
Bakery by-products as feed ingredient for lactating cows increases milk production and may lower global warming potential.

An Italian case study shows promising results for adding bakery by-products as a feed ingredient to lactating cows' diet.

Italy has a high dependency on cereal import from non EU countries. It is challenging the sustainability of milk production.

“In particular, rising raw material prices, drought and the presence of mycotoxins in maize have prompted dairy farms to make changes in the feed ration composition of lactating cows”, says researcher Martina Pavesi, Research Fellow at the University of Milan in Italy.

Bakery by-products, former food that are no longer useful for human nutrition, may be part of the solution.

“Compared to corn meal, bakery by-products are characterized by a lower starch content, which is more digestible following cooking, and it has a higher content of lipids and sugars. They can thus replace corn meal as an energy source in the ration,” says Associate Professor Stefania Colombini at the University of Milan.

A circular diet including bakery by-products were more sustainable
Colombini and her colleagues have evaluated case studies on different cattle farms that use some sources of by-products in their diet. The most promising result was seen in a farm that changed from a

standard diet to a circular one, including bakery by-products. The cows in this case study farm were fed bakery by-products in their diets as energy source.

The researchers concluded that the circular diet were more sustainable, in terms of global warming potential (GWP) related to milk production. The milk production pr cow was also slightly higher. They calculated the impact both per kilogram fat and protein corrected milk and per individual daily diet, using Life Cycle Assessment approach (LCA).

“In Vivo trials where cows were fed a control diet or a bakery by-product diet support the findings from the case farm. The milk production of the cows who were fed bakery by-products was a little higher,” says Colombini.

She explains that the difference in nutrient profile has important consequences for cattle feeding, offering several advantages over traditional corn meal. The rapid fermentation of corn starch, can cause the dangerous ruminal pH-drop, known as ruminal acidosis. On the other side, the lower more digestible starch, along with higher simple sugar and fats, tends to release energy more gradually. This promotes a more stable rumen environment and better digestion of fibre.

Rumination trials indicate higher rumination activity

“The higher levels of lipid and sugars significantly increase the feed’s energy density. This is particularly advantageous for high-producing dairy cows or growing beef cattle that have very high energy requirements. Many bakery by-products are naturally rich in fats and sugars, which makes them highly palatable for cows,” says Columbini.

Rumination trials showed increased rumination time activity when cows were fed with the bakery-by products diet. Higher rumination activity usually promotes higher digestibility, especially with regards to fibre fraction, which in turn lowers GHG-emissions. The results of the trial also showed a tendency for an increase in fibre digestibility of cows fed the bakery by-products diet.

“Automatic measures of cows chewing activity shows higher chewing activity. The studies confirm that higher digestibility lowered the cows’ enteric methane intensity (g/kg milk), because of enhanced ruminal fermentation,” says Colombini.

Questions are raised about the access to bakery by-products in large scale, but the results so far are promising for looking at other by-products included in diets to dairy cows.

“The use of bakery by-products as animal feed offers high potential for global upscaling, especially in Europe, as a circular economy solution. However, large-scale adoption is constrained by the need to develop efficient, widespread collection logistics and maintain consistent nutritional quality. This practice would position Italy and Europe as leaders in reducing dependency on imported energy feed ingredients which is becoming a critical issue too,” Columbini concludes.



Master student Ruben Carminati is sieving the ration and leftovers, preparing diet for the cows with bakery by-products at the University of Milan “Angelo Menozzi” Experimental farm.



Adding bakery by-products as a feed ingredient to lactating cows' diet may increase milk production and lower global warming potential on farm level.

Dialogue with farmers and case studies from other countries

Dialogue and knowledge sharing are an important part of the CircAgric-GHG project. At the beginning of January 2024, the Italian researchers arranged workshops with private companies and farmers to explore opportunities and barriers to adopting circular practices in Italy. Case study farms received individual feedback on their LCA-score and got advises of how they can lower the GWP level from their farms.



Weight is measured using a hypsometer to observe any changes in weight throughout the trial.



The researchers collect samples of diets, leftovers, and individual ingredients from the feeding lane. These samples are then subjected to chemical analysis in the lab and digestibility tests. Additionally, feces and urine are also collected.



Each time the cows are milked by the robot, milk samples are collected. The quality of the milk is then analyzed to observe changes, for instance in protein or

lactose levels, which might occur due to changes in their diet.

Other relevant studies:

A. Kaltenecker, E. Humer, A. Stauder, and Q. Zebeli (2020) Feeding of bakery by-products in the replacement of grains enhanced milk performance, modulated blood metabolic profile, and lowered the risk of rumen acidosis in dairy cows. (<https://doi.org/10.3168/jds.2020-18425>) J. Dairy Sci. 103:10122–10135

A. Kaltenecker, E. Humer, C. Pacífico, and Q. Zebeli (2021) Feeding dairy cows bakery by-products enhanced nutrient digestibility, but affected fecal microbial composition and pH in a dose-dependent manner. (<https://doi.org/10.3168/jds.2020-19998>) J. Dairy Sci. 104:7781–7793

Khiaosa-ard R, Kaltenecker A, Humer E and Zebeli Q (2022). Effect of inclusion of bakery by-products in the dairy cow's diet on milk fatty acid composition. (<https://doi.org/10.1017/S0022029922000619>) Journal of Dairy Research 89, 236–242.

By: Anette Tjomsland Spilling.

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