PETBIOME

NEXT GENERATION SEQUENCING

YOUR PETS MICROBIOME REPORT

Good health starts with a health gut community, the microbiome is a complex and diverse environment. Imbalances can happen with diet changes, as your dog ages, with the use of long term medication such as antibiotics and NSAID's. Understanding how these changes effect the biome is key to health and longevity.

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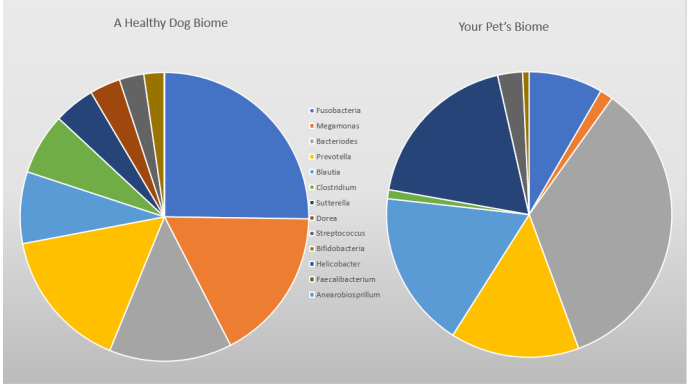
About the Biome

Your pet's biome is a community of micro-organisms, consisting of a mixture of the good (host friendly), the bad (linked to disease, and the not so bad (don't do any harm but don't contribute to good nutrition). This community is influenced by many factors including the breed of your dog, his age and the food he eats.

Although a high percentage of bacteria contribute towards your pet's health, some are pathogenic and if there is an overgrowth of these bad bacteria, they can have harmful effects. It is important to maintain the right balance between the beneficial and pathogenic bacteria. The balance can alter through stress, the use of medications and with a change in diet. Some imbalances may show as gastrointestinal discomfort and other imbalance show as allergies, diarrhea or poor gastrointestinal health.

Bacteria have jobs to do and contributions to make, some provide energy, vitamins and help to make nutrients, such as carbohydrates, more available. Other microbes interact with the immune, endocrine, nervous system and brain.



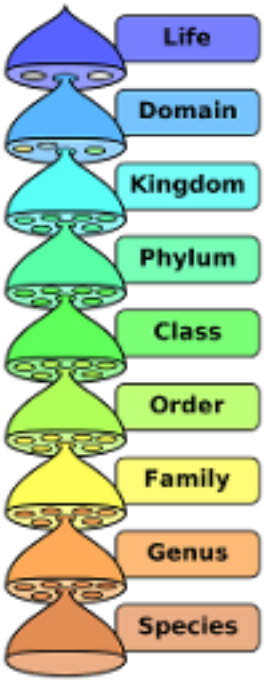
Having lots of different species of bacteria and a high enough percentage of them is key to a balanced biome. The pie chart above is a representation of the average bacteria community in a healthy dog, this is then compared to the faecal analysis of your own pet.

Your Pet's Report

Part One

Who's In There?

The first part of the report looks at the top groups of bacteria at genus level. Bacteria are divided into groups to make them easier to understand and identify, (see diagram below). Part One of this report identifies the major players and highlights the nutritional contributions and benefits made by them.



You will see in Part One, how important certain bacteria are to your pets health. You will also see how by making some small changes to the diet, beneficial bacteria can be encouraged to increase in number, providing even more benefits.

Some of the dietary changes mentioned in Part One are made by adding prebiotic ingredients such as inulin. The definition of a prebiotic is ''a nondigestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon and thus improves host health.'' Inulin is only one example of how important plant chemicals can be to the biome, another group you will hear mentioned is plant polyphenols. Probiotics are also mentioned these are live bacteria, rather than a food for the bacteria.

Other recommended dietary changes will relate to imbalances between the groups of bacteria that feed or digest carbohydrates, fats and protein. Making small changes in the amount or quality of these major nutrients will significantly improve the health of the gut and prevent any future opportunity for inflammation and colitis.

Part Two

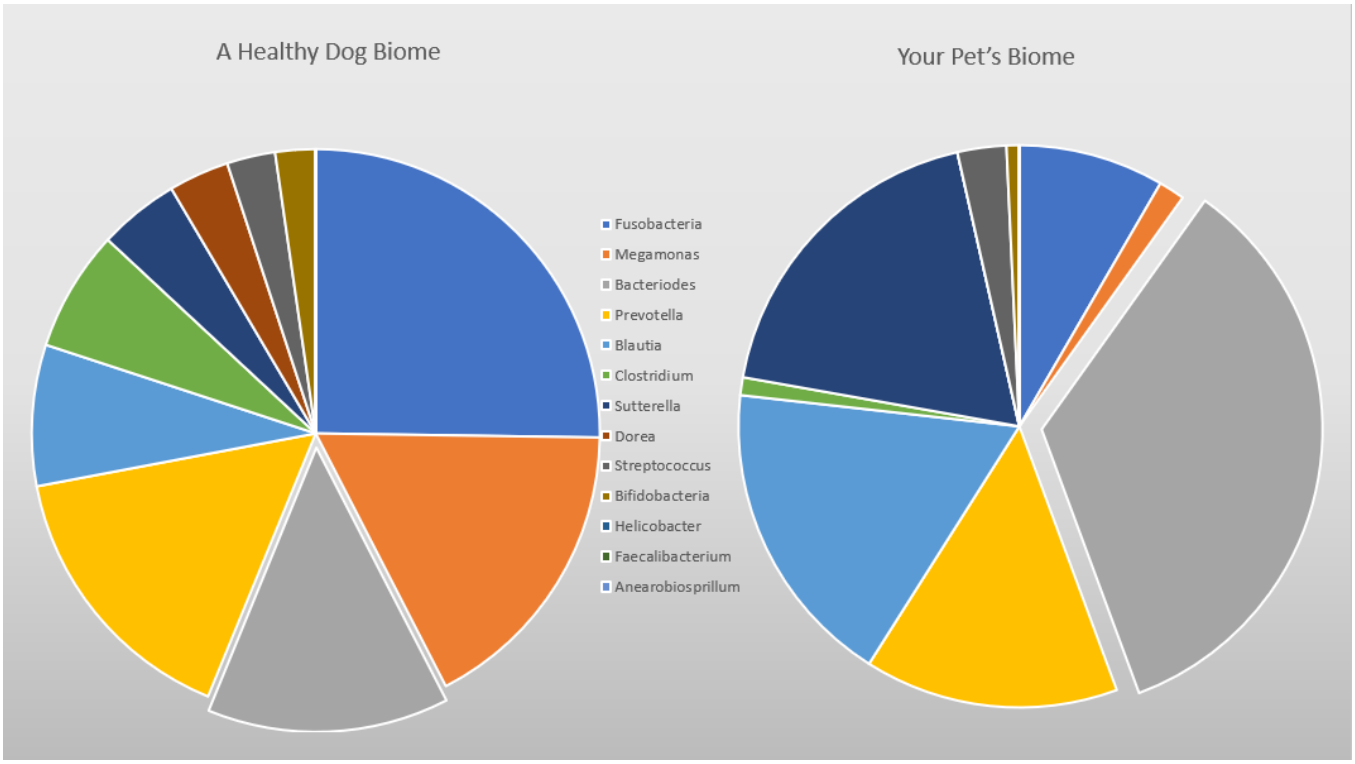
What are they doing?

