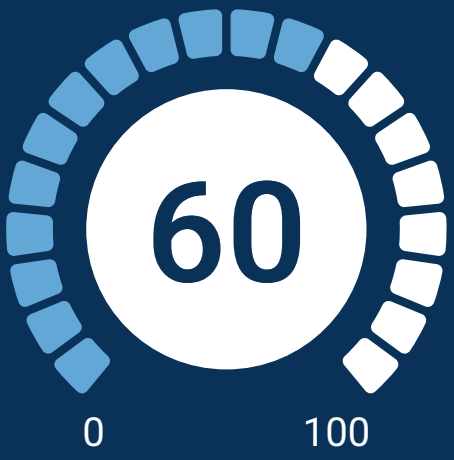
MetaBiome™ Score



MetaBiome™ Report

Report issue date
25/08/2021

Sample ID
BBD1623

The Metabiome™ score provides a snapshot of overall microbiome health, based on eleven key indicators. Their contribution to the MetaBiome™ score is weighted based on scientific evidence showing the level of influence each one has on health. When all indicators are within the healthy comparison range, the score will be 98-100.

Other markers in the Metabiome™ report provide additional information to be used in conjunction with the Metabiome™ score.

MetaBiome™ Score Contributors

Potential to promote health

Potential to reduce health

Butyrate production

The typical range in healthy people is 10.98% to 28.62%

Butyrate is a short-chain fatty acid that is very important for gut health. It is the main fuel source for gut cells, helps keep the gut cell barrier intact, can reduce inflammation, help control appetite, and stimulate the production of serotonin from our gut cells. Consuming foods high in resistant starch (e.g. lentils, peas, beans, rolled oats) has been shown to increase butyrate levels.
[1] [2] [3] [4] [5] [6] [7]

Propionate production

The typical range in healthy people is 23.23% to 49.3%

Propionate is a short-chain fatty acid that is important for gut health. It helps maintain blood glucose levels, can reduce inflammation, helps control appetite and can stimulate the production of serotonin. The consumption of fibre from foods such as fruits, vegetables, legumes and grains are associated with increased short-chain fatty acids including propionate.
[1] [2] [3] [4]

Acetate production

The typical range in healthy people is 48.13% to 72.54%

Acetate is the most abundant short-chain fatty acid produced in the gut. It plays an important role in fat metabolism, glocose metabolism and the immune system. Several bacterial species can also convert acetate to butyrate. The consumption of fruits, vegetables, legumes and fibre are associated with increased short-chain fatty acids, including acetate.
[1] [2] [3]

Fibre degradation

The typical range in healthy people is 57.02% to 72.39%

A similar or high proportion of species that can break down fibre compared to the healthy group is considered beneficial. Fibre-consuming bacteria are responsible for producing important by-products such as short chain fatty acids which play a critical role in keeping the gut healthy. Specific prebiotic fibres (detailed in the Microbiome Fuel section below) will promote the growth of beneficial bacteria.

Hexa-acylated Lipopolysaccharide

The typical range in healthy people is 0% to 0.78%

Lipopolysaccharides (LPS) are an important component of the cell wall of many bacteria, but when these bacteria die, the LPS is released into the gut where it can be pro-inflammatory, in particular hexa LPS. Diets high in fat, especially saturated fat, allow LPS to cross the intestinal barrier and enter the bloodstream. High levels of LPS in the blood have been observed in individuals with metabolic and inflammatory conditions. Avoiding excessive intake of saturated fat can help reduce the ability of LPS to enter the bloodstream.
[1] [2] [3] [4] [5] [6]

Trimethylamine production

The typical range in healthy people is 0% to 0.16%

Trimethylamine is a compound produced by some gut microbes that is converted to another compound called trimethylamine-n-oxide (TMAO) in the liver. Increased TMAO levels have been observed in individuals with cardiometabolic disorders. However, the role of TMAO in these disorders is still not clear. It is unknown if TMAO plays a causal role, is a marker of the disorder, or if it plays a protective role in repairing damage from the disorder. Levels of TMAO are influenced by many factors including our gut microbiome, diet, integrity of the gut barrier, liver function and kidney function. Although diet may only play a small role, diets high in animal protein containing choline and carnitine (e.g. eggs, red meat), as well as salt, have been associated with increased TMAO levels while diets high in soluble fibre have been shown to reduce trimethylamine and TMAO levels. If your potential to produce trimethylamine is high, you may wish to increase your consumption of fibre and avoid eating excessive amounts of red meat and eggs.
[1] [2] [3] [4] [5]

Microbial Diversity

The typical range in healthy people is 3.12% to 4.18%

Microbial diversity is a measure of both the different types and the amount of bacterial species in your sample.
A varied diet rich in plant-based foods such as fruits, vegetables, whole grains and nuts is associated with increased microbial diversity. Low microbial diversity is often associated with poor health.

3-indolepropionic acid (IPA) production

The typical range in healthy people is 0.19% to 1.78%

3-indolepropionic acid (IPA) is a strong anti-oxidant produced by some gut bacteria that can help protect the nervous system from damage. Research has shown IPA may play a role in glucose metabolism and research in animal models suggests that IPA may also play a role in maintaining the gut barrier. IPA is formed by breaking down the amino acid tryptophan. Studies have indicated that consuming foods high in dietary fibre, and in particular foods containing rye, can increase IPA production.
[1] [2] [3] [4]

Hydrogen sulphide production

The typical range in healthy people is 1.23% to 5.66%

The gas hydrogen sulphide is produced by some species in the gut microbiome when sulphur-containing foods such as eggs, garlic, onion, cabbage, kale or Brussels sprouts are broken down. Hydrogen sulphide plays an important role in gut health by acting as an energy source for gut cells and protecting the gut barrier function. However, some studies have suggested that high levels of hydrogen sulphide can also disrupt the gut mucus barrier. This gas is also responsible for the rotton egg smell of flatulence. Laboratory based studies have suggested that fibre can reduce the production of hydrogen sulphide.
[1] [2]

Protein degradation

The typical range in healthy people is 56.66% to 74.24%

A similar or low proportion of species that can break down protein compared to the healthy group is generally considered beneficial. Everyone's microbiome contains species that can break down protein. However, a high proportion of these species may reflect an insufficient amount of fibre in the diet or an excessive intake of protein.
Most protein is absorbed by your body, however excess protein will get passed to the large intestine where it is available to the gut microbiome. Microorganisms that break down protein produce a variety of compounds, including some compounds that promote inflammation.
If there are a high proportion of species that can break down protein in the microbiome, make sure there is sufficient fibre in the diet and consider avoiding excessive consumption of protein.

Human DNA

The typical range in healthy people is 0.03% to 4%

A high amount (greater than 4%) of human DNA may indicate gut inflammation. If there is greater than 4% human DNA, and there was no contamination (e.g. accidentally touched the swab during sampling), further clinical investigation is needed.

Functional Insights

Going beyond which microbes are in the gut, what they are capable of doing is more important. Through comprehensive analysis of the genes in each and every microbe, we can understand the functional capacity of the microbiome to contribute to the health of different systems in the body.

General Gut Health 73%

These metabolites and microorganisms have been shown to influence your gut barrier function.

Metabolites

Potential to promote health

Butyrate production

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Lactate production

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Lactate or lactic-acid producing bacteria have a long tradition of being used to produce fermented foods such as yoghurt, kefir, sauerkraut and kimchi. Lactate can reduce inflammation and help keep the gut cell barrier intact. Some bacterial species can also convert lactate to the short-chain fatty acids acetate, propionate and butyrate.
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Ammonia (urease) production

The typical range in healthy people is 1.48% to 7.68%

Ammonia production is a normal way that bacteria recycle protein in the gut. However, excess ammonia production has been observed in individuals with impaired gut barrier function and inflammation of the gut.

[1] [2]

Histamine production

The typical range in healthy people is 0% to 0.83%

Histamine is a chemical produced by the breakdown of the amino acid histidine. It is produced by both human cells and some bacterial species and plays an important role in immune regulation, gut function and the nervous system. Individuals with food allergies and irrritable bowel syndrome have been observed to have high levels of specific histamine receptors in the gut, making them more sensitive to histamine in the gut.

[1] [2] [3]

B. fragilis toxin production

The typical range in healthy people is 0% to 0.17%

Most people's gut microbiome contain a species of bacteria called *Bacteroides fragilis*. A small proportion of *B. fragilis* strains have the ability to secrete a toxin. In some people this toxin can cause symptoms such as diarhoea while other people can remain symptom free. There are concerns that this toxin can cause intestinal inflammation. If you are experiencing diarhoea symptoms and have this toxin, consider seeing a healthcare practitioner.

[1] [2]

Protein degradation

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A similar or low proportion of species that can break down protein compared to the healthy group is generally considered beneficial. Everyone's microbiome contains species that can break down protein. However, a high proportion of these species may reflect an insufficient amount of fibre in the diet or an excessive intake of protein.
Most protein is absorbed by your body, however excess protein will get passed to the large intestine where it is available to the gut microbiome. Microorganisms that break down protein produce a variety of compounds, including some compounds that promote inflammation. If there are a high proportion of species that can break down protein in the microbiome, make sure there is sufficient fibre in the diet and consider avoiding excessive consumption of protein.

Species

Potential to promote health

Agathobacter faecis

The typical range in healthy people is 0% to 1.52%

Previously named *Roseburia faecis*. This is a common and important member of the human gut microbiome.

Fuel sources used: It can use fibre, resistant starch, simple sugars and acetate for energy.

Key metabolites produced: It can produce the short-chain fatty acid, butyrate. Butyrate is important for a healthy gut as it is the primary fuel of cells lining the intestinal tract and is an important mediator of inflammation.

Emerging research: Low levels of this bacterium have been observed in patients with liver conditions.
[1] [2] [3]

Potential to reduce health

Bilophila wadsworthia

The typical range in healthy people is 0% to 0.2%

This is a common inhabitant of the human gut, but can become problematic at high levels.

Fuel sources used: This bacterium can use protein for energy and reduces sulphur.

Key metabolites produced: It produces the short-chain fatty acid acetate and the gas hydrogen sulphide.

Emerging research: High levels of this species can promote inflammation in the gut and is associated with a diet high in saturated fats.
[1] [2] [3] [4] [5] [6]

Agathobacter rectalis

The typical range in healthy people is 0% to 4.87%

Previously named *Eubacterium rectale*, this is a common member of the human gut.

Fuel sources used: It can use resistant plant resistant starches after initial degradation by *Ruminococcus bromii*.

Key metabolites produced: It produces the short-chain fatty acid butyrate. Butyrate is important for a healthy gut as it is the primary fuel of cells lining the intestinal tract and is an important mediator of inflammation.

Emerging research: Low levels of this species have been observed in inflammatory conditions.
[1] [2] [3]

Akkermansia muciniphila

The typical range in healthy people is 0% to 2.23%

This species is associated with a healthy metabolic status and it is being investigated as a probiotic to treat metabolic disorders.

Fuel sources used: It lives in the mucus layer of the intestine and uses the mucus as it main energy source. Mucus turnover is a normal part of our gut function and this species plays an important role in regulating mucus turnover so the right amount occurs.

Key metabolites produced: This species produces the short-chain fatty acid propionate.

Emerging research: By living in the mucus layer, *A. muciniphila* prevents potentially harmful bacteria from colonising this space through competition. Studies have associated low levels of *A. muciniphila* with metabolic conditions. Research has also indicated this species can improve the efficacy of a common immunotherapy drug used called PD-1 inhibitors.

Levels of this bacterium tend to decrease with age.

Although this bacterium appears to have mostly beneficial effects, studies have shown elevated levels are associated with neurodegenerative conditions.
[1] [2] [3] [4] [5] [6]

Clostridium_M bolteae

The typical range in healthy people is 0% to 0%

Fuel sources used: It can use fibre, simple sugars (including lactose) and protein for energy.

Key metabolites produced: It can produce lactate, the short-chain fatty acids acetate, butyrate and propionate and pro-inflammatory proteins.

Emerging research: Elevated levels of this species has been associated with metabolic conditions.
[1] [2] [3] [4] [5] [6] [7]

Eggerthella lenta

The typical range in healthy people is 0% to 0%

This is a inhabitant of the gut microbiota, but has also been associated with gastrointestinal infections.

Fuel sources used: It can use the simple sugar glucose, protein and some steroids for energy.

Key metabolites produced: It can produce the short-chain fatty acid acetate.

Emerging research: Elevated levels of this species have been associated with cardiovascular and metabolic conditions. This species can also inactivate the cardiac drug digoxin by breaking it down. Interestingly, this species prefers the amino acid arginine for growth. When arginine is present, this inhibits *E. lenta* from breaking down digoxin.
[1] [2] [3] [4] [5] [6] [7]

Bifidobacterium adolescentis

The typical range in healthy people is 0% to 0.39%

This is a common and beneficial inhabitant of the gut.

Fuel sources used: It can use fibre, resistant starch, and simple sugars (including lactose) for energy.

Key metabolites produced: It can produce lactate and the short-chain fatty acid, acetate. Acetate from *Bifidobacterium spp* promotes the growth of butyrate-producing bacteria and production of butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health. *B. adolescentis* can also produce the B vitamin folate, may have anti-obesity effects, and appears to beneficially stimulate the immune system.

Emerging research: Low levels of this species have been associated with inflammation.
[1] [2] [3] [4]

Bifidobacterium animalis

The typical range in healthy people is 0% to 0.1%

This is a naturally occurring human gut bacterium and probiotic; it is sometimes also called *Bifidobacterium lactis*.

