trax NGS
LAB SYSTEMS
Next Generation Sequencing

Cattle-Microbiome

Sample Report

Health begins with us.

Powered by
PRO COM CURE DIAGNOSTICS
QUALITY WITHOUT COMPROMISE

trax
LAB SYSTEMS

Sample-ID maNGSxx
Sample receipt DD.MM.YYYY

Table of contents

Summary of the Results

Microbial composition

Diversity of the microbiome (Shannon Index)

Balance of the microbiome (Dysbiosis Index)

Productivity

Feed efficiency

Human health

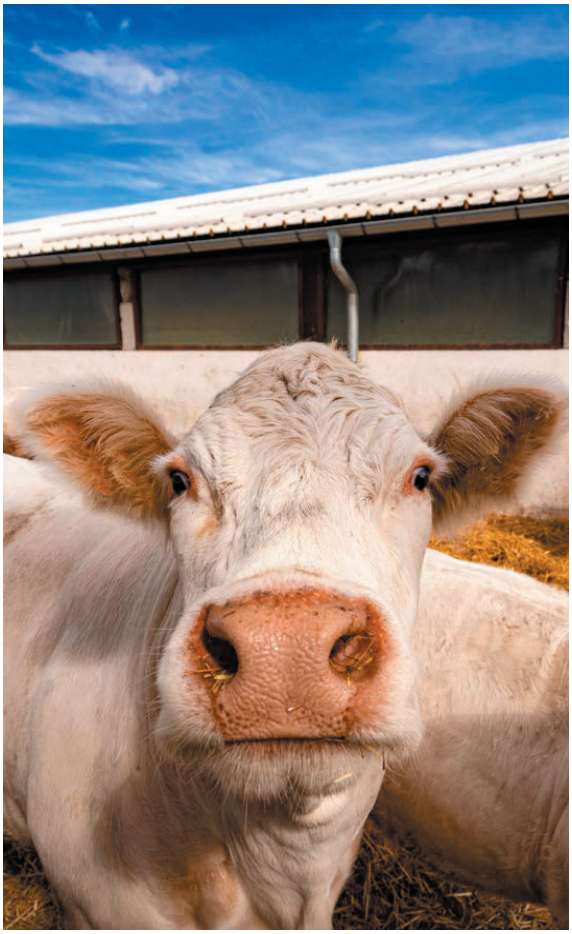
Fat composition in beef

Impact on the environment

Methane emissions

Disease-causing bacteria

Why is the gut microbiome important for your fattening cattle?



In fattening cattle in agriculture, the gut microbiome is of great importance for meat production. The gut microbiome encompasses all microorganisms, including bacteria, fungi, and viruses, that inhabit the intestines of cattle.

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

Research on the gut microbiome in cattle is still in its early stages. Nevertheless, there is an increasing understanding of how the microbiome influences meat production. A balanced composition of bacteria can lead to improved digestion, nutrient absorption, and consequently, better feed efficiency. Moreover, a balanced microbiome is associated with higher meat production [3].

Intensive farming practices and the associated stressful conditions for cattle can negatively impact the gut microbiome. The use of antibiotics in industrial animal husbandry and suboptimal nutrition can disrupt the microbiome's composition, thereby reducing feed efficiency and body mass gain [2]. To optimize meat production, the microbiome can be positively influenced through a balanced and high-quality diet tailored to the needs of cattle. Additionally, it is essential to minimize the use of antibiotics and employ alternative methods to combat diseases. A balanced gut microbiome makes it more difficult for harmful bacteria to proliferate. The use of probiotics, living microorganisms ingested through food, can support a healthy gut microbiome [3].

In the following, we provide insight into the composition of the microbiome in your fattening cattle. Over 2900 bacterial groups in the microbiome are analysed. Furthermore, we offer recommendations to improve the gut microbiome, supporting you in meat production.