Part Two refers to the bacteria identified across all of the taxonomic groups as shown in the diagram. This section explains how and why the bacteria contribute to the health and well being. For example, some bacteria help rebuild the gut wall, some trigger an immune response and some talk to the brain about what and how to act, eat and sleep. Other bacteria 'take over' and form biofilms, taking nutrients away from the host and reducing the pH of the hind gut preventing fermentation and causing discomfort.

Who are they doing it with?

Part Two also looks at the relationships and the conversations between the bacteria, some relationships contribute to health, especially the health of the immune system and some contribute to ill health, increasing the opportunity for inflammation and dysbiosis.

Part One: The Biome at Genus level



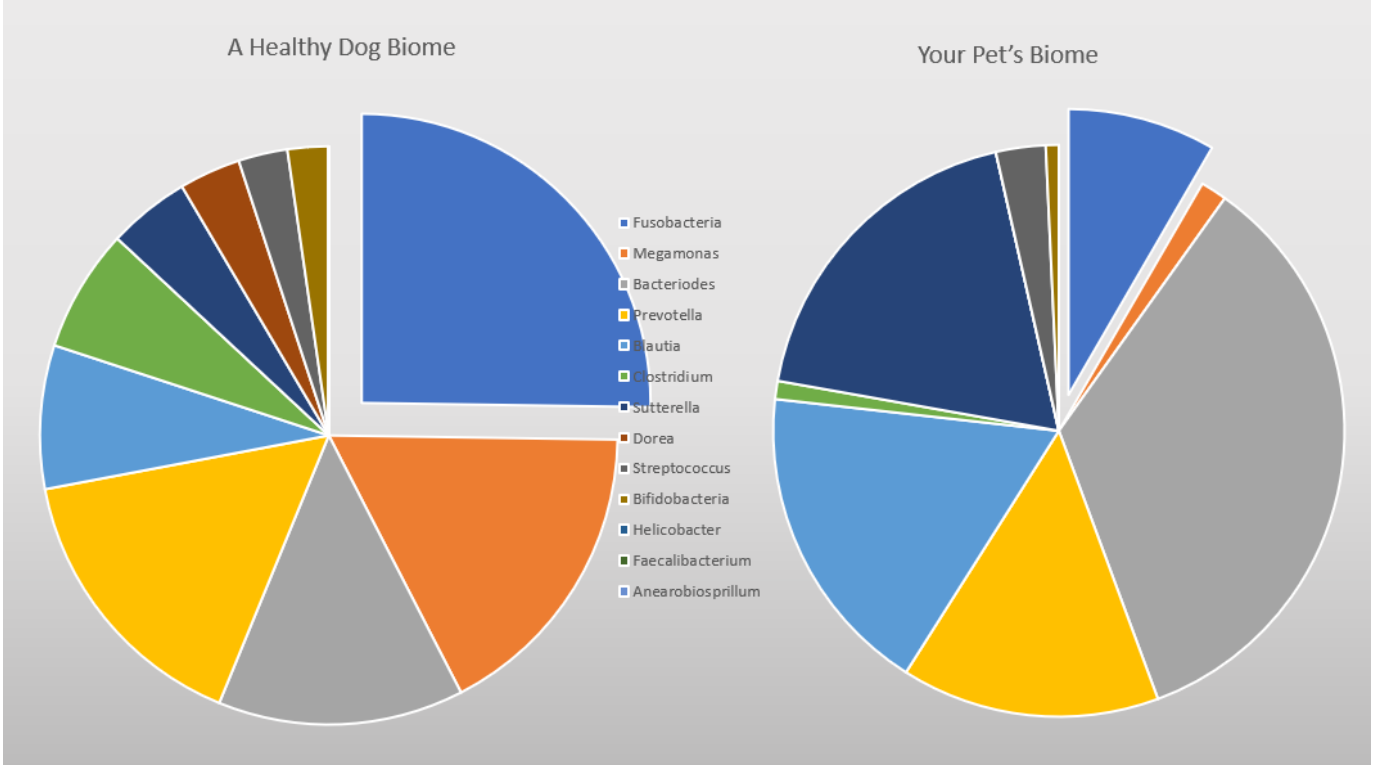
Bacteriodes

Bacteriodes belong to the family that help digest carbohydrates, if the ratio of bacteriodes is too high then the dog is more likely to gain weight easily. Bacteriodes are very flexible and can adjust to any dietary ingredients containing sugar/carbohydrates extracting nutrients as easily from kibble or a digestive biscuit!

