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# Dairy Cow-Microbiome

## Sample Report

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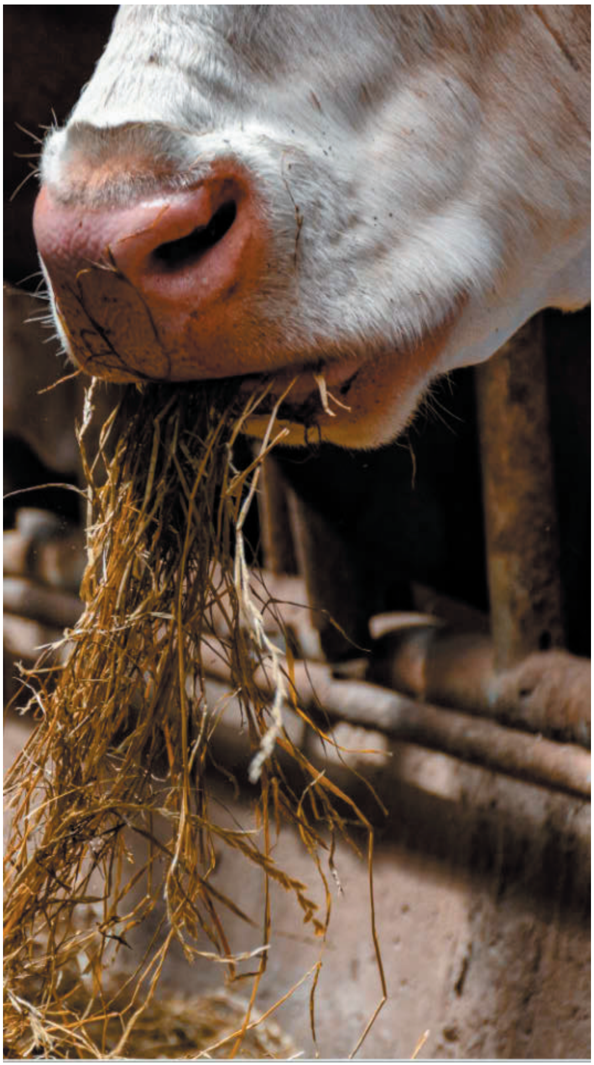
# Why is the gut microbiome important in your dairy cows?

For dairy cows in agriculture, the gut microbiome is of great importance for milk production. The microbiome encompasses all microorganisms, including bacteria, fungi, and viruses, that inhabit the cow's intestine.



Although microorganisms play a crucial role in digestion and nutrient absorption in cows, their significance becomes apparent when health issues arise. In the gut, there are many bacteria that promote digestion and nutrient absorption, while some bacteria can cause health problems [1][2].

Research on the gut microbiome in dairy cows is still in its early stages. However, there is an increasing understanding of how the microbiome influences, for example, the milk production of cows. A balanced composition of bacteria can lead to improved digestion and nutrient absorption, thereby resulting in better feed efficiency. Moreover, a balanced microbiome is associated with higher milk production [3].

Intensive farming and the associated stressful conditions for cows can negatively impact the gut microbiome. The use of antibiotics in industrial animal husbandry, as well as suboptimal nutrition, can disrupt the microbiome's composition and decrease milk production in cows [2]. To optimize milk production, the microbiome can be positively influenced through a balanced and high-quality diet tailored to the cows' needs. Furthermore, it is essential to minimize the use of antibiotics and employ alternative methods for disease control. A balanced gut microbiome hinders the proliferation of harmful bacteria. The use of probiotics, which are living microorganisms ingested through food, can support a healthy gut microbiome [3].

In the following, we provide insights into the composition of your dairy cows' microbiome, analyzing over 2900 bacterial groups. Additionally, we offer recommendations to improve the gut microbiome, thereby supporting your cows' milk production.

# MICROBIAL COMPOSITION

## Diversity of the Gut Microbiome

The diversity of the microbiome is an important indicator as a microbiome with higher diversity is generally more stable than one with low bacterial diversity. Therefore, increased diversity is often associated with a healthy microbiome. This is because a greater variety of bacteria can help maintain the balance of the microbiome and limit the proliferation of harmful bacteria.

A stable microbiome is capable of recovering and restoring itself after disturbances. However, if the microbiome is disrupted, for example, due to changes in diet or the use of various medications like antibiotics, it may lose its stability and become more susceptible to diseases [2].