MICROBIAL COMPOSITION

Diversity of the gut microbiome

The diversity of the microbiome is an important indicator, as a microbiome with higher diversity tends to be 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 contribute to maintaining the balance of the microbiome and limiting the spread of harmful bacteria.

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

To assess diversity, the Shannon index is used, which provides information about the bacterial diversity in the intestines of your cattle. A low value indicates reduced microbiome diversity and the potential presence of disease-causing bacteria. High values, on the other hand, indicate greater bacterial diversity and, consequently, a healthy balance of the microbiome.

The Result:

The Shannon Index of 4.1 is within a range considered high, indicating a higher diversity of the gut microbiome. This means that the microbiome is stable and positively supports the immune system.

MICROBIAL COMPOSITION

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. The microbiome is compared to the average composition of the microbiome in healthy cattle [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 falls within a range considered slightly elevated, indicating a minor disturbance in the balance of the microbiome. This means that your beef cattle may be more susceptible to diseases and may potentially gain less body mass.

What is the feed efficiency of your beef cattle?

The feed efficiency in cattle plays a central role in modern agriculture, as it is directly related to the productivity and cost factor of cattle farming. Efficient feed utilization means that the cattle extract an optimal amount of nutrients from their diet to support their physiological functions and achieve the desired meat production.

The gut microbiome plays a significant role in relation to feed efficiency in cattle. The microorganisms contribute to the digestion of plant fibres and other complex nutrients that would not be fully broken down otherwise. A well-balanced gut microbiome can help cattle digest their food more effectively and absorb nutrients better. This results in improved feed efficiency, as fewer nutrients are wasted and, instead, utilized for body mass production. Consequently, more meat is produced without the need to increase the amount of feed.

Below, we provide an overview of bacteria associated with feed efficiency. Scientific studies show that in cases of lower feed efficiency, there is an increased presence of Prevotella bacteria in the gut microbiome, while Howardella is more prevalent in cattle with higher feed efficiency [4][5]. However, a disrupted gut microbiome can lead to digestive disorders, reducing the intake of essential nutrients and thereby impairing feed efficiency.

The Result:

Compared to healthy reference cattle, the composition of the gut microbiome indicates a slightly reduced feed efficiency in your beef cattle. This means that your beef cattle can absorb fewer nutrients from their diet compared to the average.

What influence does the gut microbiome have on the fat composition of beef?

Beef contains high amounts of proteins and fats. In contrast to plant-based foods, the proportion of saturated fatty acids in beef is significantly higher compared to unsaturated fatty acids.

It is known that a high intake of saturated fatty acids increases the risk of cardiovascular diseases and other health problems in humans. On the other hand, unsaturated fatty acids, especially omega-3 fatty acids, are known for their positive effects on human health. Omega-3 fatty acids can have anti-inflammatory effects, reduce the risk of cardiovascular diseases, and support brain function.

The gut microbiome plays a crucial role in the fat composition of beef. The microorganisms in the digestive tract of cattle can influence and convert the fatty acids they intake through their food. The gut microbiome has the ability to convert unsaturated fatty acids from the feed into saturated fatty acids, thereby increasing the proportion of saturated fatty acids in beef [7][8].

To improve the fat composition of beef in favour of human health, new feeding practices can be implemented to influence the gut microbiome of cattle. The aim is to promote the gut microbiome in a way that the meat is richer in unsaturated fatty acids, thereby reducing the negative effects of saturated fatty acids on the human body.

In the following, we provide an overview of gut bacteria, such as Butyrivibrio fibrisolvens, that are associated with increased levels of unsaturated fatty acids in meat.

The Result:

The gut microbiome of your cattle contains slightly higher amounts of bacteria associated with an increased proportion of unsaturated fatty acids in the meat. This means that the meat of these beef cattle will likely have higher levels of unsaturated fatty acids.

How does the gut microbiome contribute to methane emissions?