Fuel sources used: It can use fibre, resistant starch, simple sugars (including lactose) and protein for energy.

Key metabolites produced: It produces lactate and the short-chain fatty acid, acetate. Acetate from Bifidobacteria promotes the growth of butyrate-producing bacteria and the production of butyrate.

Emerging research: *B. animalis* is associated with a low BMI and has been used to improve metabolic disorders such as obesity and diabetes. It can also produce antimicrobial substances effective against pathogenic bacteria and studies in mouse models suggest it can improve "leaky gut."
[1] [2] [3] [4] [5]

Fusobacterium nucleatum

The typical range in healthy people is 0% to 0%

Although a common member of the human oral microbiome, this pro-inflammatory bacterium can also be found in the human gut.

Fuel sources used: It primarily uses protein, but can also use some simple sugars for growth.

Key metabolites produced: It can produce the short-chain fatty acids acetate, propionate and butyrate and the gas hydrogen sulphide.

Emerging research: High levels of this species have been associated with inflammatory conditions and poor gut health. Laboratory-based studies suggest that black and green tea may reduce the growth of this species.
[1] [2] [3] [4] [5]

Peptostreptococcus stomatis

The typical range in healthy people is 0% to 0%

This is an inhabitant of the oral microbiome that can also be found in the gut microbiome.

Fuel sources used: It can use limited types of simple sugars and protein for energy.

Key metabolites produced: It can produce lactate, ethanol and the short-chain fatty acids acetate and butyrate.

Emerging research: Elevated levels of this species has been associated with poor gut health.
[1] [2] [3] [4]

Bifidobacterium bifidum

The typical range in healthy people is 0% to 0%

This is a naturally occurring human gut bacterium and a probiotic. This is one of the first colonisers of the human gut, and is important in the development of the infant immune system.

Fuel sources used: This species uses the mucus layer lining the gut as its main energy source. Mucus turnover is a normal function of a healthy gut, however it is important that mucus degradation does not outpace mucus re-generation. This species can also use the simple sugar lactose.

Key metabolites produced: It can produce lactate and the short-chain fatty acid acetate.
[1] [2] [3] [4] [5]

Bifidobacterium longum

The typical range in healthy people is 0% to 0.54%

This is a common, beneficial inhabitant of the gut in adults and a popular probiotic.

Fuel sources used: It can use fibre, resistant starch, simple sugars (including lactose), and mucus as energy sources.

Key metabolites produced: It primarily produces the short-chain fatty acid, acetate. Acetate from Bifidobacteria promotes the growth of butyrate-producing bacteria and production of butyrate. It can also produce folic acid (B9).

Emerging research: *B.longum* has been associated with reductions in harmful bacteria, anti-allergy effects, and anti-obesity effects in mouse models, but further research still needs to be done in humans.
[1] [2] [3] [4] [5] [6] [7]

Coprococcus eutactus

The typical range in healthy people is 0% to 0%

This is a common inhabitant of the human gut.

Fuel sources used: It can use fibre, simple sugars (including lactose) and limited types of protein for energy.

Key metabolites produced: It primarily produces formate and the short-chain fatty acid butyrate, but can also produce lactate and the short-chain fatty acids acetate and propionate in smaller amounts.

Emerging research: This species has been observed at decreased levels in children with inflammatory conditions.
[1] [2] [3] [4] [5] [6]

Eubacterium_E hallii

The typical range in healthy people is 0% to 0.64%

This is an important member of the gut microbiome.

Fuel sources used: It uses the acetate and lactate produced by bacterial species such as *Bifidobacterium spp.* and *Akkermansia muciniphila* for energy.

Key metabolites produced: It primarily produces the short-chain fatty acid butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health. *E. hallii* can also produce the short-chain fatty acid propionate, the essential vitamin cobalamin (B12), and an antimicrobial compound called reuterin.
[1] [2] [3]

Faecalibacterium prausnitzii_C

The typical range in healthy people is 0% to 2.37%

Faecalibacterium prausnitzii_C (aka strain A2-165) is an important member of the human gut microbiome.

Fuel sources used: It can use fibre, simple sugars and acetate produced by other bacteria for energy.

Key metabolites produced: It can produce the short-chain fatty acid butyrate and acetate. *F. prausnitzii_C* produces the highest levels of butyrate of all *F. prausnitzii* species and can also produce an anti-inflammatory protein called MAM.

Emerging research: Low levels of *F. prausnitzii* have been associated with inflammatory and metabolic conditions.
[1] [2] [3] [4] [5] [6] [7]

Roseburia hominis

The typical range in healthy people is 0% to 0.41%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use soluble fibre, simple sugars and acetate as energy sources and can also break down a compound called oxalate, which can form kidney stones.

Key metabolites produced: It primarily produces the short-chain fatty acid, butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: Studies suggest this bacterial species can help regulate the immune system and reduce inflammation. One study found higher levels in active women compared to sedentary women. Reduced levels of this bacterium have also been observed in patients with ulcerative colitis and hypertension.
[1] [2] [3] [4] [5] [6]

Roseburia intestinalis

The typical range in healthy people is 0% to 1.63%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use resistant starch, fibre, simple sugars and acetate for energy.

Key metabolites produced: It can produce the short-chain fatty acid butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: This species has been observed at reduced levels in individuals with metabolic and inflammatory conditions.
[1] [2] [3]

Roseburia inulinivorans

The typical range in healthy people is 0% to 0.05%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use resistant starch, fibre, and simple sugars for energy.

Key metabolites produced: It can produce the short-chain fatty acids butyrate and propionate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: This species has been observed at reduced levels in individuals with type 2 diabetes.
[1] [2] [3]

Ruminococcus_E bromii

The typical range in healthy people is 0% to 2.77%

This is a common member of the human gut and is considered a keystone species of the gut microbiome for its ability to break down resistant starch.

Fuel sources used: *Ruminococcus bromii* uses resistant starch for energy.

Key metabolites produced: It can produce the short-chain fatty acid acetate and simple sugars that other bacteria, such as *Agathobacter rectalis* can use to produce short-chain fatty acids such as butyrate.

Emerging research: Studies suggest the role of *R. bromii* as a primary starch degrader helps stimulate the growth of butyrate-producing bacterial species.
[1] [2] [3]

Gut Mucosal Health 73%

These metabolites and microorganisms have been shown to influence your gut barrier function.

Metabolites

Potential to promote health

Fibre degradation

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A similar or high proportion of species that can break down fibre compared to the healthy group is considered beneficial. Fibre-consuming bacteria are responsible for producing important by-products such as short chain fatty acids which play a critical role in keeping the gut healthy. Specific prebiotic fibres (detailed in the Microbiome Fuel section below) will promote the growth of beneficial bacteria.

Lactate production

The typical range in healthy people is 28% to 56.12%

Lactate or lactic-acid producing bacteria have a long tradition of being used to produce fermented foods such as yoghurt, kefir, sauerkraut and kimchi. Lactate can reduce inflammation and help keep the gut cell barrier intact. Some bacterial species can also convert lactate to the short-chain fatty acids acetate, propionate and butyrate.
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A high amount (greater than 4%) of human DNA may indicate gut inflammation. If there is greater than 4% human DNA, and there was no contamination (e.g. accidentally touched the swab during sampling), further clinical investigation is needed.

B. fragilis toxin production

The typical range in healthy people is 0% to 0.17%

Most people's gut microbiome contain a species of bacteria called *Bacteroides fragilis*. A small proportion of *B. fragilis* strains have the ability to secrete a toxin. In some people this toxin can cause symptoms such as diarhoea while other people can remain symptom free. There are concerns that this toxin can cause intestinal inflammation. If you are experiencing diarhoea symptoms and have this toxin, consider seeing a healthcare practitioner.
[1] [2]

Histamine production

The typical range in healthy people is 0% to 0.83%

Histamine is a chemical produced by the breakdown of the amino acid histidine. It is produced by both human cells and some bacterial species and plays an important role in immune regulation, gut function and the nervous system. Individuals with food allergies and irrritable bowel syndrome have been observed to have high levels of specific histamine receptors in the gut, making them more sensitive to histamine in the gut.
[1] [2] [3]

Species

Potential to promote health

Agathobacter faecis

The typical range in healthy people is 0% to 1.52%

Previously named *Roseburia faecis*. This is a common and important member of the human gut microbiome.

Fuel sources used: It can use fibre, resistant starch, simple sugars and acetate for energy.

Key metabolites produced: It can produce the short-chain fatty acid, butyrate. Butyrate is important for a healthy gut as it is the primary fuel of cells lining the intestinal tract and is an important mediator of inflammation.

Emerging research: Low levels of this bacterium have been observed in patients with liver conditions.
[1] [2] [3]

Potential to reduce health

Bilophila wadsworthia

The typical range in healthy people is 0% to 0.2%

This is a common inhabitant of the human gut, but can become problematic at high levels.

Fuel sources used: This bacterium can use protein for energy and reduces sulphur.

Key metabolites produced: It produces the short-chain fatty acid acetate and the gas hydrogen sulphide.

Emerging research: High levels of this species can promote inflammation in the gut and is associated with a diet high in saturated fats.
[1] [2] [3] [4] [5] [6]

Agathobacter rectalis

The typical range in healthy people is 0% to 4.87%

Previously named *Eubacterium rectale*, this is a common member of the human gut.

Fuel sources used: It can use resistant plant resistant starches after initial degradation by *Ruminococcus bromii*.

Key metabolites produced: It produces the short-chain fatty acid butyrate. Butyrate is important for a healthy gut as it is the primary fuel of cells lining the intestinal tract and is an important mediator of inflammation.

Emerging research: Low levels of this species have been observed in inflammatory conditions.
[1] [2] [3]

Akkermansia muciniphila

The typical range in healthy people is 0% to 2.23%

This species is associated with a healthy metabolic status and it is being investigated as a probiotic to treat metabolic disorders.

Fuel sources used: It lives in the mucus layer of the intestine and uses the mucus as it main energy source. Mucus turnover is a normal part of our gut function and this species plays an important role in regulating mucus turnover so the right amount occurs.

Key metabolites produced: This species produces the short-chain fatty acid propionate.

Emerging research: By living in the mucus layer, *A. muciniphila* prevents potentially harmful bacteria from colonising this space through competition. Studies have associated low levels of *A. muciniphila* with metabolic conditions. Research has also indicated this species can improve the efficacy of a common immunotherapy drug used called PD-1 inhibitors.

Levels of this bacterium tend to decrease with age.

Although this bacterium appears to have mostly beneficial effects, studies have shown elevated levels are associated with neurodegenerative conditions.
[1] [2] [3] [4] [5] [6]

Bifidobacterium animalis

The typical range in healthy people is 0% to 0.1%

This is a naturally occurring human gut bacterium and probiotic; it is sometimes also called *Bifidobacterium lactis*.

Fuel sources used: It can use fibre, resistant starch, simple sugars (including lactose) and protein for energy.

Key metabolites produced: It produces lactate and the short-chain fatty acid, acetate. Acetate from Bifidobacteria promotes the growth of butyrate-producing bacteria and the production of butyrate.

Emerging research: *B. animalis* is associated with a low BMI and has been used to improve metabolic disorders such as obesity and diabetes. It can also produce antimicrobial substances effective against pathogenic bacteria and studies in mouse models suggest it can improve "leaky gut."
[1] [2] [3] [4] [5]

Bifidobacterium bifidum

The typical range in healthy people is 0% to 0%

This is a naturally occurring human gut bacterium and a probiotic. This is one of the first colonisers of the human gut, and is important in the development of the infant immune system.

Fuel sources used: This species uses the mucus layer lining the gut as its main energy source. Mucus turnover is a normal function of a healthy gut, however it is important that mucus degradation does not outpace mucus re-generation. This species can also use the simple sugar lactose.

Key metabolites produced: It can produce lactate and the short-chain fatty acid acetate.
[1] [2] [3] [4] [5]

Coprococcus eutactus

The typical range in healthy people is 0% to 0%

This is a common inhabitant of the human gut.

Fuel sources used: It can use fibre, simple sugars (including lactose) and limited types of protein for energy.

Key metabolites produced: It primarily produces formate and the short-chain fatty acid butyrate, but can also produce lactate and the short-chain fatty acids acetate and propionate in smaller amounts.

Emerging research: This species has been observed at decreased levels in children with inflammatory conditions.
[1] [2] [3] [4] [5] [6]

Eubacterium_E hallii

The typical range in healthy people is 0% to 0.64%

This is an important member of the gut microbiome.

Fuel sources used: It uses the acetate and lactate produced by bacterial species such as *Bifidobacterium spp.* and *Akkermansia muciniphila* for energy.

Key metabolites produced: It primarily produces the short-chain fatty acid butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health. *E. hallii* can also produce the short-chain fatty acid propionate, the essential vitamin cobalamin (B12), and an antimicrobial compound called reuterin.
[1] [2] [3]

Faecalibacterium prausnitzii_C

The typical range in healthy people is 0% to 2.37%

Faecalibacterium prausnitzii_C (aka strain A2-165) is an important member of the human gut microbiome.

Fuel sources used: It can use fibre, simple sugars and acetate produced by other bacteria for energy.

Key metabolites produced: It can produce the short-chain fatty acid butyrate and acetate. *F. prausnitzii_C* produces the highest levels of butyrate of all *F. prausnitzii* species and can also produce an anti-inflammatory protein called MAM.

Emerging research: Low levels of *F. prausnitzii* have been associated with inflammatory and metabolic conditions.
[1] [2] [3] [4] [5] [6] [7]

Roseburia hominis

The typical range in healthy people is 0% to 0.41%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use soluble fibre, simple sugars and acetate as energy sources and can also break down a compound called oxalate, which can form kidney stones.