At 24.69% of the total represented bacteria at genus level your dog has a higher percentage than the recommended healthy average, which is 13%. Bacteroides are inflammatory if present in high numbers .

Dietary Advice:

The genus of *bacteriodes* like digesting carbohydrates avoid easy to digest processed carbohydrates which encourage growth, encouraging the 'good' groups of bacteria in the next sections will help reduce levels of bacteroides.



Fusobacterium

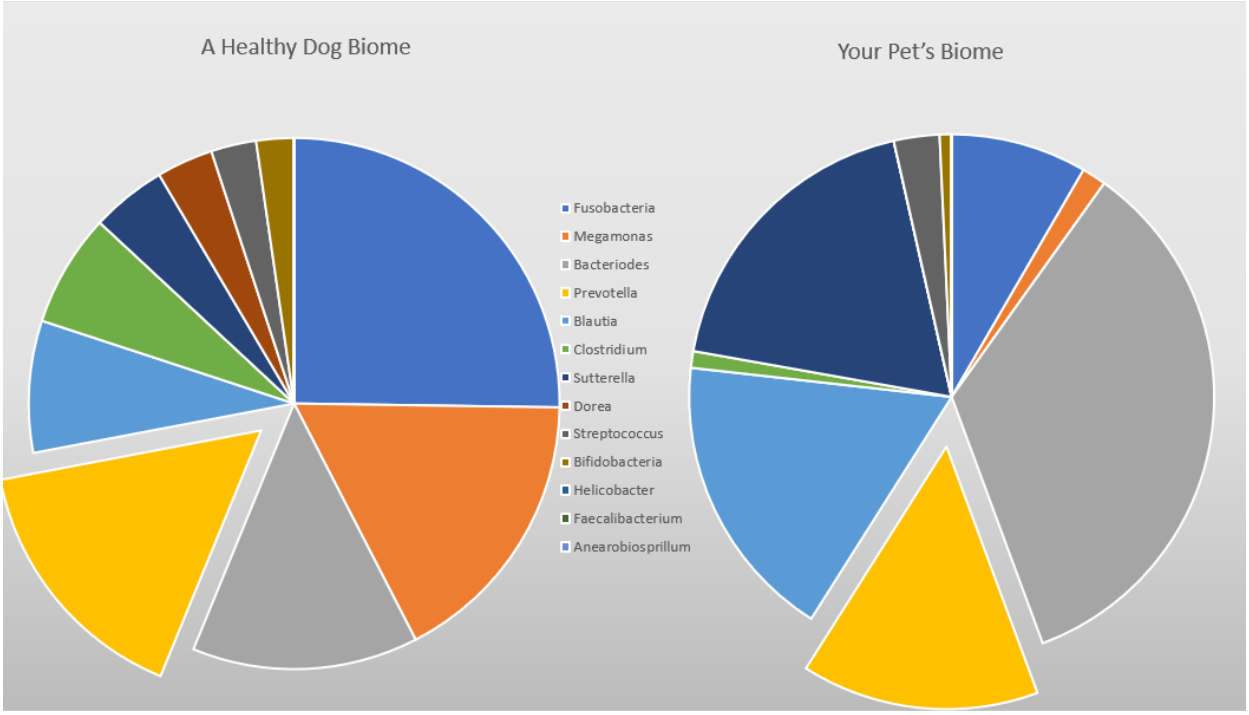
Fusobacteria is an important member of the healthy canine gut, which gets it's energy from fermenting select carbohydrates and amino acids. In high numbers it has been linked to colitis and inflammatory bowel disease in dogs. If levels are higher than the average adding a probiotic will help to reduce levels.

If levels are low then increasing the protein content of the diet will help as *fusobacteria* are happier with higher levels of amino acids. The average percentage of *fusobacterium* in healthy dogs is 25%, this dog is well below average at 6.05%

Dietary Advice; Increase the levels of *fusobacteria.*

If levels are low, then increasing the protein content of the diet will help as fusobacteria are happier with higher levels of amino acids.

Look on the labels for the ones that aren't manufactured by the dog's own body but must be added into his daily feed. The ten essential amino acids that the diet should provide to help increase the fusobacterium are- arginine, histadine, isoleucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine.



Prevotella

Prevotella are part of the normal healthy biome and contribute to the health of the dog by helping to digesting carbohydrates and protein, they also produce an important supply of energy for the dog. If there is an overgrowth these bacteria can be linked to infections of the gastrointestinal tract.