To assess diversity, the Shannon index is used, providing information about the bacterial diversity in the gut of your dairy cows. A low value indicates reduced microbiome diversity and potential room for disease-promoting bacteria. High values indicate greater bacterial diversity and a well-balanced microbiome.

### The Result:

The Shannon index of 4.1 is within a range classified as high, indicating a high diversity of the microbiome. This means that the microbiome is stable and positively supports the immune system.

## Dysbiosis of the Gut Microbiome

The Dysbiosis Index is another way to assess the balance of the microbiome. Dysbiosis refers to an imbalance of bacterial groups in the gut. In this assessment, the microbiome is compared to the average composition of the microbiome in healthy cows [1].

A low value in the Dysbiosis Index (green range) indicates a balanced microbiome, while high values (red range) are associated with dysbiosis.

### The Result:

The Dysbiosis Index of 7 is within a range classified as slightly elevated, indicating a minor disruption of the microbiome's balance. This means that your dairy cows may be more susceptible to diseases and possibly have reduced milk production.

## How high is the feed efficiency of my dairy cows?

Feed efficiency in cattle plays a central role in modern agriculture as it directly relates to the productivity and cost factor of cattle farming. Efficient feed utilization means that cattle extract an optimal amount of nutrients from their food to support their bodily functions and achieve the desired milk production.

The gut microbiome plays a significant role in relation to feed efficiency in cattle. Microorganisms in the gut contribute to the digestion of plant fibres and other complex nutrients that cannot be fully broken down on their own. A well-balanced gut microbiome can help cattle digest their food more effectively and absorb nutrients better. This leads to improved feed efficiency, as fewer nutrients are wasted and are instead utilized for milk production. As a result, more milk is produced without the need to increase the amount of feed.

In the following, we provide an overview of bacteria associated with feed efficiency. Scientific studies show that low feed efficiency is associated with an increased presence of Prevotella bacteria in the gut microbiome, while Howardella is more prevalent in cattle with lower feed intake, indicating higher feed efficiency [4][5].

However, a disrupted gut microbiome can lead to digestive disorders that reduce the absorption of essential nutrients and, thereby, impair feed efficiency.

### The Result:

Compared to healthy reference cows, the composition of the gut microbiome indicates a slightly reduced feed efficiency in your dairy cows. This means that your dairy cows may tend to absorb fewer nutrients from their food compared to the average.

## What is the relationship between heat stress and the gut microbiome?

Heat stress in dairy cows is a significant concern in modern agriculture, especially in regions with hot summers or tropical climates. Dairy cows are sensitive animals, and their well-being and milk production are strongly influenced by environmental conditions. When temperatures rise, dairy cows experience increased heat stress, which, like other stress factors, can have a negative impact on their health and productivity.

A clear sign of heat stress in dairy cows is reduced milk production. High temperatures can lead the cows to consume less feed to regulate their body temperature. This results in an energy deficit and decreased milk production. Additionally, the quality of the milk may be affected as the cows absorb fewer nutrients from the feed, which can impact the fat and protein content of the milk [7][8].

Another issue associated with heat stress is reduced fertility in dairy cows. This means cows become pregnant less frequently, leading to a decrease in the number of new calves. The reduction in fertility can have long-term effects on milk production efficiency and can result in financial losses for farmers [8].

Heat stress can also influence the balance of the cows‘ gut microbiome. Studies have shown that the composition of microorganisms in the gut can change during heat stress. A disrupted gut microbiome can affect the cows‘ ability to absorb and utilize nutrients from their food, leading to decreased feed efficiency and reduced milk production.

In the following, we provide an overview of bacteria associated with heat stress. It has been observed that Firmicutes are more abundant in the gut of cows in hot regions, while Proteobacteria are reduced.

### The Result:

The composition of the gut microbiome shows a slightly increased heat stress in comparison to healthy reference cows in your dairy herd. This means that the milk production of your cows may be reduced.

## How does the gut microbiome contribute to methane emissions?

Methane emissions in cattle in intensive livestock farming are a significant environmental issue closely associated with the gut microbiome of the animals. Methane is a greenhouse gas that contributes to global warming, and cattle are one of the primary sources of methane emissions in agriculture.

The gut microbiome of cattle plays a central role in methane production. Some of the microorganisms in the cattle's digestive tract produce methane as a byproduct during the breakdown of food components. One of the key microorganisms involved in this process is Methanobrevibacter gottschalkii. Intensive farming practices can influence the balance of the gut microbiome in cattle and exacerbate methane production through factors such as feed composition and limited movement opportunities [9][10].