Key metabolites produced: It primarily produces the short-chain fatty acid, butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: Studies suggest this bacterial species can help regulate the immune system and reduce inflammation. One study found higher levels in active women compared to sedentary women. Reduced levels of this bacterium have also been observed in patients with ulcerative colitis and hypertension.
[1] [2] [3] [4] [5] [6]

Roseburia intestinalis

The typical range in healthy people is 0% to 1.63%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use resistant starch, fibre, simple sugars and acetate for energy.

Key metabolites produced: It can produce the short-chain fatty acid butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: This species has been observed at reduced levels in individuals with metabolic and inflammatory conditions.
[1] [2] [3]

Roseburia inulinivorans

The typical range in healthy people is 0% to 0.05%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use resistant starch, fibre, and simple sugars for energy.

Key metabolites produced: It can produce the short-chain fatty acids butyrate and propionate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: This species has been observed at reduced levels in individuals with type 2 diabetes.
[1] [2] [3]

Ruminococcus_E bromii

The typical range in healthy people is 0% to 2.77%

This is a common member of the human gut and is considered a keystone species of the gut microbiome for its ability to break down resistant starch.

Fuel sources used: *Ruminococcus bromii* uses resistant starch for energy.

Key metabolites produced: It can produce the short-chain fatty acid acetate and simple sugars that other bacteria, such as *Agathobacter rectalis* can use to produce short-chain fatty acids such as butyrate.

Emerging research: Studies suggest the role of *R. bromii* as a primary starch degrader helps stimulate the growth of butyrate-producing bacterial species.
[1] [2] [3]

Gut Motility 71%

These metabolites and microorganisms have been shown to influence the rate at which food is moved through the digestive tract, which can impact bowel movement frequency.

Metabolites

Potential to promote health

Butyrate production

The typical range in healthy people is 10.98% to 28.62%

Butyrate is a short-chain fatty acid that is very important for gut health. It is the main fuel source for gut cells, helps keep the gut cell barrier intact, can reduce inflammation, help control appetite, and stimulate the production of serotonin from our gut cells. Consuming foods high in resistant starch (e.g. lentils, peas, beans, rolled oats) has been shown to increase butyrate levels.
[1] [2] [3] [4] [5] [6] [7]

Fibre degradation

The typical range in healthy people is 57.02% to 72.39%

A similar or high proportion of species that can break down fibre compared to the healthy group is considered beneficial. Fibre-consuming bacteria are responsible for producing important by-products such as short chain fatty acids which play a critical role in keeping the gut healthy. Specific prebiotic fibres (detailed in the Microbiome Fuel section below) will promote the growth of beneficial bacteria.

Propionate production

The typical range in healthy people is 23.23% to 49.3%

Propionate is a short-chain fatty acid that is important for gut health. It helps maintain blood glucose levels, can reduce inflammation, helps control appetite and can stimulate the production of serotonin. The consumption of fibre from foods such as fruits, vegetables, legumes and grains are associated with increased short-chain fatty acids including propionate.
[1] [2] [3] [4]

Potential to reduce health

Methane production

The typical range in healthy people is 0% to 0.19%

The gas methane can be produced by some species of the gut microbiome, primarily through the reduction of carbon dioxide and hydrogen. Although methane production is often detected in healthy adult populations, elevated levels of methane production has been associated with slower intestinal transit times and constipation.
[1] [2] [3] [4]

Hydrogen sulphide production

The typical range in healthy people is 1.23% to 5.66%

The gas hydrogen sulphide is produced by some species in the gut microbiome when sulphur-containing foods such as eggs, garlic, onion, cabbage, kale or Brussels sprouts are broken down. Hydrogen sulphide plays an important role in gut health by acting as an energy source for gut cells and protecting the gut barrier function. However, some studies have suggested that high levels of hydrogen sulphide can also disrupt the gut mucus barrier. This gas is also responsible for the rotton egg smell of flatulence. Laboratory based studies have suggested that fibre can reduce the production of hydrogen sulphide.
[1] [2]

Tyramine production

The typical range in healthy people is 0% to 0%

Tyramine is a chemical that is produced from the breakdown of the amino acid tyrosine. It occurs naturally in foods such as smoked or aged meats, cheese, and chocolate and is also produced by gut bacteria. Tyramine that you consume in food is absorbed in the small intestine, and foods high in tyramine are thought to trigger migraines in sensitive individuals. In contrast, tyramine produced by your gut microbiota in the large intestine can stimulate serotonin production in the gut. Tyramine is only one of several compounds that can stimulate serotonin production in the gut. Other compounds include butyrate, propionate and vitamin E.

More than 90% of the body's serotonin is produced by cells in the gut, where it plays an important role in many bodily functions such as the immune response, gut motility, bone development, and cardiac function. Only about 10% of the body's serotonin is produced in the brain, where it is used to regulate mood, appetite and sleep. Consuming a sufficient amount of fibre, including fruits and vegetables, can help support serotonin production in your gut.
[1] [2]

Protein degradation

The typical range in healthy people is 56.66% to 74.24%

A similar or low proportion of species that can break down protein compared to the healthy group is generally considered beneficial. Everyone's microbiome contains species that can break down protein. However, a high proportion of these species may reflect an insufficient amount of fibre in the diet or an excessive intake of protein.
Most protein is absorbed by your body, however excess protein will get passed to the large intestine where it is available to the gut microbiome. Microorganisms that break down protein produce a variety of compounds, including some compounds that promote inflammation. If there are a high proportion of species that can break down protein in the microbiome, make sure there is sufficient fibre in the diet and consider avoiding excessive consumption of protein.

Species

Potential to promote health

Potential to reduce health

Methanobrevibacter_A smithii

The typical range in healthy people is 0% to 0.2%

This is a single celled organism belonging to the Archaea domain and is the most common archaeal species found in the human gut.

Fuel sources used: It uses hydrogen, carbon dioxide and formate.

Key metabolites produced: It produces methane gas.

Emerging research: *M. smithii* plays an important role in the gut because it is one of the few species that can remove excess hydrogen. However, large amounts of this species are not good either, as high levels of methane can promote constipation.
[1] [2] [3] [4]

Bilophila wadsworthia

The typical range in healthy people is 0% to 0.2%

This is a common inhabitant of the human gut, but can become problematic at high levels.

Fuel sources used: This bacterium can use protein for energy and reduces sulphur.

Key metabolites produced: It produces the short-chain fatty acid acetate and the gas hydrogen sulphide.

Emerging research: High levels of this species can promote inflammation in the gut and is associated with a diet high in saturated fats.
[1] [2] [3] [4] [5] [6]

Metabolic Health 80%

These metabolites and microorganisms have been shown to influence how the body metabolises nutrients such as glucose and fats, as well as the health of the circulatory system.

Metabolites

Potential to promote health

Butyrate production

The typical range in healthy people is 10.98% to 28.62%

Butyrate is a short-chain fatty acid that is very important for gut health. It is the main fuel source for gut cells, helps keep the gut cell barrier intact, can reduce inflammation, help control appetite, and stimulate the production of serotonin from our gut cells. Consuming foods high in resistant starch (e.g. lentils, peas, beans, rolled oats) has been shown to increase butyrate levels.
[1] [2] [3] [4] [5] [6] [7]

Propionate production

The typical range in healthy people is 23.23% to 49.3%

Propionate is a short-chain fatty acid that is important for gut health. It helps maintain blood glucose levels, can reduce inflammation, helps control appetite and can stimulate the production of serotonin. The consumption of fibre from foods such as fruits, vegetables, legumes and grains are associated with increased short-chain fatty acids including propionate.
[1] [2] [3] [4]

Acetate production

The typical range in healthy people is 48.13% to 72.54%

Acetate is the most abundant short-chain fatty acid produced in the gut. It plays an important role in fat metabolism, glucose metabolism and the immune system. Several bacterial species can also convert acetate to butyrate. The consumption of fruits, vegetables, legumes and fibre are associated with increased short-chain fatty acids, including acetate.
[1] [2] [3]

Potential to reduce health

Branched chain amino acids production

The typical range in healthy people is 36.74% to 66.45%

Branched chain amino acids (BCAAs) are building blocks for muscles, are involved in the regulation of glucose and fat metabolism, and are involved in the regulation of the immune system. They can be obtained from your diet as well as from your gut microbiome. However, the right amount of BCAAs is important. High levels of BCAAs have been associated with metabolic diseases. One study found that an increased potential for the gut microbiome to produce BCAAs is correlated with an increased BCAA level in the blood.
[1] [2]

Hexa-acylated Lipopolysaccharide

The typical range in healthy people is 0% to 0.78%

Lipopolysaccharides (LPS) are an important component of the cell wall of many bacteria, but when these bacteria die, the LPS is released into the gut where it can be pro-inflammatory, in particular hexa LPS. Diets high in fat, especially saturated fat, allow LPS to cross the intestinal barrier and enter the bloodstream. High levels of LPS in the blood have been observed in individuals with metabolic and inflammatory conditions. Avoiding excessive intake of saturated fat can help reduce the ability of LPS to enter the bloodstream.
[1] [2] [3] [4] [5] [6]

Fibre degradation

The typical range in healthy people is 57.02% to 72.39%

A similar or high proportion of species that can break down fibre compared to the healthy group is considered beneficial. Fibre-consuming bacteria are responsible for producing important by-products such as short chain fatty acids which play a critical role in keeping the gut healthy. Specific prebiotic fibres (detailed in the Microbiome Fuel section below) will promote the growth of beneficial bacteria.

3-indolepropionic acid (IPA) production

The typical range in healthy people is 0.19% to 1.78%

3-indolepropionic acid (IPA) is a strong anti-oxidant produced by some gut bacteria that can help protect the nervous system from damage. Research has shown IPA may play a role in glucose metabolism and research in animal models suggests that IPA may also play a role in maintaining the gut barrier. IPA is formed by breaking down the amino acid tryptophan. Studies have indicated that consuming foods high in dietary fibre, and in particular foods containing rye, can increase IPA production.
[1] [2] [3] [4]

Folate (B9) production

The typical range in healthy people is 29.03% to 55.54%

Folate or folic acid plays an important role in cell replication and repair and deficiencies can result in an increased risk of of heart disease, anemia, stroke, and neural tube defects in newborn infants. Folate cannot be produced by human cells and must be obtained through diet or from the microbiome. The large intestine has the ability to absorb folate produced by the gut microbiome and it is estimated that the human gut microbiome can provide up to 37% of the daily folate requirement. All non-organic bread in Australia must be fortified with folate while rich dietary sources include dark green leafy vegetables, fruit, legumes, and nuts.
[1] [2] [3]

Trimethylamine production

The typical range in healthy people is 0% to 0.16%

Trimethylamine is a compound produced by some gut microbes that is converted to another compound called trimethylamine-n-oxide (TMAO) in the liver. Increased TMAO levels have been observed in individuals with cardiometabolic disorders. However, the role of TMAO in these disorders is still not clear. It is unknown if TMAO plays a causal role, is a marker of the disorder, or if it plays a protective role in repairing damage from the disorder. Levels of TMAO are influenced by many factors including our gut microbiome, diet, integrity of the gut barrier, liver function and kidney function. Although diet may only play a small role, diets high in animal protein containing choline and carnitine (e.g. eggs, red meat), as well as salt, have been associated with increased TMAO levels while diets high in soluble fibre have been shown to reduce trimethylamine and TMAO levels. If your potential to produce trimethylamine is high, you may wish to increase your consumption of fibre and avoid eating excessive amounts of red meat and eggs.
[1] [2] [3] [4] [5]

Succinate production

The typical range in healthy people is 15.8% to 47.25%

Succinate is an important intermediate compound involved in glucose and protein metabolism and it is also involved in the production of the short-chain fatty acid, propionate. It can be produced by both human cells and the gut microbiome. Although succinate is usually converted into another product and does not stick around for long, in individuals with metabolic conditions, this conversion does not happen efficiently and can lead to elevated levels of succinate in the blood.
[1] [2]

Species

Potential to promote health

Potential to reduce health

Akkermansia muciniphila

The typical range in healthy people is 0% to 2.23%

This species is associated with a healthy metabolic status and it is being investigated as a probiotic to treat metabolic disorders.

Fuel sources used: It lives in the mucus layer of the intestine and uses the mucus as it main energy source. Mucus turnover is a normal part of our gut function and this species plays an important role in regulating mucus turnover so the right amount occurs.

Key metabolites produced: This species produces the short-chain fatty acid propionate.

Emerging research: By living in the mucus layer, *A. muciniphila* prevents potentially harmful bacteria from colonising this space through competition. Studies have associated low levels of *A. muciniphila* with metabolic conditions. Research has also indicated this species can improve the efficacy of a common immunotherapy drug used called PD-1 inhibitors.

Levels of this bacterium tend to decrease with age.

Although this bacterium appears to have mostly beneficial effects, studies have shown elevated levels are associated with neurodegenerative conditions.
[1] [2] [3] [4] [5] [6]

Bifidobacterium adolescentis

The typical range in healthy people is 0% to 0.39%

This is a common and beneficial inhabitant of the gut.

Fuel sources used: It can use fibre, resistant starch, and simple sugars (including lactose) for energy.

Key metabolites produced: It can produce lactate and the short-chain fatty acid, acetate. Acetate from *Bifidobacterium spp* promotes the growth of butyrate-producing bacteria and production of butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health. *B. adolescentis* can also produce the B vitamin folate, may have anti-obesity effects, and appears to beneficially stimulate the immune system.

