemic index of different food items and their bioavailability.



There is an insulin like substance produced by the E. coli bacteria. It is a sort of analogue. This substance is thought to be absorbed into the blood and situates itself on the receptors where the human insulin is normally positioned. Thereby it will inhibit the action of the insulin. In diabetic patients you often find dysbiotic conditions.

Endotoxins

When there is dysbiosis certain bacterium, such as clostridia, produce endotoxins, which will influence the immune system. A great number of chronic inflammatory diseases are related to dysbiosis. These immune-related diseases will appear in the most various soft tissues such as the skin, joints, urinary system, intestine, eyes, glands and so on.

Vitamins and analogues

The bacterial flora in the colon produce a variety of vitamins. The absorption of these is relatively poor. It is impossible to estimate how important this vitamin production is. All of the B vitamins and the K vitamin are produced. The latter is essential for the coagulation ability. Most of our need is absorbed in the small intestine. What is of most interest is, the bacteria consume vitamins for their own survival. When there is dysbiosis this consumption is increased in the lower part of the small intestine. Vitamin B12 will be consumed in this manner.

Depressed levels of vitamin B12 are seen among older people; compare this with the reduced action of the bifidobacteria. It is known, bacteria are able to produce so-called vitamin analogues. These analogues compete with the real vitamins. They act as ghosts and are believed to cause functional conditions of insufficiency. The traditional tests on vitamin B12 are inadequate and insufficient. The level of homocysteine gives a better understanding of the vitamin condition. It could also in some cases function as an indirect parameter estimating dysbiosis. As mentioned above, the autochthonous flora creates a barrier and a protection against hostile and unwelcome guests. The majority of the pathogen or disease-provoking bacteria are sensitive to competition from the natural flora. When there is dysbiosis

their establishment will be facilitated. Probiotics reduce the pH in the intestine by 1–2 units. This will aggravate the establishment of salmonella, cholera and so on.

The bifidobacteria defend their territory by producing different organic acids such as acetic acid, lactic acid and special natural antibiotics.

Certain conditions when probiotics are of importance	
Below there will follow a variety of conditions, more or less related to intestinal dysbiosis. The dysbiotic condition is directly or indirectly related to symptoms.	
Gastritis and ulcer	Gallbladder dysfunction and liver diseases
Constipation or irritable colon	Constipation or diarrhea
Dyspepsia	Migraine; conversion of tyrosine to tyrosamine
Atopies i.e. eczema, hayfever, urticaria asthma	Food intolerance i.e. gluten intolerance
Chronic inflammatory diseases or autoimmune diseases such as rheumatism, SLE, fibromyalgia, psoriasis, colitis ulcerosa, mb.Crohn etc.	
Infections in the urinary system	Mycosis i.e. Candida albicans
Exposure to radiation, cortisone, antibiotics, contraceptives	
Conditions with impaired immune defence i.e. malignant disease i.e. leukaemias	
Insufficiency of vitamins or minerals	Stress
Skin disease i.e. acne, herpes	
Hormonal dysfunction i.e. bleedings, menstruation dysfunction, infertility and osteoporosis	
Metabolic syndrome and diabetes	Chronic fatigue syndrome

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