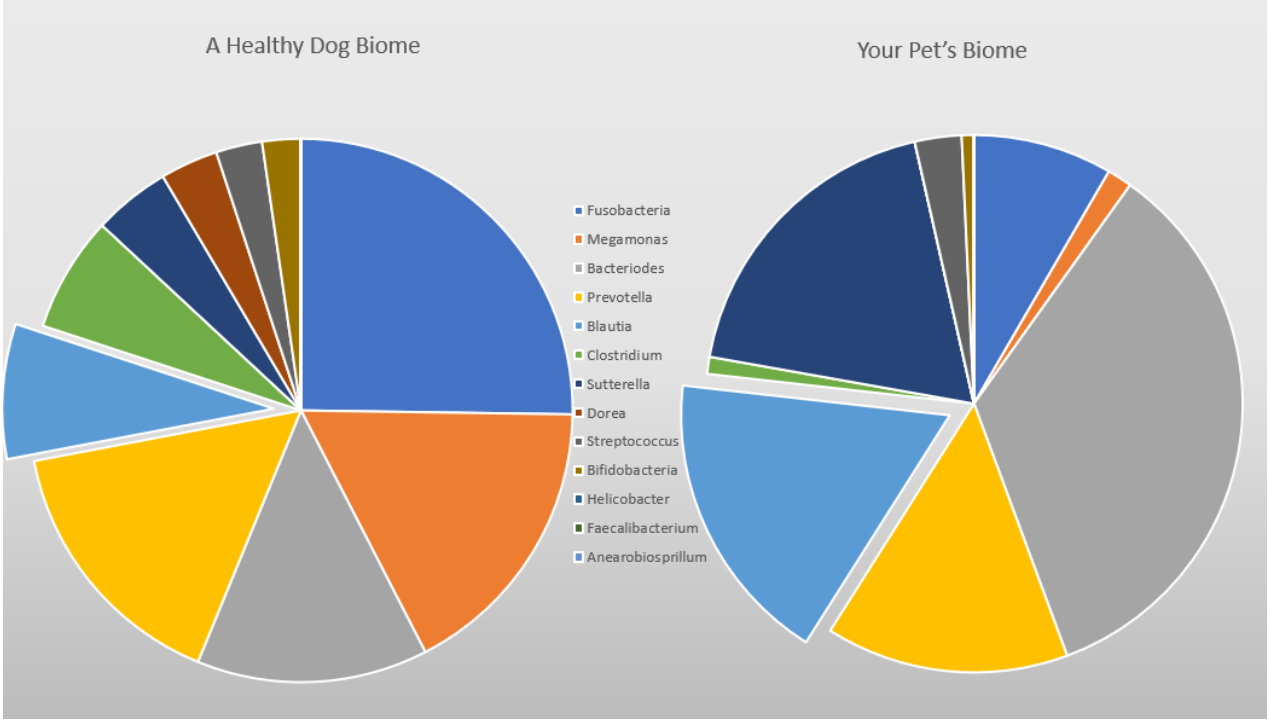
The average for *Prevotella* in a healthy dog is 14.7%, levels for your pet are low at 10.56%.

Dietary Advice; Increase the *Prevotella*

As the levels of bacteroides are reduced this will make the gut environment more favourable and the levels of *prevotella* should increase naturally .

Feed Complex carbohydrates are better than processed food, found in grains, oat bran, hulls of brown rice, and beet pulp.

Avoid 'grain-free' feeds as these contain carbohydrates such as tapioca, sweet potatoes and potatoes these tend to increase the bacteriodes.



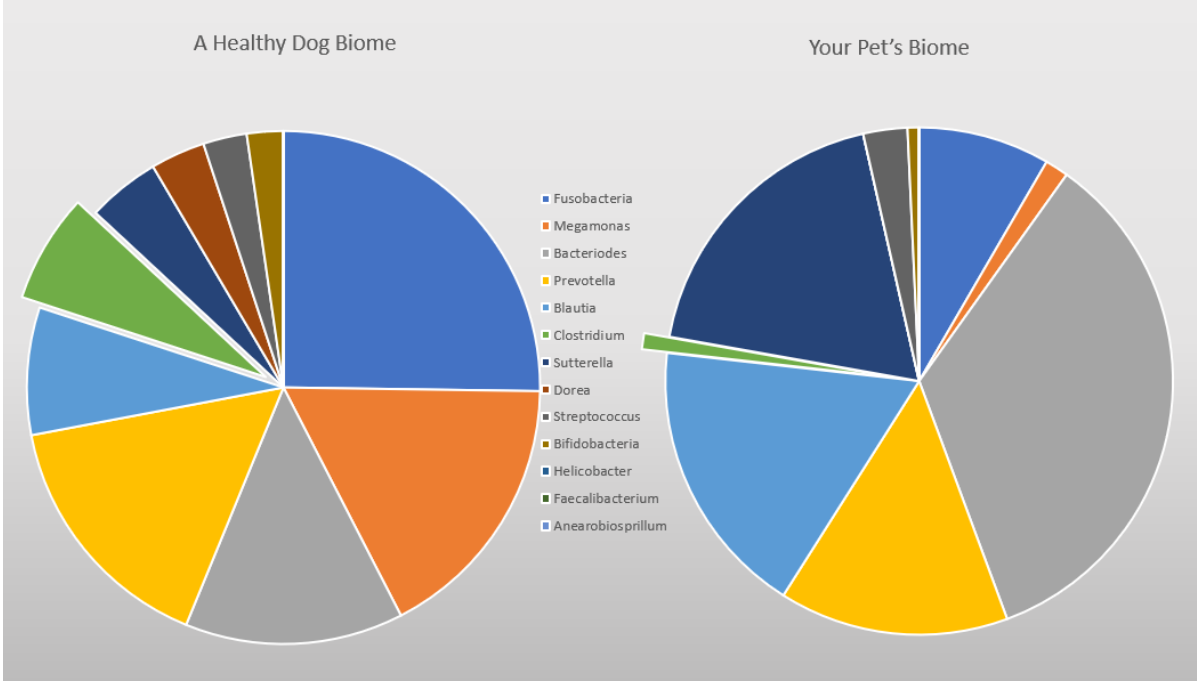
Blautia

An abundance of *Blautia* are linked to a healthy biome, with recommended levels being 8%. *Blautia* is an important member of the gut- brain communication axis and contributes to the feeling of well -being and satiety or fullness after eating. Your pet has 12.84% *Blautia*, which is above the recommended levels.

Low levels may indicate oxidative stress, which is the balance between the release of free radicals and the ability of the body to deal with toxins. *Blautia* bacteria are an important component in the management of free radical damage within the gastrointestinal tract.

Dietary Advice

An increase in the percentage of *blautia* indicate a corresponding increase in bile acids either from the diet , (check the fat content) or from an underlying medical condition, please check with your vet. The levels of blautia are only a small percent above the average, making the recommended changes to the diet should help reduce them.