Emerging research: Low levels of this species have been associated with inflammation.
[1] [2] [3] [4]

Bilophila wadsworthia

The typical range in healthy people is 0% to 0.2%

This is a common inhabitant of the human gut, but can become problematic at high levels.

Fuel sources used: This bacterium can use protein for energy and reduces sulphur.

Key metabolites produced: It produces the short-chain fatty acid acetate and the gas hydrogen sulphide.

Emerging research: High levels of this species can promote inflammation in the gut and is associated with a diet high in saturated fats.
[1] [2] [3] [4] [5] [6]

Eggerthella lenta

The typical range in healthy people is 0% to 0%

This is a inhabitant of the gut microbiota, but has also been associated with gastrointestinal infections.

Fuel sources used: It can use the simple sugar glucose, protein and some steroids for energy.

Key metabolites produced: It can produce the short-chain fatty acid acetate.

Emerging research: Elevated levels of this species have been associated with cardiovascular and metabolic conditions. This species can also inactivate the cardiac drug digoxin by breaking it down. Interestingly, this species prefers the amino acid arginine for growth. When arginine is present, this inhibits *E. lenta* from breaking down digoxin.
[1] [2] [3] [4] [5] [6] [7]

Bifidobacterium animalis

The typical range in healthy people is 0% to 0.1%

This is a naturally occurring human gut bacterium and probiotic; it is sometimes also called *Bifidobacterium lactis*.

Fuel sources used: It can use fibre, resistant starch, simple sugars (including lactose) and protein for energy.

Key metabolites produced: It produces lactate and the short-chain fatty acid, acetate. Acetate from Bifidobacteria promotes the growth of butyrate-producing bacteria and the production of butyrate.

Emerging research: *B. animalis* is associated with a low BMI and has been used to improve metabolic disorders such as obesity and diabetes. It can also produce antimicrobial substances effective against pathogenic bacteria and studies in mouse models suggest it can improve "leaky gut."
[1] [2] [3] [4] [5]

Bifidobacterium bifidum

The typical range in healthy people is 0% to 0%

This is a naturally occurring human gut bacterium and a probiotic. This is one of the first colonisers of the human gut, and is important in the development of the infant immune system.

Fuel sources used: This species uses the mucus layer lining the gut as its main energy source. Mucus turnover is a normal function of a healthy gut, however it is important that mucus degradation does not outpace mucus re-generation. This species can also use the simple sugar lactose.

Key metabolites produced: It can produce lactate and the short-chain fatty acid acetate.
[1] [2] [3] [4] [5]

Prevotella copri

The typical range in healthy people is 0% to 25.35%

This is a common inhabitant of the human gut and includes a large number of strains.

Fuel sources used: It can use resistant starch, fibre, simple sugars, and protein as energy sources.

Key metabolites produced: It can produce succinate, the short-chain fatty acids, acetate and propionate and ethanol. It can also produce branched chain amino acids (BCAA); high levels of BCAAs have been linked to metabolic conditions.

Emerging research: High levels of some strains within this species have been associated with metabolic and inflammatory conditions.
[1] [2] [3] [4] [5]

Bifidobacterium longum

The typical range in healthy people is 0% to 0.54%

This is a common, beneficial inhabitant of the gut in adults and a popular probiotic.

Fuel sources used: It can use fibre, resistant starch, simple sugars (including lactose), and mucus as energy sources.

Key metabolites produced: It primarily produces the short-chain fatty acid, acetate. Acetate from Bifidobacteria promotes the growth of butyrate-producing bacteria and production of butyrate. It can also produce folic acid (B9).

Emerging research: *B.longum* has been associated with reductions in harmful bacteria, anti-allergy effects, and anti-obesity effects in mouse models, but further research still needs to be done in humans.
[1] [2] [3] [4] [5] [6] [7]

Eubacterium_E hallii

The typical range in healthy people is 0% to 0.64%

This is an important member of the gut microbiome.

Fuel sources used: It uses the acetate and lactate produced by bacterial species such as *Bifidobacterium spp.* and *Akkermansia muciniphila* for energy.

Key metabolites produced: It primarily produces the short-chain fatty acid butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health. *E. hallii* can also produce the short-chain fatty acid propionate, the essential vitamin cobalamin (B12), and an antimicrobial compound called reuterin.
[1] [2] [3]

Faecalibacterium prausnitzii_C

The typical range in healthy people is 0% to 2.37%

Faecalibacterium prausnitzii_C (aka strain A2-165) is an important member of the human gut microbiome.

Fuel sources used: It can use fibre, simple sugars and acetate produced by other bacteria for energy.

Key metabolites produced: It can produce the short-chain fatty acid butyrate and acetate. *F. prausnitzii_C* produces the highest levels of butyrate of all *F. prausnitzii* species and can also produce an anti-inflammatory protein called MAM.

Emerging research: Low levels of *F. prausnitzii* have been associated with inflammatory and metabolic conditions.
[1] [2] [3] [4] [5] [6] [7]

Roseburia hominis

The typical range in healthy people is 0% to 0.41%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use soluble fibre, simple sugars and acetate as energy sources and can also break down a compound called oxalate, which can form kidney stones.

Key metabolites produced: It primarily produces the short-chain fatty acid, butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: Studies suggest this bacterial species can help regulate the immune system and reduce inflammation. One study found higher levels in active women compared to sedentary women. Reduced levels of this bacterium have also been observed in patients with ulcerative colitis and hypertension.
[1] [2] [3] [4] [5] [6]

Roseburia intestinalis

The typical range in healthy people is 0% to 1.63%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use resistant starch, fibre, simple sugars and acetate for energy.

Key metabolites produced: It can produce the short-chain fatty acid butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: This species has been observed at reduced levels in individuals with metabolic and inflammatory conditions.
[1] [2] [3]

Roseburia inulinivorans

The typical range in healthy people is 0% to 0.05%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use resistant starch, fibre, and simple sugars for energy.

Key metabolites produced: It can produce the short-chain fatty acids butyrate and propionate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: This species has been observed at reduced levels in individuals with type 2 diabetes.
[1] [2] [3]

Ruminococcus_E bromii

The typical range in healthy people is 0% to 2.77%

This is a common member of the human gut and is considered a keystone species of the gut microbiome for its ability to break down resistant starch.

Fuel sources used: *Ruminococcus bromii* uses resistant starch for energy.

Key metabolites produced: It can produce the short-chain fatty acid acetate and simple sugars that other bacteria, such as *Agathobacter rectalis* can use to produce short-chain fatty acids such as butyrate.

Emerging research: Studies suggest the role of *R. bromii* as a primary starch degrader helps stimulate the growth of butyrate-producing bacterial species.
[1] [2] [3]

Nervous System Health 73%

These metabolites and microorganisms have been shown to have a role in regulating the function of the brain and nervous system.

Metabolites

Potential to promote health

3-indolepropionic acid (IPA) production

The typical range in healthy people is 0.19% to 1.78%

3-indolepropionic acid (IPA) is a strong anti-oxidant produced by some gut bacteria that can help protect the nervous system from damage. Research has shown IPA may play a role in glucose metabolism and research in animal models suggests that IPA may also play a role in maintaining the gut barrier. IPA is formed by breaking down the amino acid tryptophan. Studies have indicated that consuming foods high in dietary fibre, and in particular foods containing rye, can increase IPA production.

[1] [2] [3] [4]

Butyrate production

The typical range in healthy people is 10.98% to 28.62%

Butyrate is a short-chain fatty acid that is very important for gut health. It is the main fuel source for gut cells, helps keep the gut cell barrier intact, can reduce inflammation, help control appetite, and stimulate the production of serotonin from our gut cells. Consuming foods high in resistant starch (e.g. lentils, peas, beans, rolled oats) has been shown to increase butyrate levels.

[1] [2] [3] [4] [5] [6] [7]

Fibre degradation

The typical range in healthy people is 57.02% to 72.39%

A similar or high proportion of species that can break down fibre compared to the healthy group is considered beneficial. Fibre-consuming bacteria are responsible for producing important by-products such as short chain fatty acids which play a critical role in keeping the gut healthy. Specific prebiotic fibres (detailed in the Microbiome Fuel section below) will promote the growth of beneficial bacteria.

Potential to reduce health

Histamine production

The typical range in healthy people is 0% to 0.83%

Histamine is a chemical produced by the breakdown of the amino acid histidine. It is produced by both human cells and some bacterial species and plays an important role in immune regulation, gut function and the nervous system. Individuals with food allergies and irrritable bowel syndrome have been observed to have high levels of specific histamine receptors in the gut, making them more sensitive to histamine in the gut.

[1] [2] [3]

GABA consumption

The typical range in healthy people is 0.86% to 5.69%

GABA is short for gamma-butyric acid and is an important signaling molecule for the brain (called a neurotransmitter). GABA's role is to reduce the activity of nerve cells and it is thought to reduce anxiety. GABA is primarily produced by your body, but some bacterial species can also produce (and consume) GABA. It is unknown if bacterially produced GABA can influence nerve cells in humans and this is currently an active area of research. If you are concerned about your mental health, it is important to seek professional help.

[1] [2] [3]

GABA production

The typical range in healthy people is 5.28% to 24.73%

GABA is short for gamma-butyric acid and is an important signaling molecule for the brain (called a neurotransmitter). GABA's role is to reduce the activity of nerve cells and it is thought to reduce anxiety. GABA is primarily produced by your body, but some bacterial species can also produce (and consume) GABA. It is unknown if bacterially produced GABA can influence nerve cells in humans and this is currently an active area of research. If you are concerned about your mental health, it is important to seek professional help.
[1] [2] [3]

Hexa-acylated Lipopolysaccharide

The typical range in healthy people is 0% to 0.78%

Lipopolysaccharides (LPS) are an important component of the cell wall of many bacteria, but when these bacteria die, the LPS is released into the gut where it can be pro-inflammatory, in particular hexa LPS. Diets high in fat, especially saturated fat, allow LPS to cross the intestinal barrier and enter the bloodstream. High levels of LPS in the blood have been observed in individuals with metabolic and inflammatory conditions. Avoiding excessive intake of saturated fat can help reduce the ability of LPS to enter the bloodstream.
[1] [2] [3] [4] [5] [6]

Propionate production

The typical range in healthy people is 23.23% to 49.3%

Propionate is a short-chain fatty acid that is important for gut health. It helps maintain blood glucose levels, can reduce inflammation, helps control appetite and can stimulate the production of serotonin. The consumption of fibre from foods such as fruits, vegetables, legumes and grains are associated with increased short-chain fatty acids including propionate.
[1] [2] [3] [4]

Trimethylamine production

The typical range in healthy people is 0% to 0.16%

Trimethylamine is a compound produced by some gut microbes that is converted to another compound called trimethylamine-n-oxide (TMAO) in the liver. Increased TMAO levels have been observed in individuals with cardiometabolic disorders. However, the role of TMAO in these disorders is still not clear. It is unknown if TMAO plays a causal role, is a marker of the disorder, or if it plays a protective role in repairing damage from the disorder. Levels of TMAO are influenced by many factors including our gut microbiome, diet, integrity of the gut barrier, liver function and kidney function. Although diet may only play a small role, diets high in animal protein containing choline and carnitine (e.g. eggs, red meat), as well as salt, have been associated with increased TMAO levels while diets high in soluble fibre have been shown to reduce trimethylamine and TMAO levels. If your potential to produce trimethylamine is high, you may wish to increase your consumption of fibre and avoid eating excessive amounts of red meat and eggs.
[1] [2] [3] [4] [5]

Tyramine production

The typical range in healthy people is 0% to 0%

Tyramine is a chemical that is produced from the breakdown of the amino acid tyrosine. It occurs naturally in foods such as smoked or aged meats, cheese, and chocolate and is also produced by gut bacteria. Tyramine that you consume in food is absorbed in the small intestine, and foods high in tyramine are thought to trigger migraines in sensitive individuals. In contrast, tyramine produced by your gut microbiota in the large intestine can stimulate serotonin production in the gut. Tyramine is only one of several compounds that can stimulate serotonin production in the gut. Other compounds include butyrate, propionate and vitamin E.

More than 90% of the body's serotonin is produced by cells in the gut, where it plays an important role in many bodily functions such as the immune response, gut motility, bone development, and cardiac function. Only about 10% of the body's serotonin is produced in the brain, where it is used to regulate mood, appetite and sleep. Consuming a sufficient amount of fibre, including fruits and vegetables, can help support serotonin production in your gut.
[1] [2]

Folate (B9) production

The typical range in healthy people is 29.03% to 55.54%

Folate or folic acid plays an important role in cell replication and repair and deficiencies can result in an increased risk of of heart disease, anemia, stroke, and neural tube defects in newborn infants. Folate cannot be produced by human cells and must be obtained through diet or from the microbiome. The large intestine has the ability to absorb folate produced by the gut microbiome and it is estimated that the human gut microbiome can provide up to 37% of the daily folate requirement. All non-organic bread in Australia must be fortified with folate while rich dietary sources include dark green leafy vegetables, fruit, legumes, and nuts.
[1] [2] [3]

Immune Health 89%

These metabolites and microorganisms have been shown to be involved in regulating the immune system.