### The Result:

In the gut of your dairy cows, there are average amounts of bacteria contributing to methane emissions compared to reference cows. This means that your dairy cows do not emit elevated levels of methane.

# DISEASE-CAUSING BACTERIA

Pathogenic microorganisms can be present in the gut of cattle, potentially posing a risk to the animals' health. They can disrupt the balance of the microbiome, cause digestive disturbances, and affect the feed intake of dairy cows.

Furthermore, the presence of pathogenic microorganisms in the gut can negatively impact the feed efficiency of cattle. These pathogens can lead to reduced nutrient uptake and utilization from the feed, resulting in an energy deficit and adversely affecting milk production.

When dairy cows are affected by pathogenic microorganisms, they may experience discomfort and reduced appetite, leading to lower feed intake. Additionally, these microorganisms often cause gastrointestinal issues, further impairing nutrient absorption. This has a long-term negative impact on milk production. Below is an overview of pathogenic bacteria in the gut of dairy cows [6].

## The Result:

Enterobacter spp.

Mycobacterium paratuberculosis

Clostridium perfringens

Salmonella spp.

Staphylococcus spp.

In the gut microbiome of your dairy cows, no pathogenic bacteria were found above the threshold that would negatively influence milk production.

## How can a healthy gut microbiome and, consequently, high feed efficiency be achieved?

The health of the gut microbiome is closely linked to the health and performance of dairy cows. A balanced microbiome supports digestion and nutrient absorption, strengthens the immune system, and overall promotes the well-being of the animals. A balanced diet is crucial for promoting a healthy gut microbiome. Farmers should ensure that the animals are provided with an appropriate amount of feed, as excessive intake can increase the risk of digestive disorders [11][12].

The feed composition should meet the needs of the animals in different growth stages and contain all necessary nutrients in sufficient amounts. Particularly, fibre-rich foods (such as wheat bran, sugar beet pulp without molasses, soybean hulls, etc.) are essential as fibres serve as a food source for the microorganisms in the gut. Additionally, bacteria in the gut produce short-chain fatty acids from the fibres, which have anti-inflammatory properties and promote the health of the intestinal mucosa. Moreover, they support a healthy gut flora and contribute to a high diversity of the microbiome.

Disruptions in the balance of the gut microbiome are mainly favoured by stress and the use of antibiotics. Therefore, it is important to minimize stress situations for the animals and limit the use of antibiotics to the necessary extent [13].

The health of the gut microbiome can also be positively influenced by the use of probiotics. Probiotics are live microorganisms that can be fed as dietary supplements and promote the growth of beneficial bacteria in the gut.

# RECOMMENDATIONS

## How can you reduce heat stress and its effects on dairy cows?

Heat stress is a major challenge for dairy cows, especially during the warmer months of the year. It is essential to take appropriate measures to minimize the negative effects of heat stress on milk production and fertility.

One of the most important measures to prevent heat stress in dairy cows is providing adequate protection and cooling options. This includes shaded areas outdoors, fans, and water spraying systems in the barn to lower the ambient temperature. Regularly refreshing drinking water is crucial to ensure the animals stay hydrated.

Nutrition also plays a significant role in coping with heat stress. The feed ration should consider the increased energy demand due to high temperatures. Easily digestible feed sources, such as juicy grass, can be preferred to minimize the heat load caused by digestion.

A healthy gut microbiome can help reduce stress responses and strengthen the animals' immune systems. Promoting a balanced microbiome can be supported by adding probiotics to the feed ration and incorporating a high amount of fibre-rich foods. These supplements can help strengthen the gut microbiome's balance and facilitate coping with heat stress.

# RECOMMENDATIONS

## How can methane emissions be reduced in dairy cows?

Reducing methane production in dairy cows is an important step to decrease environmental impact and promote sustainable livestock farming. A stable gut microbiome, achieved through higher feed efficiency and fewer methane-producing bacteria, can help decrease gas emissions [14][15]. Additionally, the addition of plant-based oils (especially rapeseed oil) and tannin-rich hay from plants like Common Bird's-foot Trefoil, Sainfoin, and Small-flowered Tonka Bean can reduce methane production by inhibiting the activity of methane-producing microorganisms in the gut [16][17]. These additives can positively influence the gut microbiome and result in lower methane emissions. Tannins also possess antimicrobial properties, reducing the need for antibiotics and their negative impact on the gut microbiome.