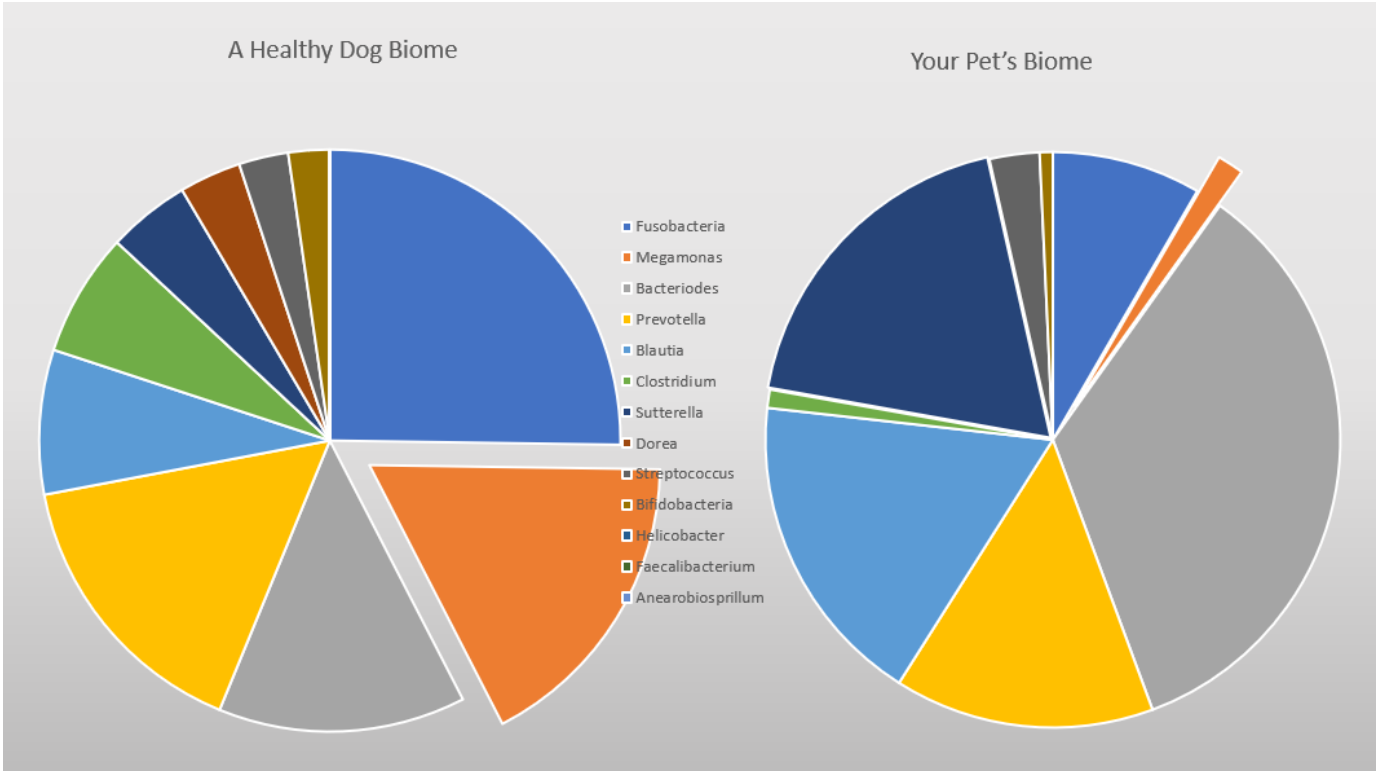
Clostridium

Clostridium are very important members of the biome, although there are some that are pathogens, such as botulin, most are host friendly. They form part of the police force that defend the gut wall barrier against invading bacteria, they also signal for an immune response and make sure that members of the biome get along together.

They should make up 7% of the total biome but your pet has only 0.74% of the total biome. There should be a high diversity within the individual species of *clostridia* which is the parent family of *clostridium*, an average number is 30 different species, but your pet has 52 different species, this adds stability to the biome and as the *bacteroides* are reduced the percentages of clostridium should increase naturally.

Dietary Advice; Decrease the percentage of *bacteroides* within the biome

With the recommended dietary changes, the levels/percentages of *clostridium* will naturally increase, ensuring a better immune response and greater protection against infections and/or inflammation within the gastrointestinal tract.



Megamonas

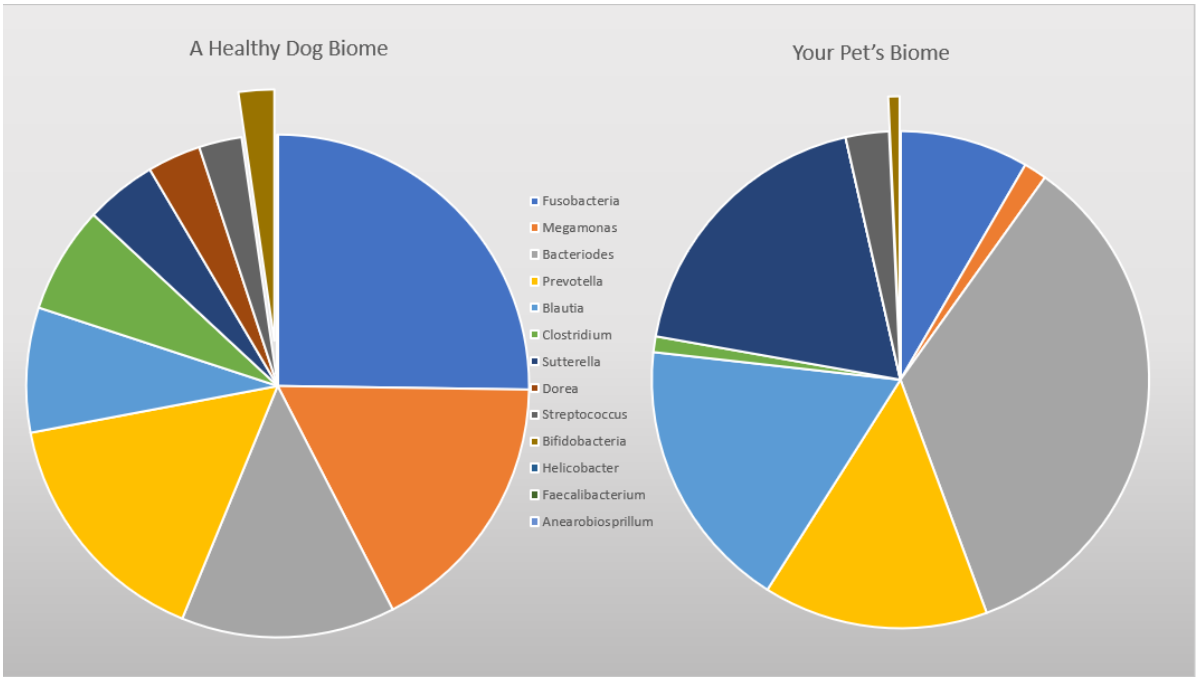
Megamonas is a core member of a healthy carnivore gut community and is recommended at levels of around 17% of the total biome. Low levels of *megamonas* relate to a poor metabolic rate, higher levels indicate more protection against weight loss and stress.