Metabolites

Potential to promote health

Butyrate production

The typical range in healthy people is 10.98% to 28.62%

Butyrate is a short-chain fatty acid that is very important for gut health. It is the main fuel source for gut cells, helps keep the gut cell barrier intact, can reduce inflammation, help control appetite, and stimulate the production of serotonin from our gut cells. Consuming foods high in resistant starch (e.g. lentils, peas, beans, rolled oats) has been shown to increase butyrate levels.
[1] [2] [3] [4] [5] [6] [7]

Propionate production

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Propionate is a short-chain fatty acid that is important for gut health. It helps maintain blood glucose levels, can reduce inflammation, helps control appetite and can stimulate the production of serotonin. The consumption of fibre from foods such as fruits, vegetables, legumes and grains are associated with increased short-chain fatty acids including propionate.
[1] [2] [3] [4]

Acetate production

The typical range in healthy people is 48.13% to 72.54%

Acetate is the most abundant short-chain fatty acid produced in the gut. It plays an important role in fat metabolism, glucose metabolism and the immune system. Several bacterial species can also convert acetate to butyrate. The consumption of fruits, vegetables, legumes and fibre are associated with increased short-chain fatty acids, including acetate.
[1] [2] [3]

Potential to reduce health

Hexa-acylated Lipopolysaccharide

The typical range in healthy people is 0% to 0.78%

Lipopolysaccharides (LPS) are an important component of the cell wall of many bacteria, but when these bacteria die, the LPS is released into the gut where it can be pro-inflammatory, in particular hexa LPS. Diets high in fat, especially saturated fat, allow LPS to cross the intestinal barrier and enter the bloodstream. High levels of LPS in the blood have been observed in individuals with metabolic and inflammatory conditions. Avoiding excessive intake of saturated fat can help reduce the ability of LPS to enter the bloodstream.
[1] [2] [3] [4] [5] [6]

B. fragilis toxin production

The typical range in healthy people is 0% to 0.17%

Most people's gut microbiome contain a species of bacteria called *Bacteroides fragilis*. A small proportion of *B. fragilis* strains have the ability to secrete a toxin. In some people this toxin can cause symptoms such as diarhoea while other people can remain symptom free. There are concerns that this toxin can cause intestinal inflammation. If you are experiencing diarhoea symptoms and have this toxin, consider seeing a healthcare practitioner.
[1] [2]

Histamine production

The typical range in healthy people is 0% to 0.83%

Histamine is a chemical produced by the breakdown of the amino acid histidine. It is produced by both human cells and some bacterial species and plays an important role in immune regulation, gut function and the nervous system. Individuals with food allergies and irrritable bowel syndrome have been observed to have high levels of specific histamine receptors in the gut, making them more sensitive to histamine in the gut.
[1] [2] [3]

Fibre degradation

The typical range in healthy people is 57.02% to 72.39%

A similar or high proportion of species that can break down fibre compared to the healthy group is considered beneficial. Fibre-consuming bacteria are responsible for producing important by-products such as short chain fatty acids which play a critical role in keeping the gut healthy. Specific prebiotic fibres (detailed in the Microbiome Fuel section below) will promote the growth of beneficial bacteria.

Folate (B9) production

The typical range in healthy people is 29.03% to 55.54%

Folate or folic acid plays an important role in cell replication and repair and deficiencies can result in an increased risk of of heart disease, anemia, stroke, and neural tube defects in newborn infants. Folate cannot be produced by human cells and must be obtained through diet or from the microbiome. The large intestine has the ability to absorb folate produced by the gut microbiome and it is estimated that the human gut microbiome can provide up to 37% of the daily folate requirement. All non-organic bread in Australia must be fortified with folate while rich dietary sources include dark green leafy vegetables, fruit, legumes, and nuts.
[1] [2] [3]

Protein degradation

The typical range in healthy people is 56.66% to 74.24%

A similar or low proportion of species that can break down protein compared to the healthy group is generally considered beneficial. Everyone's microbiome contains species that can break down protein. However, a high proportion of these species may reflect an insufficient amount of fibre in the diet or an excessive intake of protein.
Most protein is absorbed by your body, however excess protein will get passed to the large intestine where it is available to the gut microbiome. Microorganisms that break down protein produce a variety of compounds, including some compounds that promote inflammation. If there are a high proportion of species that can break down protein in the microbiome, make sure there is sufficient fibre in the diet and consider avoiding excessive consumption of protein.

Species

Potential to promote health

Potential to reduce health

Bifidobacterium adolescentis

The typical range in healthy people is 0% to 0.39%

This is a common and beneficial inhabitant of the gut.

Fuel sources used: It can use fibre, resistant starch, and simple sugars (including lactose) for energy.

Key metabolites produced: It can produce lactate and the short-chain fatty acid, acetate. Acetate from *Bifidobacterium spp* promotes the growth of butyrate-producing bacteria and production of butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health. *B. adolescentis* can also produce the B vitamin folate, may have anti-obesity effects, and appears to beneficially stimulate the immune system.

Emerging research: Low levels of this species have been associated with inflammation.
[1] [2] [3] [4]

Bifidobacterium animalis

The typical range in healthy people is 0% to 0.1%

This is a naturally occurring human gut bacterium and probiotic; it is sometimes also called *Bifidobacterium lactis*.

Fuel sources used: It can use fibre, resistant starch, simple sugars (including lactose) and protein for energy.

Key metabolites produced: It produces lactate and the short-chain fatty acid, acetate. Acetate from Bifidobacteria promotes the growth of butyrate-producing bacteria and the production of butyrate.

Emerging research: *B. animalis* is associated with a low BMI and has been used to improve metabolic disorders such as obesity and diabetes. It can also produce antimicrobial substances effective against pathogenic bacteria and studies in mouse models suggest it can improve "leaky gut."
[1] [2] [3] [4] [5]

Eggerthella lenta

The typical range in healthy people is 0% to 0%

This is a inhabitant of the gut microbiota, but has also been associated with gastrointestinal infections.

Fuel sources used: It can use the simple sugar glucose, protein and some steroids for energy.

Key metabolites produced: It can produce the short-chain fatty acid acetate.

Emerging research: Elevated levels of this species have been associated with cardiovascular and metabolic conditions. This species can also inactivate the cardiac drug digoxin by breaking it down. Interestingly, this species prefers the amino acid arginine for growth. When arginine is present, this inhibits *E. lenta* from breaking down digoxin.
[1] [2] [3] [4] [5] [6] [7]

Fusobacterium nucleatum

The typical range in healthy people is 0% to 0%

Although a common member of the human oral microbiome, this pro-inflammatory bacterium can also be found in the human gut.

Fuel sources used: It primarily uses protein, but can also use some simple sugars for growth.

Key metabolites produced: It can produce the short-chain fatty acids acetate, propionate and butyrate and the gas hydrogen sulphide.

Emerging research: High levels of this species have been associated with inflammatory conditions and poor gut health. Laboratory-based studies suggest that black and green tea may reduce the growth of this species.
[1] [2] [3] [4] [5]

Bifidobacterium bifidum

The typical range in healthy people is 0% to 0%

This is a naturally occurring human gut bacterium and a probiotic. This is one of the first colonisers of the human gut, and is important in the development of the infant immune system.

Fuel sources used: This species uses the mucus layer lining the gut as its main energy source. Mucus turnover is a normal function of a healthy gut, however it is important that mucus degradation does not outpace mucus re-generation. This species can also use the simple sugar lactose.

Key metabolites produced: It can produce lactate and the short-chain fatty acid acetate.
[1] [2] [3] [4] [5]

Bifidobacterium longum

The typical range in healthy people is 0% to 0.54%

This is a common, beneficial inhabitant of the gut in adults and a popular probiotic.

Fuel sources used: It can use fibre, resistant starch, simple sugars (including lactose), and mucus as energy sources.

Key metabolites produced: It primarily produces the short-chain fatty acid, acetate. Acetate from Bifidobacteria promotes the growth of butyrate-producing bacteria and production of butyrate. It can also produce folic acid (B9).

Emerging research: *B.longum* has been associated with reductions in harmful bacteria, anti-allergy effects, and anti-obesity effects in mouse models, but further research still needs to be done in humans.
[1] [2] [3] [4] [5] [6] [7]

Coprococcus eutactus

The typical range in healthy people is 0% to 0%

This is a common inhabitant of the human gut.

Fuel sources used: It can use fibre, simple sugars (including lactose) and limited types of protein for energy.

Key metabolites produced: It primarily produces formate and the short-chain fatty acid butyrate, but can also produce lactate and the short-chain fatty acids acetate and propionate in smaller amounts.

Emerging research: This species has been observed at decreased levels in children with inflammatory conditions.
[1] [2] [3] [4] [5] [6]

Eubacterium_E hallii

The typical range in healthy people is 0% to 0.64%

This is an important member of the gut microbiome.

Fuel sources used: It uses the acetate and lactate produced by bacterial species such as *Bifidobacterium spp.* and *Akkermansia muciniphila* for energy.

Key metabolites produced: It primarily produces the short-chain fatty acid butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health. *E. hallii* can also produce the short-chain fatty acid propionate, the essential vitamin cobalamin (B12), and an antimicrobial compound called reuterin.
[1] [2] [3]

Faecalibacterium prausnitzii

The typical range in healthy people is 0% to 0%

This is an important member of the gut microbiome.

Fuel sources used: It can use fibre, starch and simple sugars and acetate for energy.

Key metabolites produced: It can produce the short-chain fatty acid butyrate.

Emerging research: This species has recently been split into several different species, and low levels of some of these species have been associated with inflammatory and metabolic conditions.
[1] [2] [3] [4] [5] [6]

Roseburia hominis

The typical range in healthy people is 0% to 0.41%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use soluble fibre, simple sugars and acetate as energy sources and can also break down a compound called oxalate, which can form kidney stones.

Key metabolites produced: It primarily produces the short-chain fatty acid, butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: Studies suggest this bacterial species can help regulate the immune system and reduce inflammation. One study found higher levels in active women compared to sedentary women. Reduced levels of this bacterium have also been observed in patients with ulcerative colitis and hypertension.
[1] [2] [3] [4] [5] [6]

Roseburia intestinalis

The typical range in healthy people is 0% to 1.63%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use resistant starch, fibre, simple sugars and acetate for energy.

Key metabolites produced: It can produce the short-chain fatty acid butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: This species has been observed at reduced levels in individuals with metabolic and inflammatory conditions.
[1] [2] [3]

Roseburia inulinivorans

The typical range in healthy people is 0% to 0.05%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use resistant starch, fibre, and simple sugars for energy.

Key metabolites produced: It can produce the short-chain fatty acids butyrate and propionate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: This species has been observed at reduced levels in individuals with type 2 diabetes.
[1] [2] [3]

Inflammatory Balance 71%

These metabolites and microorganisms have been associated with the levels of inflammation in the body.

Metabolites

Potential to promote health

Butyrate production

The typical range in healthy people is 10.98% to 28.62%

Butyrate is a short-chain fatty acid that is very important for gut health. It is the main fuel source for gut cells, helps keep the gut cell barrier intact, can reduce inflammation, help control appetite, and stimulate the production of serotonin from our gut cells. Consuming foods high in resistant starch (e.g. lentils, peas, beans, rolled oats) has been shown to increase butyrate levels.
[1] [2] [3] [4] [5] [6] [7]

Propionate production

The typical range in healthy people is 23.23% to 49.3%

Propionate is a short-chain fatty acid that is important for gut health. It helps maintain blood glucose levels, can reduce inflammation, helps control appetite and can stimulate the production of serotonin. The consumption of fibre from foods such as fruits, vegetables, legumes and grains are associated with increased short-chain fatty acids including propionate.
[1] [2] [3] [4]

Acetate production

The typical range in healthy people is 48.13% to 72.54%

Acetate is the most abundant short-chain fatty acid produced in the gut. It plays an important role in fat metabolism, glucose metabolism and the immune system. Several bacterial species can also convert acetate to butyrate. The consumption of fruits, vegetables, legumes and fibre are associated with increased short-chain fatty acids, including acetate.
[1] [2] [3]

Potential to reduce health

Hexa-acylated Lipopolysaccharide

The typical range in healthy people is 0% to 0.78%

Lipopolysaccharides (LPS) are an important component of the cell wall of many bacteria, but when these bacteria die, the LPS is released into the gut where it can be pro-inflammatory, in particular hexa LPS. Diets high in fat, especially saturated fat, allow LPS to cross the intestinal barrier and enter the bloodstream. High levels of LPS in the blood have been observed in individuals with metabolic and inflammatory conditions. Avoiding excessive intake of saturated fat can help reduce the ability of LPS to enter the bloodstream.
[1] [2] [3] [4] [5] [6]

Histamine production

The typical range in healthy people is 0% to 0.83%

Histamine is a chemical produced by the breakdown of the amino acid histidine. It is produced by both human cells and some bacterial species and plays an important role in immune regulation, gut function and the nervous system. Individuals with food allergies and irrritable bowel syndrome have been observed to have high levels of specific histamine receptors in the gut, making them more sensitive to histamine in the gut.
[1] [2] [3]

Ammonia (urease) production

The typical range in healthy people is 1.48% to 7.68%

Ammonia production is a normal way that bacteria recycle protein in the gut. However, excess ammonia production has been observed in individuals with impaired gut barrier function and inflammation of the gut.
[1] [2]

Fibre degradation

The typical range in healthy people is 57.02% to 72.39%

A similar or high proportion of species that can break down fibre compared to the healthy group is considered beneficial. Fibre-consuming bacteria are responsible for producing important by-products such as short chain fatty acids which play a critical role in keeping the gut healthy. Specific prebiotic fibres (detailed in the Microbiome Fuel section below) will promote the growth of beneficial bacteria.

Lactate production

The typical range in healthy people is 28% to 56.12%

Lactate or lactic-acid producing bacteria have a long tradition of being used to produce fermented foods such as yoghurt, kefir, sauerkraut and kimchi. Lactate can reduce inflammation and help keep the gut cell barrier intact. Some bacterial species can also convert lactate to the short-chain fatty acids acetate, propionate and butyrate.

