National Research Programme NRP 69
Healthy Nutrition and
Sustainable Food Prodution

Reducing ammonia and greenhouse gas emissions in dairy farming

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Structural measures and feeding strategies reduce ammonia emissions in dairy husbandry

To protect the environment, it is necessary to achieve substantial reductions in ammonia and greenhouse gas emissions from agriculture. As part of NRP 69, a collaborative research cooperation between Agroscope, Empa and ETH Zurich investigated the impact of various strategies for reducing these emissions. They demonstrated that structural measures in dairy housings can significantly reduce the formation of ammonia from cow excrement. Ammonia emissions in the experimental dairy housing decreased by up to 20% because solid floors with a slight slope allowed the rapid drainage of urine, which contains nitrogen. A similar effect was achieved with a raised feeding area, which reduced the heavily soiled area. Balanced, needs-based feeding can also reduce ammonia.

Dairy farming is responsible for a relevant proportion of greenhouse gas and ammonia emissions. Because ammonia emissions harm sensitive ecosystems and can contribute to the formation of particulate matter, Switzerland's "Environmental Goals for Agriculture" state they should be reduced by around 40%. The Swiss "Climate Strategy for Agriculture" also specifies the goal of reducing greenhouse gases emitted by agriculture by at least one third by 2050. This target relates in particular to methane, which accounts for the largest share of agricultural greenhouse gases. Achieving these ambitious goals calls for efficient reduction strategies and practical solutions.

In NRP 69, the researchers tested various measures for the sustainable reduction of emissions in dairy husbandry. In an experimental dairy housing for emission measurements built

Less soiled areas mean fewer ammonia emissions. In Agroscope's experimental dairy housing for emission measurements, various structural measures were implemented in order to keep the floors as clean as possible. Feeding stalls consist of a raised platform with partitions. This reduces the heavily soiled area in the feeding area, thus less ammonia is formed. The aisle behind the platform can be frequently cleaned using an automated manure scraper, without disturbing the cows while they are feeding.
Source: Agroscope

by Agroscope, they investigated structural and organisational measures as well as feeding strategies. The experimental dairy housing makes it possible to measure and compare the emissions from two spatially separate compartments each containing 20 animals under the same climatic conditions. The researchers implemented the measures in one compartment and compared the effects with the reference compartment.

Gradient delivers reduction of around 20%

In dairy farming, ammonia is formed mainly from the urine puddles of soiled exercise areas. An initial investigation therefore involved designing the aisles in one compartment with a transverse slope of 3%, so that the cows' urine could drain rapidly away from the floor into a central gutter. The floors were also cleaned using an automatic manure scraper twelve times a day to enable unhindered drainage. This resulted in dry and comparatively clean floors. Initial measurements showed that ammonia emissions of the compartment with the sloped floor were around 20% lower than in the reference compartment, which did not have a gradient. The clean, dry floors also help to improve claw health and housing hygiene.

A second experiment investigated the effect of feeding stalls. The cows are standing on a slightly raised feeding area with partitions. Since there are hardly no faeces and urine on the platform, this reduced the heavily soiled area of the housing system. The aisle behind the feeding stalls could be frequently cleaned using a manure scraper without disturbing the cows while they were feeding. Initial results showed that ammonia emissions fell by between 8% (in summer) and 19% (in autumn).

Needs-based feeding reduces ammonia

Feeding strategies to reduce ammonia emissions were subsequently investigated. The researchers compared two common feed rations with differing nitrogen levels. The formation of ammonia is directly related to the quantity of unused nitrogen that cows excrete, particularly via urine. The results showed that balanced, needs-based feeding without nitrogen surplus can significantly reduce ammonia emissions.

A further experiment was intended to show whether the cows emitted less enteric methane if their diet is supplemented with linseed. However, the linseed supplement only decreased methane levels marginally, both when emissions were measured at herd level in the experimental dairy housing for emission measurements and also at individual animal level in respiration chambers. On the other hand, the oil-containing linseed did increase the amount of omega-3 fatty acids in the cows' milk.

Further information:
www.nrp69.ch

Recommendation

Exploiting the potential to reduce ammonia

The project demonstrated that there is huge potential to reduce ammonia emissions in dairy husbandry. The researchers recommend incorporating solid floors with a transverse slope into new dairy housings. The sloped floor allows a rapid drainage of nitrogen-containing urine. Moreover, the heavily soiled area of the housing can be reduced and dung removal improved by using feeding stalls. To fully exploit the potential to reduce ammonia, the recommendation is to combine these two structural measures.

Balanced, needs-based feeding also proved to be an effective strategy for avoiding ammonia emissions. The researchers recommend optimising the nitrogen efficiency of feeding by selecting the individual feed components. This measure can be implemented universally and without additional structural modifications.

To achieve the ambitious environmental goals of reducing ammonia and greenhouse gas emissions in agriculture, it is essential to develop and evaluate further structural and organisational measures as well as feeding strategies.