Megamonas are higher in healthy individuals than those with inflammation of the hind gut, indicating a protective role.

Your pet has 0.1% which is well below the recommended level.

Dietary Advice; *I*ncrease *megamonas*.

Levels of *Megamonas* will increase with the addition of complex carbohydrates they thrive on the indigestible fibre part of the ration. Follow the advice given on the *Prevotella* section, ie providing complex carbs, and the levels of *Megamonas* will increase naturally



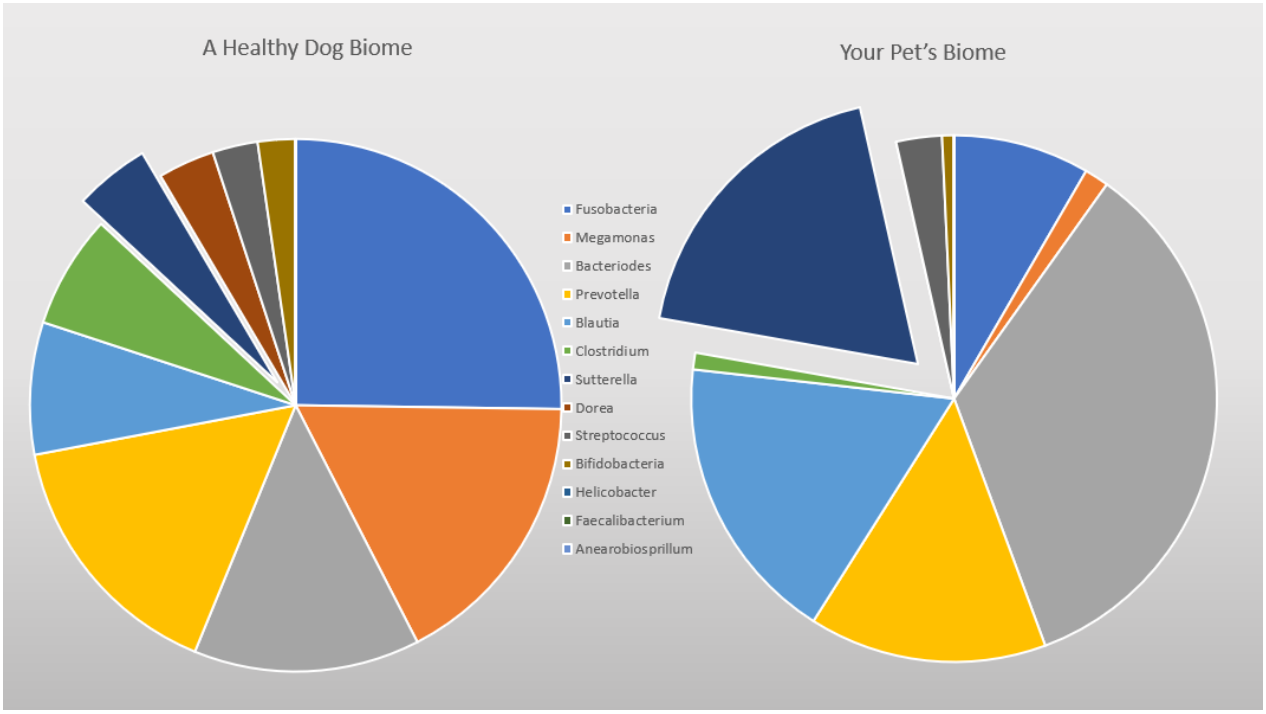
Bifidobacteria

Bifidobacteria are the good gut bacteria, producing thiamine, riboflavin, vitamin B6 and vitamin K. They also synthesize folic acid, niacin and pyridoxine. Good levels of *bifidobacteria* help increase the bioavailability of calcium and zinc because they lower the pH of the gut.

The recommended average is 2% though many animals and humans have low levels, your pet has 0.53% which is well below the amount required to supply levels of vitamin K and B6.

Dietary Advice; feed the *bifidobacteria* by including fermented food or a probiotic in the daily feed.

Long term recommendations for increasing the levels of *bifidobacteria* are to add fermented foods such as kimchi or sauerkraut. Both can be added, at a dose of 1 teaspoon of keffir/ kimchi or sauerkraut per day for 7 days then increase the dose to 2 teaspoons for a small dog, 3 for a medium sized dog and 4 teaspoons for a large dog.