[1] [2]

3-indolepropionic acid (IPA) production

The typical range in healthy people is 0.19% to 1.78%

3-indolepropionic acid (IPA) is a strong anti-oxidant produced by some gut bacteria that can help protect the nervous system from damage. Research has shown IPA may play a role in glucose metabolism and research in animal models suggests that IPA may also play a role in maintaining the gut barrier. IPA is formed by breaking down the amino acid tryptophan. Studies have indicated that consuming foods high in dietary fibre, and in particular foods containing rye, can increase IPA production.

[1] [2] [3] [4]

Trimethylamine production

The typical range in healthy people is 0% to 0.16%

Trimethylamine is a compound produced by some gut microbes that is converted to another compound called trimethylamine-n-oxide (TMAO) in the liver. Increased TMAO levels have been observed in individuals with cardiometabolic disorders. However, the role of TMAO in these disorders is still not clear. It is unknown if TMAO plays a causal role, is a marker of the disorder, or if it plays a protective role in repairing damage from the disorder. Levels of TMAO are influenced by many factors including our gut microbiome, diet, integrity of the gut barrier, liver function and kidney function. Although diet may only play a small role, diets high in animal protein containing choline and carnitine (e.g. eggs, red meat), as well as salt, have been associated with increased TMAO levels while diets high in soluble fibre have been shown to reduce trimethylamine and TMAO levels. If your potential to produce trimethylamine is high, you may wish to increase your consumption of fibre and avoid eating excessive amounts of red meat and eggs.

[1] [2] [3] [4] [5]

Human DNA

The typical range in healthy people is 0.03% to 4%

A high amount (greater than 4%) of human DNA may indicate gut inflammation. If there is greater than 4% human DNA, and there was no contamination (e.g. accidentally touched the swab during sampling), further clinical investigation is needed.

Protein degradation

The typical range in healthy people is 56.66% to 74.24%

A similar or low proportion of species that can break down protein compared to the healthy group is generally considered beneficial. Everyone's microbiome contains species that can break down protein. However, a high proportion of these species may reflect an insufficient amount of fibre in the diet or an excessive intake of protein.
Most protein is absorbed by your body, however excess protein will get passed to the large intestine where it is available to the gut microbiome. Microorganisms that break down protein produce a variety of compounds, including some compounds that promote inflammation. If there are a high proportion of species that can break down protein in the microbiome, make sure there is sufficient fibre in the diet and consider avoiding excessive consumption of protein.

Hydrogen sulphide production

The typical range in healthy people is 1.23% to 5.66%

The gas hydrogen sulphide is produced by some species in the gut microbiome when sulphur-containing foods such as eggs, garlic, onion, cabbage, kale or Brussels sprouts are broken down. Hydrogen sulphide plays an important role in gut health by acting as an energy source for gut cells and protecting the gut barrier function. However, some studies have suggested that high levels of hydrogen sulphide can also disrupt the gut mucus barrier. This gas is also responsible for the rotton egg smell of flatulence. Laboratory based studies have suggested that fibre can reduce the production of hydrogen sulphide.
[1] [2]

B. fragilis toxin production

The typical range in healthy people is 0% to 0.17%

Most people's gut microbiome contain a species of bacteria called *Bacteroides fragilis*. A small proportion of *B. fragilis* strains have the ability to secrete a toxin. In some people this toxin can cause symptoms such as diarhoea while other people can remain symptom free. There are concerns that this toxin can cause intestinal inflammation. If you are experiencing diarhoea symptoms and have this toxin, consider seeing a healthcare practitioner.
[1] [2]

Species

Potential to promote health

Agathobacter faecis

The typical range in healthy people is 0% to 1.52%

Previously named *Roseburia faecis*. This is a common and important member of the human gut microbiome.

Fuel sources used: It can use fibre, resistant starch, simple sugars and acetate for energy.

Key metabolites produced: It can produce the short-chain fatty acid, butyrate. Butyrate is important for a healthy gut as it is the primary fuel of cells lining the intestinal tract and is an important mediator of inflammation.

Emerging research: Low levels of this bacterium have been observed in patients with liver conditions.
[1] [2] [3]

Agathobacter rectalis

The typical range in healthy people is 0% to 4.87%

Previously named *Eubacterium rectale*, this is a common member of the human gut.

Fuel sources used: It can use resistant plant resistant starches after initial degradation by *Ruminococcus bromii*.

Key metabolites produced: It produces the short-chain fatty acid butyrate. Butyrate is important for a healthy gut as it is the primary fuel of cells lining the intestinal tract and is an important mediator of inflammation.

Emerging research: Low levels of this species have been observed in inflammatory conditions.
[1] [2] [3]

Potential to reduce health

Bilophila wadsworthia

The typical range in healthy people is 0% to 0.2%

This is a common inhabitant of the human gut, but can become problematic at high levels.

Fuel sources used: This bacterium can use protein for energy and reduces sulphur.

Key metabolites produced: It produces the short-chain fatty acid acetate and the gas hydrogen sulphide.

Emerging research: High levels of this species can promote inflammation in the gut and is associated with a diet high in saturated fats.
[1] [2] [3] [4] [5] [6]

Clostridium_M bolteae

The typical range in healthy people is 0% to 0%

Fuel sources used: It can use fibre, simple sugars (including lactose) and protein for energy.

Key metabolites produced: It can produce lactate, the short-chain fatty acids acetate, butyrate and propionate and pro-inflammatory proteins.

Emerging research: Elevated levels of this species has been associated with metabolic conditions.
[1] [2] [3] [4] [5] [6] [7]

Akkermansia muciniphila

The typical range in healthy people is 0% to 2.23%

This species is associated with a healthy metabolic status and it is being investigated as a probiotic to treat metabolic disorders.

Fuel sources used: It lives in the mucus layer of the intestine and uses the mucus as it main energy source. Mucus turnover is a normal part of our gut function and this species plays an important role in regulating mucus turnover so the right amount occurs.

Key metabolites produced: This species produces the short-chain fatty acid propionate.

Emerging research: By living in the mucus layer, *A. muciniphila* prevents potentially harmful bacteria from colonising this space through competition. Studies have associated low levels of *A. muciniphila* with metabolic conditions. Research has also indicated this species can improve the efficacy of a common immunotherapy drug used called PD-1 inhibitors.

Levels of this bacterium tend to decrease with age.

Although this bacterium appears to have mostly beneficial effects, studies have shown elevated levels are associated with neurodegenerative conditions.
[1] [2] [3] [4] [5] [6]

Bifidobacterium adolescentis

The typical range in healthy people is 0% to 0.39%

This is a common and beneficial inhabitant of the gut.

Fuel sources used: It can use fibre, resistant starch, and simple sugars (including lactose) for energy.

Key metabolites produced: It can produce lactate and the short-chain fatty acid, acetate. Acetate from *Bifidobacterium spp* promotes the growth of butyrate-producing bacteria and production of butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health. *B. adolescentis* can also produce the B vitamin folate, may have anti-obesity effects, and appears to beneficially stimulate the immune system.

Emerging research: Low levels of this species have been associated with inflammation.
[1] [2] [3] [4]

Eggerthella lenta

The typical range in healthy people is 0% to 0%

This is a inhabitant of the gut microbiota, but has also been associated with gastrointestinal infections.

Fuel sources used: It can use the simple sugar glucose, protein and some steroids for energy.

Key metabolites produced: It can produce the short-chain fatty acid acetate.

Emerging research: Elevated levels of this species have been associated with cardiovascular and metabolic conditions. This species can also inactivate the cardiac drug digoxin by breaking it down. Interestingly, this species prefers the amino acid arginine for growth. When arginine is present, this inhibits *E. lenta* from breaking down digoxin.
[1] [2] [3] [4] [5] [6] [7]

Fusobacterium nucleatum

The typical range in healthy people is 0% to 0%

Although a common member of the human oral microbiome, this pro-inflammatory bacterium can also be found in the human gut.

Fuel sources used: It primarily uses protein, but can also use some simple sugars for growth.

Key metabolites produced: It can produce the short-chain fatty acids acetate, propionate and butyrate and the gas hydrogen sulphide.

Emerging research: High levels of this species have been associated with inflammatory conditions and poor gut health. Laboratory-based studies suggest that black and green tea may reduce the growth of this species.
[1] [2] [3] [4] [5]

Bifidobacterium longum

The typical range in healthy people is 0% to 0.54%

This is a common, beneficial inhabitant of the gut in adults and a popular probiotic.

Fuel sources used: It can use fibre, resistant starch, simple sugars (including lactose), and mucus as energy sources.

Key metabolites produced: It primarily produces the short-chain fatty acid, acetate. Acetate from Bifidobacteria promotes the growth of butyrate-producing bacteria and production of butyrate. It can also produce folic acid (B9).

Emerging research: *B.longum* has been associated with reductions in harmful bacteria, anti-allergy effects, and anti-obesity effects in mouse models, but further research still needs to be done in humans.
[1] [2] [3] [4] [5] [6] [7]

Coprococcus eutactus

The typical range in healthy people is 0% to 0%

This is a common inhabitant of the human gut.

Fuel sources used: It can use fibre, simple sugars (including lactose) and limited types of protein for energy.

Key metabolites produced: It primarily produces formate and the short-chain fatty acid butyrate, but can also produce lactate and the short-chain fatty acids acetate and propionate in smaller amounts.

Emerging research: This species has been observed at decreased levels in children with inflammatory conditions.
[1] [2] [3] [4] [5] [6]

Eubacterium_E hallii

The typical range in healthy people is 0% to 0.64%

This is an important member of the gut microbiome.

Fuel sources used: It uses the acetate and lactate produced by bacterial species such as *Bifidobacterium spp.* and *Akkermansia muciniphila* for energy.

Key metabolites produced: It primarily produces the short-chain fatty acid butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health. *E. hallii* can also produce the short-chain fatty acid propionate, the essential vitamin cobalamin (B12), and an antimicrobial compound called reuterin.
[1] [2] [3]

Faecalibacterium prausnitzii_C

The typical range in healthy people is 0% to 2.37%

Faecalibacterium prausnitzii_C (aka strain A2-165) is an important member of the human gut microbiome.

Fuel sources used: It can use fibre, simple sugars and acetate produced by other bacteria for energy.

Key metabolites produced: It can produce the short-chain fatty acid butyrate and acetate. *F. prausnitzii_C* produces the highest levels of butyrate of all *F. prausnitzii* species and can also produce an anti-inflammatory protein called MAM.

Emerging research: Low levels of *F. prausnitzii* have been associated with inflammatory and metabolic conditions.
[1] [2] [3] [4] [5] [6] [7]

Roseburia hominis

The typical range in healthy people is 0% to 0.41%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use soluble fibre, simple sugars and acetate as energy sources and can also break down a compound called oxalate, which can form kidney stones.

Key metabolites produced: It primarily produces the short-chain fatty acid, butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: Studies suggest this bacterial species can help regulate the immune system and reduce inflammation. One study found higher levels in active women compared to sedentary women. Reduced levels of this bacterium have also been observed in patients with ulcerative colitis and hypertension.
[1] [2] [3] [4] [5] [6]

Roseburia intestinalis

The typical range in healthy people is 0% to 1.63%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use resistant starch, fibre, simple sugars and acetate for energy.

Key metabolites produced: It can produce the short-chain fatty acid butyrate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: This species has been observed at reduced levels in individuals with metabolic and inflammatory conditions.
[1] [2] [3]

Roseburia inulinivorans

The typical range in healthy people is 0% to 0.05%

This is a common and important member of the human gut microbiome.

Fuel sources used: It can use resistant starch, fibre, and simple sugars for energy.

Key metabolites produced: It can produce the short-chain fatty acids butyrate and propionate. Butyrate is the main energy source for cells lining the gut, has anti-inflammatory properties and is important for gut health.

Emerging research: This species has been observed at reduced levels in individuals with type 2 diabetes.
[1] [2] [3]

Ruminococcus_E bromii

The typical range in healthy people is 0% to 2.77%

This is a common member of the human gut and is considered a keystone species of the gut microbiome for its ability to break down resistant starch.

Fuel sources used: *Ruminococcus bromii* uses resistant starch for energy.

Key metabolites produced: It can produce the short-chain fatty acid acetate and simple sugars that other bacteria, such as *Agathobacter rectalis* can use to produce short-chain fatty acids such as butyrate.

Emerging research: Studies suggest the role of *R. bromii* as a primary starch degrader helps stimulate the growth of butyrate-producing bacterial species.
[1] [2] [3]

Detoxification 100%

These markers and microorganism have been shown to influence the rates of inactivation and elimination of drugs and toxins from the body.

Metabolites

Potential to promote health

Oxalate consumption

The typical range in healthy people is 7.3% to 16.59%

Calcium oxalate is a common component of kidney stones. People who suffer from repeated unexplained kidney stones have been observed to have a reduced level of genes for oxalate degradation in their microbiome compared to healthy people.
[1] [2]

Fibre degradation

The typical range in healthy people is 57.02% to 72.39%

A similar or high proportion of species that can break down fibre compared to the healthy group is considered beneficial. Fibre-consuming bacteria are responsible for producing important by-products such as short chain fatty acids which play a critical role in keeping the gut healthy. Specific prebiotic fibres (detailed in the Microbiome Fuel section below) will promote the growth of beneficial bacteria.