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

The gut microbiome of cattle plays a central role in methane production. Some of the microorganisms in the digestive tract of cattle produce methane as a byproduct during the breakdown of food components. One of these microorganisms is Methanobrevibacter gottschalkii. Intensive farming practices can influence the balance of the gut microbiome in cattle and increase methane production through the choice of feed and limited opportunities for movement [9][10].

DISEASE-CAUSING BACTERIA

In the gut of cattle, pathogenic microorganisms can be present, which can potentially be harmful to the health of the animals. These microorganisms can disrupt the balance of the microbiome, cause digestive disorders, and affect the feed intake of cattle.

Moreover, the presence of disease-causing bacteria in the gut can also affect the feed efficiency of cattle. These pathogenic microorganisms can lead to reduced absorption and utilization of nutrients from the feed. This can result in an energy deficit and negatively impact the weight gain of the animals.

When fattening cattle are infected with pathogenic microorganisms, it can lead to discomfort and reduced feed intake. Additionally, these microorganisms often cause gastrointestinal problems, thereby affecting the nutrient absorption. This has long-term negative effects on meat production. Below, we provide an overview of pathogenic bacteria in the gut of fattening cattle [6].

The Result:

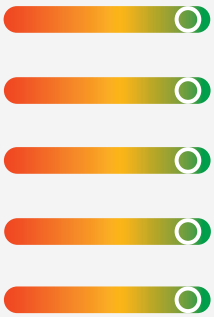
Enterobacter spp.

Mycobacterium paratuberculosis

Clostridium perfringens

Salmonella spp.

Staphylococcus spp.



No pathogenic bacteria were found in the gut microbiome of your cattle above the threshold , which would negatively affect meat 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 the cattle. 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 feed intake increases the risk of digestive disorders [11][12].

The composition of the feed should meet the needs of the animals in different growth stages and contain all the necessary nutrients in sufficient amounts. Particularly, foods rich in fibre (such as wheat bran, sugar beet pulp without molasses, soybean hulls, etc.) are important as fibres serve as a food source for the microorganisms in the gut.

Furthermore, bacteria in the gut convert fibres into short-chain fatty acids. These fatty acids have anti-inflammatory properties and promote the health of the intestinal mucosa. Moreover, they support a healthy gut flora and contribute to a diverse gut microbiome.

Imbalances in the gut microbiome are mainly favoured by stress and the use of antibiotics. Therefore, it is important to minimize stressful 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 living microorganisms that can be fed as supplements and promote the growth of beneficial bacteria in the gut.

How can the fat composition of beef be improved?

The proportion of unsaturated fats in beef can be increased by promoting a healthy gut microbiome. The composition of the diet can significantly influence the fatty acid profile of the meat. Adding more unsaturated fats to the diet, such as flaxseed, soybean oil, or rapeseed oil, can increase the concentration of unsaturated fatty acids in beef. Additionally, feeding grass (as opposed to grains) has been shown to result in lower amounts of saturated fatty acids in beef [14].

How can methane emissions be reduced in cattle?

Reducing methane production in fattening cattle is an important step to decrease environmental impact and promote sustainable animal husbandry. A stable gut microbiome, achieved through higher feed efficiency and fewer methane-producing bacteria, can help reduce gas emissions [15][16]. Additionally, the inclusion of plant-based oils, especially rapeseed oil, and tannin-rich forage from plants like common hornbeam, sainfoin, and small-flowered everlasting, can reduce methane production by inhibiting the activity of methane-producing microorganisms in the digestive system [17][18]. These additives can influence the gut microbiome and result in lower methane emissions. Tannins also possess antimicrobial properties, which can reduce the need for antibiotics and their negative effects on the gut microbiome.

How can disease-causing bacteria in the intestines of my fattening cattle be prevented?