## How can disease-causing bacteria in the intestines of dairy cows be prevented?

Preventing disease-causing bacteria in the intestines of dairy cows is of great importance to ensure the well-being of the animals and enable efficient milk production. Additionally, reducing the use of antibiotics for disease prevention can help maintain the long-term health of the cows by preserving a balanced gut microbiome. To achieve this, reducing antibiotic usage and promoting probiotic supplementation along with a fibre-rich diet can strengthen the gut microbiome of the animals. A robust gut microbiome makes it difficult for disease-causing bacteria to colonize and spread in the intestines, thereby reducing the risk of infections.

Other measures include quarantining new animals and maintaining good hygiene practices in the animal husbandry to prevent the spread of harmful bacteria. Wearing protective clothing and equipment, disinfecting shoes and vehicles, and enforcing strict visitor protocols can also help prevent the introduction of diseases. Regular monitoring of animal health is also crucial to identify diseases early and implement appropriate measures.

## Literature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## Miscellaneous

**Report created by:**

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*Next Generation Sequencing*

**Measurement Method:**

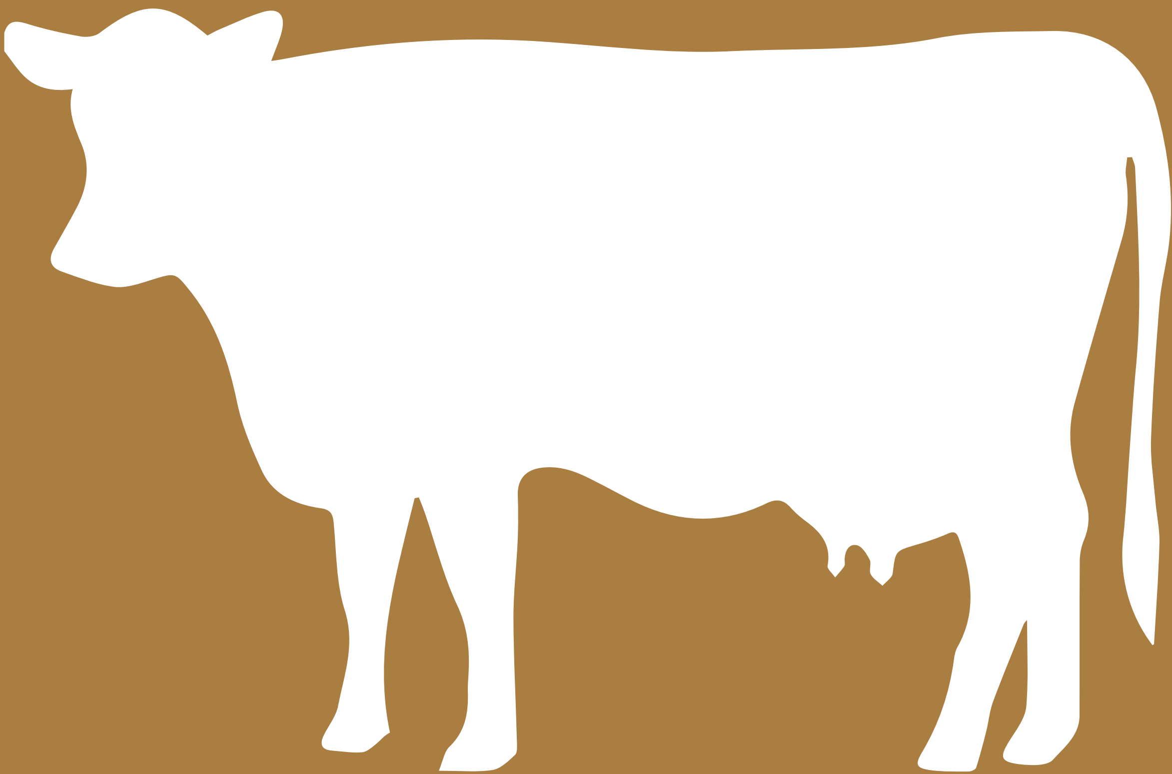
**NGS**
Next-Generation-Sequencing (16S rRNA Gen)

**Primary sample or submitted material:**

stool sample

**Disclaimer:**

The analysis is based on the sequencing of the 16S rRNA gene, which allows for the classification of bacterial strains in the microbiome. The results of the microbiome test and their interpretation may be incomplete. The number of detected microorganisms is not exhaustive, and there may be other microorganisms present that are not captured by the sequencing. The current interpretation of the microbiome test may change in the future due to the publication of new scientific studies. Inac-curateor missing information can lead to misleading interpretation. This report is provided to you solely for informational and educational purposes and does not replace a visit to a veterinarian or the advice or services of a veterinarian.



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