Potential to reduce health

Beta-glucuronidase production

The typical range in healthy people is 6.53% to 20.76%

The human body will process and inactivate drugs and other compounds (hormones, neurotransmitters and environmental toxins) by adding a type of sugar to them called glucuronic acid. However, some bacteria can use this sugar as a fuel source, and they remove the sugar using beta-glucoronidase, thus re-activating the compound. These re-activated compounds can then be re-absorbed into the blood stream, increasing their potency. How increased levels of beta-glucoronidase in the gut influences drug metabolism is an active area of research.
[1] [2]

Species

Potential to promote health

Oxalobacter formigenes

0

The typical range in healthy people is 0% to 0%

Fuel sources used: This bacterial species use a compound called oxalate for energy, which is one of the main components of calcium oxalate kidney stones.

Emerging research: People that suffer from kidney stones often do not have this species. It is very sensitive to antibiotics, and is less abundant in people that have been treated by antibiotics at some point in their lives.
[1] [2] [3] [4]

Potential to reduce health

Eggerthella lenta

0

The typical range in healthy people is 0% to 0%

This is a inhabitant of the gut microbiota, but has also been associated with gastrointestinal infections.

Fuel sources used: It can use the simple sugar glucose, protein and some steroids for energy.

Key metabolites produced: It can produce the short-chain fatty acid acetate.

Emerging research: Elevated levels of this species have been associated with cardiovascular and metabolic conditions. This species can also inactivate the cardiac drug digoxin by breaking it down. Interestingly, this species prefers the amino acid arginine for growth. When arginine is present, this inhibits *E. lenta* from breaking down digoxin.
[1] [2] [3] [4] [5] [6] [7]

Microbiome Diversity

Microbial diversity is a measure of the number of different microorganisms and the amount of each of these microorganisms in the sample.

Average to high microbial diversity is associated with good health. A varied diet rich in plant-based foods such as fruits, vegetables, whole grains and nuts can help increase microbiome diversity. The Shannon Index is a measure of diversity which is used by members of the scientific community to compare results through time.

Shannon Diversity Index

Microbiome Composition

Complete Microbiome Profile

Below is a list of each species detected in your microbiome, listed in order of abundance. Click on any species name to learn more about that species. Some microbes have been associated with health outcomes in scientific studies, while for others, little is known about them.

Everybody's microbiome composition is different, and science is telling us that the functional capacity of the microbiome is more important than which species inhabit it.

Species with this symbol beside the table have been implicated in influencing health.

	Phylum	Species	Abundance ^	Range	Level	
	Proteobacteria	*Escherichia coli*	4.27%	0.00% - 0.40%	High	
	Bacteroidetes	*Bacteroides_B dorei*	4.21%	0.00% - 2.30%	High	
	Bacteroidetes	*Alistipes putredinis*	4.13%	0.00% - 3.56%	High	
	Bacteroidetes	*Bacteroides_B vulgatus*	3.36%	0.00% - 3.77%	Average	
	Firmicutes_A	*Faecalibacterium prausnitzii_A*	2.87%	0.00% - 2.65%	High	
	Bacteroidetes	*Bacteroides caccae*	2.64%	0.00% - 0.52%	High	
	Bacteroidetes	*Prevotella copri*	2.59%	0.00% - 25.35%	Average	
	Bacteroidetes	*Bacteroides uniformis*	2.26%	0.00% - 4.25%	Average	

	Bacteroidetes	*Bacteroides_B massiliensis*	2.13%	0.00% - 1.53%	High	
	Firmicutes_A	*CAG-170 sp*	2.07%	0.00% - 0.03%	High	
	Firmicutes	*Lactobacillus crispatus*	1.85%	0.00% - 0.00%	High	
	Firmicutes_A	*Subdoligranulum formicile*	1.53%	0.00% - 1.47%	High	
	Firmicutes_A	*Ruminiclostridium_E siraeum*	1.24%	0.00% - 0.86%	High	
	Firmicutes_A	*CAG-83 sp2*	1.23%	0.00% - 0.41%	High	
	Bacteroidetes	*Alistipes onderdonkii*	1.19%	0.00% - 1.77%	Average	
	Firmicutes_A	*Butyricicoccus sp1*	1.08%	0.00% - 0.80%	High	
	Firmicutes_A	*Oscillibacter sp6*	1.06%	0.00% - 0.19%	High	
	Firmicutes_A	*Ruminococcus_E bromii*	1.06%	0.00% - 2.77%	Average	
	Bacteroidetes	*Bacteroides cellulosilyticus*	1.04%	0.00% - 1.33%	Average	
	Firmicutes_A	*Faecalibacterium prausnitzii_B*	1.02%	0.00% - 2.37%	Average	
	Firmicutes_A	*Coprococcus sp*	0.93%	0.00% - 0.86%	High	
	Bacteroidetes	*Barnesiella intestinihominis*	0.93%	0.00% - 1.02%	Average	
	Firmicutes_A	*Fusicatenibacter saccharivorans*	0.88%	0.00% - 2.29%	Average	
	Bacteroidetes	*Parabacteroides merdae*	0.87%	0.00% - 0.69%	High	
	Firmicutes_A	*CAG-180 sp*	0.85%	0.00% - 0.65%	High	

	Proteobacteria	*Parasutterella excrementihominis*	0.81%	0.00% - 0.40%	High	
	Firmicutes_A	*CAG-56 sp*	0.78%	0.00% - 0.66%	High	
	Firmicutes_A	*CAG-83 sp3*	0.73%	0.00% - 1.28%	Average	
	Desulfobacterota	*Bilophila wadsworthia*	0.72%	0.00% - 0.20%	High	
	Firmicutes_A	*ER4 sp*	0.69%	0.00% - 0.18%	High	
	Firmicutes_A	*CAG-273 sp*	0.65%	0.00% - 0.00%	High	
	Firmicutes	*CAG-582 sp*	0.63%	0.00% - 0.00%	High	
	Bacteroidetes	*Bacteroides eggerthii*	0.62%	0.00% - 1.63%	Average	
	Bacteroidetes	*Odoribacter splanchnicus*	0.61%	0.00% - 0.36%	High	
	Firmicutes_A	*PeH17 sp1*	0.59%	0.00% - 0.86%	Average	
	Firmicutes_A	*Blautia_A obeum*	0.58%	0.00% - 0.41%	High	
	Firmicutes_A	*Lachnospira eligens*	0.54%	0.00% - 1.30%	Average	
	Firmicutes_A	*CAG-245 sp1*	0.52%	0.00% - 0.37%	High	
	Actinobacteria	*Corynebacterium vitaeruminis_A*	0.51%	0.00% - 0.00%	High	
	Firmicutes_C	*Dialister sp*	0.51%	0.00% - 0.49%	High	
	Bacteroidetes	*Alistipes shahii*	0.50%	0.00% - 1.52%	Average	
	Firmicutes_A	*CAG-110 sp*	0.50%	0.00% - 0.64%	Average	
	Firmicutes_A	*Blautia_A sp*	0.48%	0.00% - 0.23%	High	
	Euryarchaeota	*Methanobrevibacter_A smithii*	0.46%	0.00% - 0.20%	High	

	Bacteroidetes	*Parabacteroides distasonis*	0.44%	0.00% - 0.99%	Average	
	Firmicutes_A	*Eubacterium_E sp*	0.43%	0.00% - 0.32%	High	
	Firmicutes_A	*Ruminococcus_B faecis*	0.43%	0.00% - 0.61%	Average	
	Firmicutes_A	*KLE1615 sp1*	0.43%	0.00% - 0.79%	Average	
	Firmicutes_A	*Dorea longicatena*	0.39%	0.00% - 0.67%	Average	
	Bacteroidetes	*Alistipes finegoldii*	0.39%	0.00% - 0.51%	Average	
	Firmicutes_A	*Coprococcus_A catus*	0.39%	0.00% - 0.21%	High	
	Firmicutes	*Faecalitalea cylindroides*	0.33%	0.00% - 0.00%	High	
	Firmicutes_A	*Ruminiclostridium_C sp*	0.32%	0.00% - 0.22%	High	
	Firmicutes_A	*Coprococcus_B comes*	0.30%	0.00% - 0.48%	Average	
	Firmicutes_A	*ER4 sp1*	0.30%	0.00% - 1.00%	Average	
	Firmicutes_A	*Lachnospira sp*	0.29%	0.00% - 0.45%	Average	
	Firmicutes_A	*Faecalibacterium sp*	0.29%	0.00% - 0.54%	Average	
	Verrucomicrobia	*Akkermansia muciniphila*	0.28%	0.00% - 2.23%	Average	
	Bacteroidetes	*Alistipes obesi*	0.27%	0.00% - 0.61%	Average	
	Bacteroidetes	*Butyricimonas virosa*	0.27%	0.00% - 0.01%	High	
	Firmicutes_A	*Fenollaria massiliensis*	0.26%	0.00% - 0.00%	High	
	Firmicutes_A	*Faecalibacterium sp*	0.25%	0.12% - 1.02%	Average	
	Firmicutes_A	*Dorea formicigenerans*	0.25%	0.00% - 0.21%	High	
	Firmicutes_A	*CAG-177 sp1*	0.24%	0.00% - 0.50%	Average	
	Firmicutes	*Erysipelatoclostridium sp*	0.23%	0.00% - 0.25%	Average	

	Firmicutes_C	*CAG-207 sp*	0.23%	0.00% - 0.64%	Average	
	Firmicutes_A	*Negativibacillus sp*	0.22%	0.00% - 0.00%	High	
	Firmicutes_A	*Coprococcus_A sp*	0.22%	0.00% - 0.09%	High	
	Bacteroidetes	*UBA7173 sp*	0.21%	0.00% - 0.72%	Average	
	Firmicutes_A	*Finegoldia sp*	0.21%	0.00% - 0.00%	High	
	Firmicutes_A	*Flavonifractor plautii*	0.21%	0.00% - 0.00%	High	
	Firmicutes_A	*Blautia_A sp*	0.19%	0.00% - 0.41%	Average	
	Bacteroidetes	*Bacteroides finegoldii*	0.19%	0.00% - 0.24%	Average	
	Actinobacteria	*Corynebacterium tuberculostearicum*	0.19%	0.00% - 0.00%	High	
	Firmicutes	*Streptococcus anginosus*	0.18%	0.00% - 0.00%	High	
	Firmicutes_A	*Dorea longicatena_B*	0.17%	0.00% - 0.18%	Average	
	Firmicutes_A	*Ruminococcus_B lactaris*	0.17%	0.00% - 0.35%	Average	
	Firmicutes_A	*Levyella massiliensis*	0.16%	0.00% - 0.00%	High	
	Actinobacteria	*CAG-1427 sp*	0.16%	0.00% - 0.11%	High	
	Firmicutes	*CAG-288 sp1*	0.15%	0.00% - 0.39%	Average	
	Firmicutes_A	*CAG-156 sp*	0.15%	0.00% - 0.00%	High	
	Firmicutes_A	*Oscillibacter sp*	0.14%	0.00% - 0.41%	Average	
	Bacteroidetes	*Prevotella disiens*	0.14%	0.00% - 0.00%	High	
	Bacteroidetes	*CAG-1031 sp*	0.14%	0.00% - 0.00%	High	
	Firmicutes_A	*CAG-110 sp*	0.14%	0.00% - 0.28%	Average	
	Firmicutes_A	*Neglecta sp1*	0.14%	0.00% - 0.69%	Average	

	Firmicutes_A	*Peptoniphilus_A lacrimalis*	0.12%	0.00% - 0.00%	High	
	Firmicutes_A	*UBA4263 sp*	0.12%	0.00% - 0.25%	Average	
	Bacteroidetes	*Alistipes_A ihumii*	0.12%	0.00% - 0.25%	Average	
	Fusobacteria	*Fusobacterium animalis*	0.12%	0.00% - 0.00%	High	
	Firmicutes	*CAG-313 sp*	0.11%	0.00% - 0.23%	Average	
	Firmicutes_A	*Dorea longicatena_A*	0.11%	0.00% - 0.12%	Average	
	Firmicutes_A	*CAG-303 sp*	0.11%	0.00% - 0.76%	Average	
	Firmicutes_A	*Blautia_A obeum_A*	0.09%	0.00% - 0.17%	Average	
	Firmicutes_A	*TF01-11 sp*	0.09%	0.00% - 0.11%	Average	
	Firmicutes_A	*Oscillibacter sp*	0.09%	0.00% - 0.00%	High	
	Bacteroidetes	*Alistipes_A indistinctus*	0.08%	0.00% - 0.16%	Average	
	Firmicutes_A	*CAG-81 sp*	0.08%	0.00% - 0.11%	Average	
	Firmicutes_A	*Anaerococcus sp*	0.08%	0.00% - 0.00%	High	
	Firmicutes_A	*Peptoniphilus_A sp*	0.07%	0.00% - 0.00%	High	
	Firmicutes	*UBA5026 sp*	0.07%	0.00% - 0.00%	High	
	Actinobacteria	*UBA1382 sp*	0.07%	0.00% - 0.00%	High	
	Bacteroidetes	*Bacteroides salyersiae*	0.07%	0.00% - 0.10%	Average	
	Firmicutes_A	*Intestinibacter bartlettii*	0.06%	0.00% - 0.10%	Average	
	Firmicutes_A	*Blautia_A sp*	0.06%	0.00% - 0.38%	Average	
	Firmicutes_A	*Dorea sp*	0.06%	0.00% - 0.00%	High	

Health Associated Species

Below is a list of all species detected in the sample that have been implicated in influencing health.

	Phylum	Species	Abundance ^	Range	Level	
+	Proteobacteria	*Escherichia coli*	4.27%	0.00% - 0.40%	High	

This species is a common inhabitant of the gut, although it is usually present at a low abundance compared to other normal gut species. This species encompasses a large number of strains with diverse properties; the most well-known are the pathogenic strains that are a common cause of gastrointestinal disease. However, most strains are not harmful.