Preventing disease-causing intestinal bacteria is of great importance to ensure the well-being of the animals and enable efficient meat production. Moreover, it can also reduce the need for antibiotics, ensuring that the meat production is not negatively affected in the long term due to a disrupted gut microbiome in the animals. When reducing antibiotic usage for disease prevention, administering probiotics and providing a fiber-rich diet can strengthen the gut microbiome of the animals. A robust gut microbiome makes it difficult for disease-causing bacteria to establish and spread in the intestines, thus reducing the risk of infections [13].

Other measures include quarantining new animals and maintaining good hygiene in the livestock facility to prevent the spread of harmful bacteria. Wearing protective clothing and equipment, disinfecting shoes and vehicles, and enforcing strict visitor rules can also help prevent the introduction of diseases. Additionally, regular monitoring of animal health is crucial to detect diseases early and implement appropriate measures.

Literature

[1] Welch, Christina B., et al. „Utilizing the gastrointestinal microbiota to modulate cattle health through the microbiome-gut-organ axes.“ Microorganisms 10.7 (2022): 1391.
[2] Forcina, Giovanni, et al. „Gut Microbiome Studies in Livestock: Achievements, Challenges, and Perspectives.“ Animals 12.23 (2022): 3375.
[3] Lin, Limei, et al. „The gastrointestinal microbiome in dairy cattle is constrained by the deterministic driver of the region and the modified effect of diet.“ Microbiome 11.1 (2023): 1-21.
[4] Carberry, Ciara A., et al. „Effect of phenotypic residual feed intake and dietary forage content on the rumen microbial community of beef cattle.“ Applied and environmental microbiology 78.14 (2012): 4949-4958.
[5] Monteiro, Hugo F., et al. „Rumen and lower gut microbiomes relationship with feed efficiency and production traits throughout the lactation of Holstein dairy cows.“ Scientific reports 12.1 (2022): 4904.
[6] Xu, Qingbiao, et al. „Gut microbiota and their role in health and metabolic disease of dairy cow.“ Frontiers in Nutrition 8 (2021): 701511.
[7] Martínez-Álvaro, Marina, et al. „Microbiome-driven breeding strategy potentially improves beef fatty acid profile benefiting human health and reduces methane emissions.“ Microbiome 10.1 (2022): 166.
[8] Lourenço, M., E. Ramos-Morales, and R. J. Wallace. „The role of microbes in rumen lipolysis and biohydrogenation and their manipulation.“ Animal 4.7 (2010): 1008-1023.
[9] Tapio, Ilma, et al. „The ruminal microbiome associated with methane emissions from ruminant livestock.“ Journal of animal science and biotechnology 8.1 (2017): 1-11.
[10] Ramayo□Caldas, Yuliaxis, et al. „Identification of rumen microbial biomarkers linked to methane emission in Holstein dairy cows.“ Journal of Animal Breeding and Genetics 137.1 (2020): 49-59.
[11] Fischer, A., X. Dai, and K. F. Kalscheur. „Feed efficiency of lactating Holstein cows is repeatable within diet but less reproducible when changing dietary starch and forage concentrations.“ animal 16.8 (2022): 100599.
[12] Lahart, B., et al. „The repeatability of feed intake and feed efficiency in beef cattle offered high-concentrate, grass silage and pasture-based diets.“ Animal 14.11 (2020): 2288-2297.
[13] Ji, Shoukun, et al. „Ecological restoration of antibiotic-disturbed gastrointestinal microbiota in foregut and hindgut of cows.“ Frontiers in Cellular and Infection Microbiology 8 (2018): 79.
[14] Fatty Acid Composition of Grain- and Grass-Fed Beef and Their Nutritional Value and Health Implication
[15] Tapio, Ilma, et al. „The ruminal microbiome associated with methane emissions from ruminant livestock.“ Journal of animal science and biotechnology 8.1 (2017): 1-11.
[16] Chagas, Juana C., et al. „Effect of a low-methane diet on performance and microbiome in lactating dairy cows accounting for individual pre-trial methane emissions.“ Animals 11.9 (2021): 2597.
[17] Stewart, Elizabeth K., et al. „Effect of tannin-containing hays on enteric methane emissions and nitrogen partitioning in beef cattle.“ Journal of Animal Science 97.8 (2019): 3286-3299.
[18] Besharati, Maghsoud, et al. „Tannin in Ruminant Nutrition.“ Molecules 27.23 (2022): 8273.