Sutterella

Sutterella is a gram negative bacteria from the betaproteobacteria family, whilst little is known about it's contribution to the host nutrition, it is a commonly found inhabitant of the biome. Though generally host friendly if numbers rise then there is the potential to cause inflammation and when present in high numbers it has links to diseases such as IBD in dogs and autism in humans. This bacteria lives and adheres to the gut wall but is not mucin degrading and therefore does not contribute poor gut wall integrity.

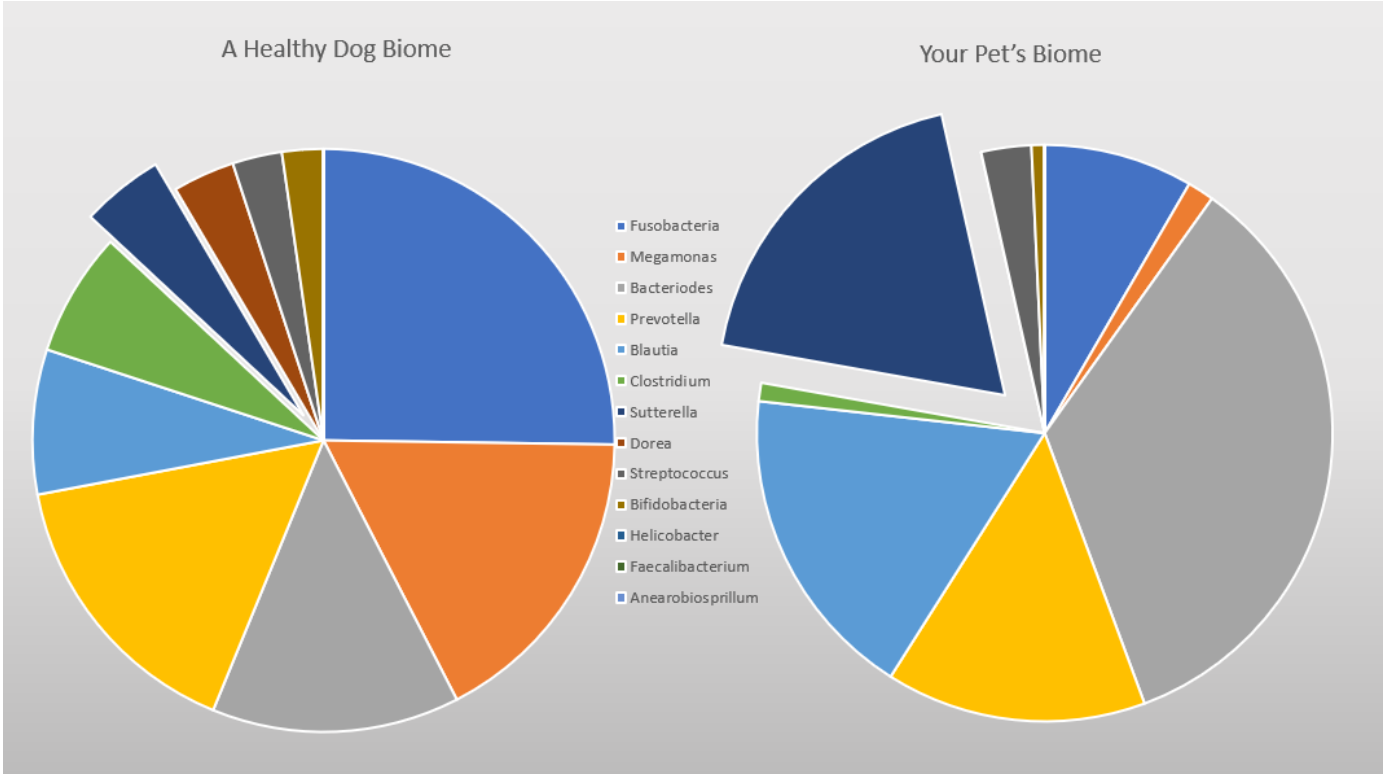
The average recommended levels are 4% and your pets levels are 13.4%.

Dietary Advice;

High levels of *Sutterella* are linked to inflammation, dysbiosis and colitis

Dietary Advice

Adding a small portion of meat ie chicken of lean mince will help make the biome less favourable for *Sutterella*



Streptococcus

S*treptococcus* is found in the gut of healthy animals, usually residing in the small intestine where it digests simple carbohydrates and produces lactic acid.

An over growth of *streptococcus* can cause health problems for dogs, average levels are calculated to be 2.4% and your pet has 2.03%.

S*treptococcus* produce D-lactic acid, in humans an over growth of *streptococcus* and an increase in d-lactic acid produces mood swings and aggressive behaviour.

Dietary Advice

None needed as *streptoccocus* are at recommended levels

Part Two: Bacteria & Links to Health

Metabolism

Name of Bacteria	Average % Recommended	Healthy	Your Pet Be Aware	Action Needed
Verrucomicrobia Akkermansia	**2.5-3**			**0.005**
Verrucomicrobia Methylacidiphales	**0.25-2.00**			**0.004**
Blautia	**8-10**		**12.84**	
Akkermansia. muciniphila	**0.25**			**0.01**

Verrucomicrobia Akkermansia are very low at 0.005% optimum glucose metabolism is calculated to be 2.5- 3%, this indicates a sluggish/poor glucose metabolism.

Verrucomicrobia Methylacidaphales are below normal indicating a low insulin/GLP -1 function.

Akkermansia Muciniphila is considered to be a good measure of a healthy biome it is directly linked to insulin sensitivity. It is also an important anti-inflammatory, helps repair the gut wall and has a direct relationship with the immune system.

Blautia is anti-inflammatory, antimicrobial and correlated to good metabolism, blautia contribute greatly to the overall health of the biome, though it should not be above the 8-10% as it then seems to disrupt rather than help metabolism, your pet's levels are above those recommended, indicating low grade inflammation.