Fuel sources used: This species can use fibre, simple sugars (including lactose), protein and fats. Some strains can also break down a compound called oxalate, which can form kidney stones.

Key metabolites produced: It can produce lactate, succinate, the short-chain fatty acid acetate, and essential B and K vitamins. Some strains can also produce histamine and a compound called trimethylamine, which has been associated with cardiovascular conditions.

Emerging research: The harmful strains can produce pro-inflammatory compounds, and toxins that cause infection and diarrhea.
[1] [2] [3] [4] [5] [6]

+	Bacteroidetes	*Bacteroides_B dorei*	4.21%	0.00% - 2.30%	High	

This is a common inhabitant of the gut and is closely related to Bacteroides vulgatus.

Fuel sources used: It can use fibre, resistant starch, simple sugars (including lactose), a wide range of proteins and mucus as energy sources.

Key metabolites produced: It can produce succinate, lactate, and the short-chain fatty acid acetate. It can also produce GABA, an important neurotransmitter.

Emerging research: High levels of this species have been associated with poor gut health and autoimmune conditions in children. This species has also been associated with diets high in red meat.
[1] [2] [3] [4] [5] [6]

+	Bacteroidetes	*Alistipes putredinis*	4.13%	0.00% - 3.56%	High	

This is a common inhabitant of the gut microbiome.

Fuel sources used: It can use limited types of simple sugars (including lactose) and protein for energy.

Key metabolites produced: It primarily produces succinate but can also produce low amounts of the short-chain fatty acids acetate, propionate and butyrate, and the neurotransmitter GABA.

Emerging research: High levels of this species have been associated with both poor gut health and improved markers of cardiac health.
[1] [2] [3] [4] [5] [6] [7] [8]

⊕	Bacteroidetes	*Bacteroides_B vulgatus*	3.36%	0.00% - 3.77%	Average	▾

This is one of the most common inhabitants of the human gut.

Fuel sources used: It can use dietary fibre, simple sugars, protein and mucus for energy.

Key metabolites produced: It primarily produces succinate and the short-chain fatty acid propionate. It can also produce branched chain amino acids, which have been linked to metabolic conditions.

Emerging research: High levels of this bacterium have been associated with metabolic and inflammatory conditions. This species has also been associated with a diet high in red meat.
[1] [2] [3] [4] [5]

⊕	Firmicutes_A	*Faecalibacterium prausnitzii_A*	2.87%	0.00% - 2.65%	High	▾

Faecalibacterium prausnitzii_A (aka strains SL3/3 and M21/2) is an inhabitant of the human gut microbiome.

Fuel sources used: It can use fibre, resistant starch, simple sugars and acetate for energy.

Key metabolites produced: It can produce lactate, ethanol, and the short-chain fatty acids acetate and butyrate.

Emerging research: Low levels of F. prausnitzii have been associated with inflammatory and metabolic conditions. This species produces lower levels of butyrate than F. prausnitzii_C.
[1] [2] [3] [4] [5] [6]

⊕	Bacteroidetes	*Bacteroides caccae*	2.64%	0.00% - 0.52%	High	▾

This is a common member of the human gut.

Fuel sources used: It uses mostly simple sugars, limited fibre types, protein, and mucus for energy.

Key metabolites produced: It produces succinate and the short-chain fatty acid, acetate.

Emerging research: A protein produced by this species has been linked to inflammation.
[1] [2] [3] [4] [5]

⊕	Bacteroidetes	*Prevotella copri*	2.59%	0.00% - 25.35%	Average	▾

This is a common inhabitant of the human gut and includes a large number of strains.

Fuel sources used: It can use resistant starch, fibre, simple sugars, and protein as energy sources.

Key metabolites produced: It can produce succinate, the short-chain fatty acids, acetate and propionate and ethanol. It can also produce branched chain amino acids (BCAA); high levels of BCAAs have been linked to metabolic conditions.

Emerging research: High levels of some strains within this species have been associated with metabolic and inflammatory conditions.
[1] [2] [3] [4] [5]

	Bacteroidetes	*Bacteroides uniformis*	2.26%	0.00% - 4.25%	Average	

This is one of the most common inhabitants of the human gut.

Fuel sources used: It can use fibre, resistant starch, simple sugars (including lactose), protein and mucus for energy.

Key metabolites produced: It primarily produces succinate, although it can also produce lactate and the short-chain fatty acids, acetate and propionate. This species can also produce the neurotransmitter GABA, which is important for mental health.

Emerging research: Certain strains have been observed to promote the production of anti-inflammatory compounds, improve immune function, and provide protection against diet induced obesity in mouse models. Further research needs to be conducted to determine if these benefits translate to humans.
[1] [2] [3] [4]

	Bacteroidetes	*Bacteroides_B massiliensis*	2.13%	0.00% - 1.53%	High	

This is a normal inhabitant of the human gut microbiome.

Fuel sources used: This species can use resistant starch, simple sugars (including lactose), protein and mucus for energy. It can also break down a compound called oxalate, which can form kidney stones.

Emerging research: High levels of this species have been correlated with poor gut health and a diet high in red meat.
[1] [2] [3] [4]

	Firmicutes_A	*Ruminococcus_E bromii*	1.06%	0.00% - 2.77%	Average	

This is a common member of the human gut and is considered a keystone species of the gut microbiome for its ability to break down resistant starch.

Fuel sources used: Ruminococcus bromii uses resistant starch for energy.

Key metabolites produced: It can produce the short-chain fatty acid acetate and simple sugars that other bacteria, such as Agathobacter rectalis can use to produce short-chain fatty acids such as butyrate.

Emerging research: Studies suggest the role of R. bromii as a primary starch degrader helps stimulate the growth of butyrate-producing bacterial species.
[1] [2] [3]

	Bacteroidetes	*Bacteroides cellulosilyticus*	1.04%	0.00% - 1.33%	Average	

This is a common gut inhabitant.

Fuel sources used: It can use numerous types of fibre, as well as resistant starch, simple sugars, protein and mucus for energy.

Key metabolites produced: It can produce succinate and the short-chain fatty acids, acetate and propionate.
[1] [2] [3] [4]

	Bacteroidetes	*Parabacteroides merdae*	0.87%	0.00% - 0.69%	High	

Formerly known as Bacteroides merdae. This is a common inhabitant of the human gut.

Fuel sources used: It can use simple sugars (including lactose), protein and mucus as energy sources.

Key metabolites produced: It can produce succinate and the short fatty acid acetate and lactate.

Emerging research: High levels of this species have been associated with poor gut and cardiovascular health. This species has also been associated with a diet low in fruits and vegetables.
[1] [2] [3] [4] [5]

	Desulfobacterota	*Bilophila wadsworthia*	0.72%	0.00% - 0.20%	High	

This is a common inhabitant of the human gut, but can become problematic at high levels.

Fuel sources used: This bacterium can use protein for energy and reduces sulphur.

Key metabolites produced: It produces the short-chain fatty acid acetate and the gas hydrogen sulphide.

Emerging research: High levels of this species can promote inflammation in the gut and is associated with a diet high in saturated fats.
[1] [2] [3] [4] [5] [6]

	Bacteroidetes	*Bacteroides eggerthii*	0.62%	0.00% - 1.63%	Average	

This is a common inhabitant of the gut.

Fuel sources used: It can use fibre, resistant starch, simple sugars (including lactose), protein and mucus as an energy source.

Key metabolites produced: It can produce succinate, lactate and the short-chain factty acid, acetate.

Emerging research: Elevated levels have been associated with cardiovascular condition and a diet high in red meat.
[1] [2] [3] [4]

	Bacteroidetes	*Odoribacter splanchnicus*	0.61%	0.00% - 0.36%	High	

Formerly known as Bacteroides splanchnicus. This a common inhabitant of the human gut.

Fuel sources used: It can use fibre, resistant starch, simple sugars (including lactose), protein and mucus as energy sources.

Key metabolites produced: It can produce succinate, lactate and the short fatty acids, acetate, propionate and butyrate.

Emerging research: This species has been negatively correlated with metabolic conditions in postmenopausal obese women, suggesting it may have a beneficial role in metabolism. Another study observed this species was reduced in women with bladder pain.
[1] [2] [3]

Bacteroidetes	*Alistipes shahii*	0.50%	0.00% - 1.52%	Average	

This is a common inhabitant of the human gut.

Fuel sources used: It can use fibre, simple sugars (including lactose) and protein for energy.

Key metabolites produced: It primarily produces succinate, but can also produce the short-chain fatty acid acetate.

Emerging research: This species appears to have mostly beneficial effects. It has been associated with beneficial markers of cardiac health, and a study in mice showed this species may improve the efficacy of immunotherapy. However, high levels of this species have also been observed in neurodegenerative conditions.
[1] [2] [3] [4] [5] [6]

Bacteroidetes	*Parabacteroides distasonis*	0.44%	0.00% - 0.99%	Average	

Formerly known as Bacteroides distasonis. This is a common inhabitant of the human gut.

Fuel sources used: It can use fibre, resistant starch, simple sugars (including lactose), protein and mucus for energy.

Key metabolites produced: It primarily produces succinate and the short-chain fatty acid, acetate. It can also produce GABA, an important neurotransmitter.

Emerging research: High levels of this species have been associated with poor gut health and metabolic conditions in pregnant women.
[1] [2] [3] [4] [5] [6]

Firmicutes_A	*Dorea longicatena*	0.39%	0.00% - 0.67%	Average	

This is a common inhabitant of the human gut.

Fuel sources used: It can use fibre, simple sugars (including lactose) and protein for energy.

Key metabolites produced: It can produce formate, ethanol, and the short-chain fatty acids acetate and propionate.

Emerging research: There are conflicting results about the association of this species with metabolic conditions and more study is needed.
[1] [2] [3] [4] [5] [6] [7]

Bacteroidetes	*Alistipes finegoldii*	0.39%	0.00% - 0.51%	Average	

This is a common inhabitant of the gut microbiome.

Fuel sources used: It can use simple sugars and protein for energy.

Key metabolites produced: It primarily produces succinate and can also produce low amounts of the neurotransmitter GABA.

Emerging research: High levels of this species have been associated with poor gut health and a diet high in red meat and/or low in fruits and vegetables.
[1] [2] [3]

	Firmicutes_A	*Coprococcus_B comes*	0.30%	0.00% - 0.48%	Average	

This is a common inhabitant of the human gut.

Fuel sources used: It can use fibre, simple sugars (including lactose), protein and mucus for energy.

Key metabolites produced: It can produce lactate and the short-chain fatty acids butyrate and acetate.

Emerging research: This species likely plays a beneficial role in health as it has been observed at decreased levels in individuals with inflammatory conditions.
[1] [2] [3] [4] [5] [6]

	Verrucomicrobia	*Akkermansia muciniphila*	0.28%	0.00% - 2.23%	Average	

This species is associated with a healthy metabolic status and it is being investigated as a probiotic to treat metabolic disorders.

Fuel sources used: It lives in the mucus layer of the intestine and uses the mucus as it main energy source. Mucus turnover is a normal part of our gut function and this species plays an important role in regulating mucus turnover so the right amount occurs.

Key metabolites produced: This species produces the short-chain fatty acid propionate.

Emerging research: By living in the mucus layer, A. muciniphila prevents potentially harmful bacteria from colonising this space through competition. Studies have associated low levels of A. muciniphila with metabolic conditions. Research has also indicated this species can improve the efficacy of a common immunotherapy drug used called PD-1 inhibitors.

Levels of this bacterium tend to decrease with age.

Although this bacterium appears to have mostly beneficial effects, studies have shown elevated levels are associated with neurodegenerative conditions.
[1] [2] [3] [4] [5] [6]

	Firmicutes_A	*Dorea formicigenerans*	0.25%	0.00% - 0.21%	High	

Formerly known as Eubacterium formicgenerans. This is a common inhabitant of the human gut.

Fuel sources used: It can use simple sugars (including lactose) and protein for energy.

Key metabolites produced: It can produce lactate, formate, ethanol and the short-chain fatty acid acetate.

Emerging research: This species has been observed at decreased levels in individuals with poor gut health and fatigue, indicating it likely plays a beneficial role in health.
[1] [2] [3] [4] [5]

	Firmicutes	*Streptococcus anginosus*	0.18%	0.00% - 0.00%	High	

Fuel sources used: It can use fibre, resistant starch, simple sugars (including lactose) and protein for energy.

Key metabolites produced: It can produce lactate, the short-chain fatty acid acetate, and the compound trimethylamine. High levels of the trimethylamine have been associated with cardiovascular conditions.

Emerging research: This species has been associated with poor cardiovascular health.
[1] [2] [3]

	Firmicutes_A	*Ruminococcus_B lactaris*	0.17%	0.00% - 0.35%	Average	

This is a common inhabitant of the human gut.

Fuel sources used: It can use simple sugars (including lactose) and protein for energy.

Key metabolites produced: It can produce lactate and the short-chain fatty acids acetate and propionate.

Emerging research: Elevated levels of this species have been observed with inflammatory conditions, but reduced levels have been observed with metabolic conditions.
[1] [2] [3]

	Bacteroidetes	*Alistipes_A indistinctus*	0.08%	0.00% - 0.16%	Average	

This is a recently discovered inhabitant of the human gut.

Fuel sources used: It can use simple sugars (including lactose) and protein for energy.

Key metabolites produced: It can produce succinate, the short-chain fatty acid acetate, and low amounts of the neurotransmitter GABA.

Emerging research: High levels of this species have been associated with metabolic conditions.
[1] [2] [3]