Miscellaneous

Report created by:

trax NGS
LAB SYSTEMS
Next Generation Sequencing

Measurement Method:

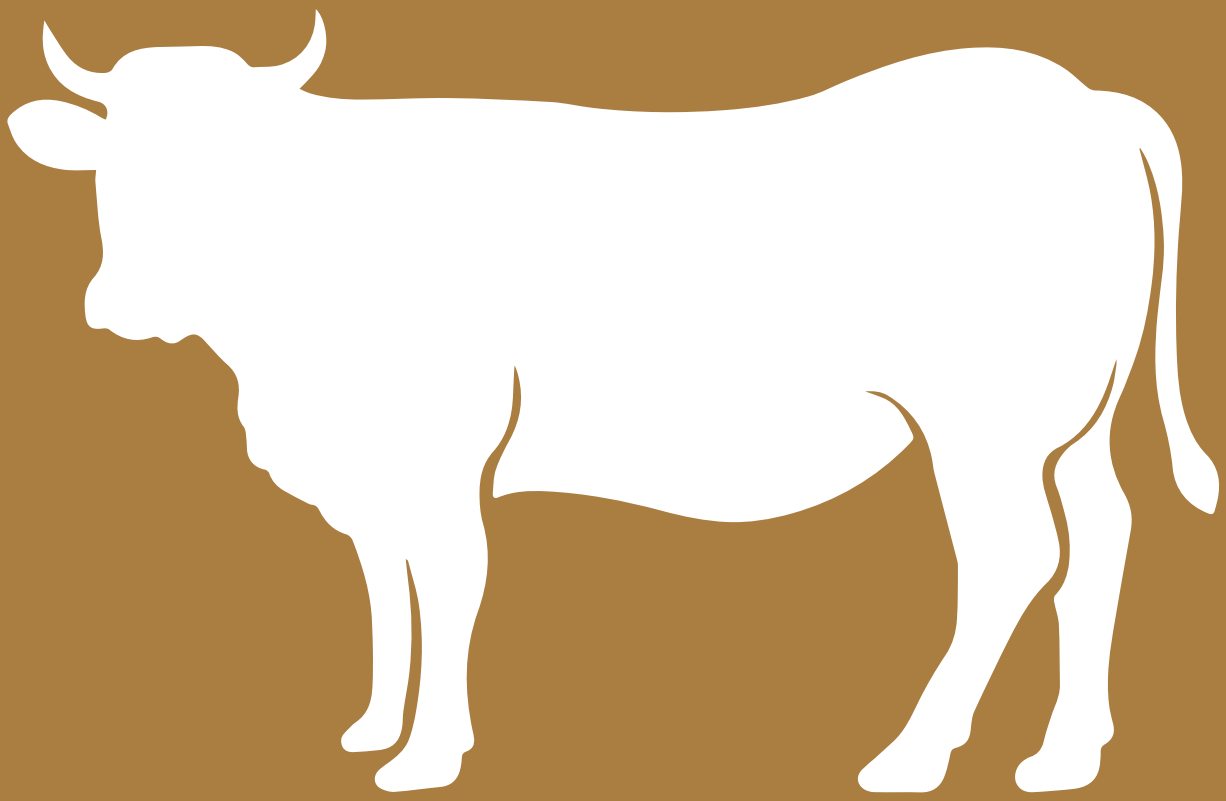
NGS
Next-Generation-Sequencing (16S rRNA Gen)

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. Inaccurate or 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.



Health begins with us.

trax
LAB SYSTEMS

Powered By

PRO COM CURE DIAGNOSTICS
QUALITY WITHOUT COMPROMISE

www.traxlabsystems.com