Gut Wall Renewal

Name of Bacteria	Average % Recommended	Healthy	Your Pet Be Aware	Action Needed
Akkermansia. muciniphila	**0.25**			**0.01**
Roseburia	**0.2**			**0.001**
Eubacteria	**0.2**			**0.017**

The members of this group of bacteria help to renew the gut wall, if enough are present within the biome then the gut wall will be stronger and healthier.

The gut wall exists to protect the inside of the dog from any outside environmental or bacteria invaders which may cause ill health. Some bacteria are pathogenic and can cause disease if allowed to translocate or travel across the gut wall.

Action is needed to improve the levels of two of these bacteria, numbers can be encourage by increasing important plant polyphenols, these can be found in Biome Food 7, please contact us for details.

Inflammation/colitis/IBD

Name of Bacteria	Average% Recommended	Healthy	Your Pet's Be Aware	Action Needed
Proteobacteria	**34**		**31.27**	
Planctomycetes	**0**	**0**		
Fusobacteria	**24**			**6.05**
Firmicutes	**35**		**24.45**	
Actinobacteria	**1.5**			**0.51**
Cyanobacteria	**0**	**0.3**		
Bacteriodetes	**24.2**		**36.31**	
Tenericutes	**< 0.7**	**0.002**		
Burkholderiales	**1.6**			**14.0**
Roseburia, Eubacteria, Ruminococcus (Clostridium Cluster)			**Below Average Diversity**	
Enterobacter	**0.005**			**2.9**
Species diversity		**709**		

The recommendations made in relation to the addition of probiotics in Part One, plus the dietary changes should move all of the amber figures into the healthy green and all of the bacteria from the red into the amber.

Percentages of *proteobacteria* are slightly too low and are dominated by two pathogens Burkholderiales and ***E-coli,*** this leaves no room in the biome for the good gut bacteria (alphproteobacteria). Both are linked to gastri infections and weight loss.

F*usobacteria* are important members of the canine biome, though high levels have been linked to disease in other species, in dogs they have an important part to play in the digestion process, this dog has low levels indicating poor digestion.

TThe Clostridium Cluster provides protection against pathogens, the levels are low and lack diversity, decreasing the ***bacteroides and the other pathogens from the proteobacteria*** will help to increase these important bacterium.

Aggressive and Phobic Disorders Linked to Gut Bacteria

Aggressive Phylogenic Type	**High Levels of: -** Lactobacillacea Paraprevotellacea Firmicutes	**Level in the biome** Below average Below Average Average
Non- Aggressive Phylogenic Type	**High Levels** Proteobacteria Fusobacteria	 **High** Below average
Anxiety Phylogenic Type	**Low Levels** Bacteriodes fragilis Lactobacillus Rhamnosus	 Non Detected None detected

Your pet has higher levels of bacteria relating to non -aggression but only 1 out of 2 readings are high, as high proteobacteria are also linked to inflammtion these levels should be reduced, once the dysbiosis is addressed.

These readings may not be accurate if antibiotics have been administered recently, as the effect of antibiotics is to significantly reduce the overall diversity within the biome and temprarily wipe out some of these bacteria.

Pathogenic Bacteria

	Hits	Average
Bartonella	5	3.01
Borrelia	7	0.25
Rickettsia	19	0.22
Piscrickettsia	6	2.0
Ehrlichia	5	8.3
Helminthoeca	3	1.00
Neorickettsia	2	2.8
Leptospira	0	3.9
Shewanella	238	20.0

Shewanella and Rickettsia are at higher than average level increasing the risk of associated illnesses. As diversity and stability are increased within the biome (by feeding the good gut bacteria), the levels of pathogens should fall as the biome environment becomes less favourable.

Summary

Owner

The loss of diversity is causing health problems for your pet, together with high levels of inflammatory bacteria linked to gut discomfort. The good gut bacteria are at low levels so the dog is short on some vitamins and scfa that improve and support health of the host.

It's important to increase the levels of complex carbohydrates and the polyphenol content, this can be achieved in one go by adding plant- based carbohydrates, such as apples, grapes, broccoli, cauliflower and kale. Other complex carbohydrates can be found in beet pulp and hulls of brown rice, these complex phytonutrient carbs should make up 25% of the daily feed. Start slowly by adding small amounts until you are sure his system can cope with it, your pet has only small numbers of good gut bacteria which will only be able to ferment small amounts of additions to the diet.

Adding carbs with a phytonutrient content will help to rebalance the biome and will provide food for the bacteria that reduce and control oxidative stress, the addition of these food items will also help to improve the bacteria that are associated with better metabolism. High -glycemic index carbs also contribute to oxidative stress and inflammation, thus reducing the bacteria that are responsible for renewing the gut wall.

With this change in diet the bifidobacteria should increase in numbers as the diet is now providing food for them, the addition of a teaspoon of kefir/kimchi/sauerkraut should also help.

Veterinary

The levels of *bacteriodes* are exceptionally high, being inflammatory and pathogenic in nature, therefore reducing these should be a priority. Bacteriodes form biofilms within the gut reducing diversity and thus reducing a healthy immune response, high levels also produce a sluggish metabolism and reduce the bacteria that are associated with the endocrine system (verrucomicrobia).

With the recommended dietary changes, levels in the amber and red (on page 16 under General Health/ Dysbiosis) should move into the green or amber creating a healthier state and making the biome less favourable for the pathogenic bacteria.

The bacteria involved with good metabolism are low, many dogs have similar readings, in those bred for hunting levels increase significantly with exercise. It is possible to add a hormonally active prebiotic phytonutrient, to stimulate the verrucomicrobia, increasing the exercise will have the same effect.

This dog has medium diversity within the bacteria species reducing the overall stability within the biome, but should improve quite quickly if the good gut bacteria can be increased.

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