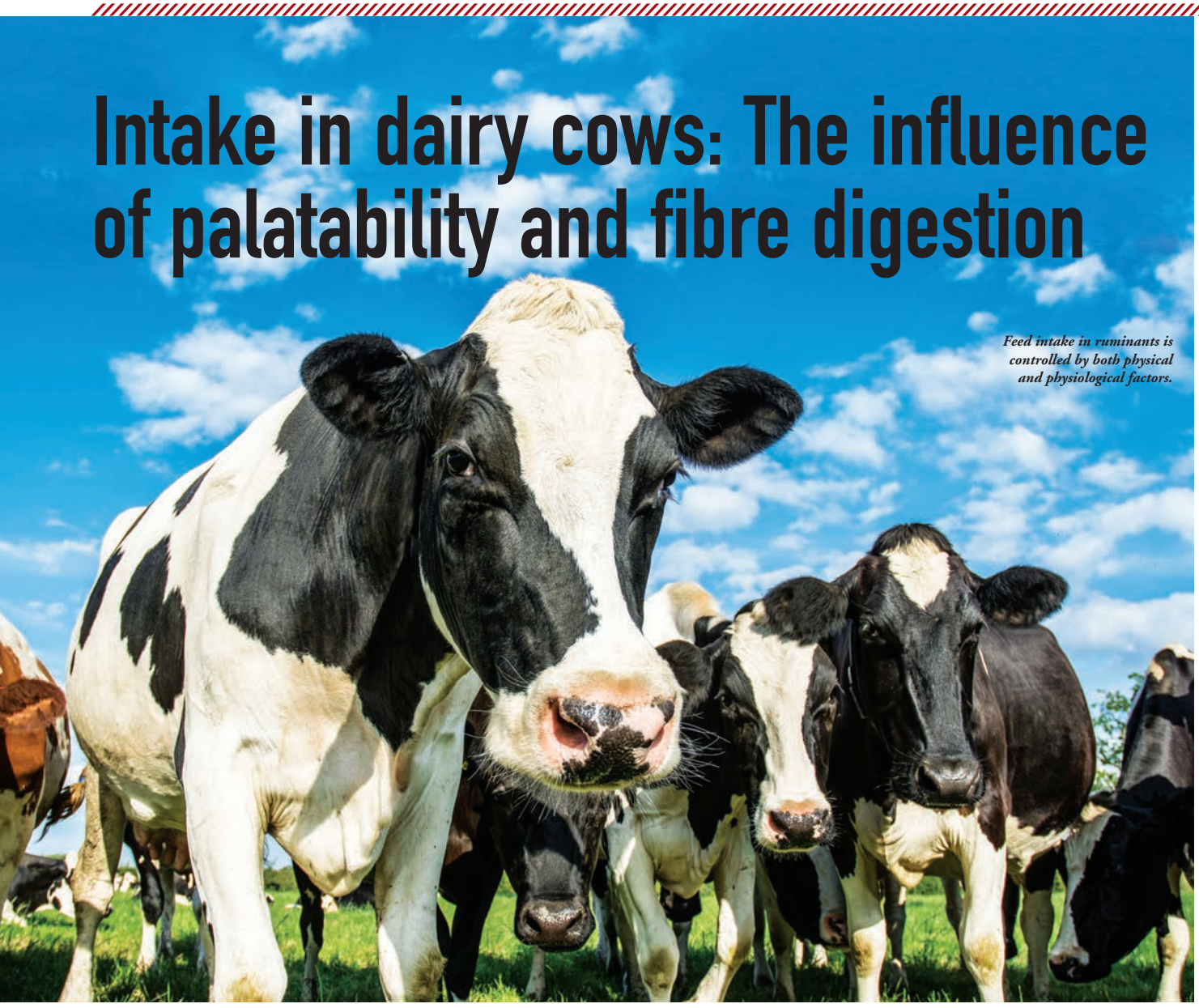
Intake in dairy cows: The influence of palatability and fibre digestion



Feed intake in ruminants is controlled by both physical and physiological factors.

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Cattle have been shown to be sensitive to the same principal flavours (sweet, sour, salt and bitter) as humans, but they have different sensation thresholds

THE GOAL OF all dairy operations in the world is to maximise milk production in a cost-effective manner while sustaining the health and welfare of the animals. To minimise production costs, it is important to maximise feed efficiency and nutrient utilisation with less toll on the environment, especially during early lactation. The intense genetic selection for higher milk production during the past decades has resulted in increased genetic potential for milk yield in the modern dairy cow. But high producing dairy cows in early lactation fail to consume enough feed to fulfill their energy requirements and consequently suffer from nutritional and metabolic disorders that compromise their health, fertility and longevity.

In ruminants, DMI (dry matter intake) is, in addition to metabolic constraints, a function of the balance between eating motivation, which is strongly related to palatability, on one hand and rumen capacity on the other. Therefore, increasing DMI could be achieved by either improving palatability or increasing rumen capacity or both. Rumen capacity is related to the rate of clearance of material, mainly fibre from the rumen, which is the summation of both rates of degradation and passage. A fast rate of removal of fibre from the rumen increases its capacity to hold more material and delays rumen fill signals, encouraging the animals to consume more and thus have a higher DMI. Palatability is mainly a function of flavour and taste, which arise from certain compounds in the feed, especially water-soluble carbohydrates (WSC).

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Feed intake in ruminants is controlled by both physical and physiological factors. Physical factors include the cow’s rumen holding capacity (rumen fill) for dry matter or fibre. Physiological factors include end

products of rumen fermentation and intestinal digestion, rumen pH and osmolality, hormones secreted by the endocrine system such as insulin and glucagon, or secreted by the gastrointestinal tract such as gastrin and cholecystokinin. As energy density in the ration increases and fibre content decreases, physical factors pose less of a constraint on feed intake and physiological factors become more important in regulating feed intake. Therefore, the intake of low to medium quality ration may be limited mainly by distension and fill of the rumen, but when high quality ration is fed, additional factors, mainly physiological, may become important in signalling satiety and consequently limit intake.

"Sweeteners have potential to enhance palatability at high concentrations and thus increase DMI."

Within this framework, many factors related to rumen function could influence DMI. Anything that increases the rate of breakdown of fibre in the rumen would be expected to increase the throughput. Moreover, anything that contributes to the dilution of fermentation end products in the rumen would also be expected to increase intake at a given concentration level that would signal satiety. Improving microbial activity in the rumen, loosening plant cell wall structure, increasing saliva flow and the frequency and strength of rumen contractions could positively influence DMI.

Palatability is a major determinant of what and how much a healthy non-starved ruminant will eat. Palatability includes all oral pharyngeal and olfactory sensations arising from the feed such as flavour, taste, smell and texture but does not include any of its post-ingestive effects. Flavour and taste provide the primary information for food preference, tolerance or rejection, while visual and olfactory messages function as secondary re-inforcers. Cattle have been shown to be sensitive to the same principal flavours (sweet, sour, salt and bitter) as humans, but they have different sensation thresholds. Feeds with strong bitter, salty and sour flavours were avoided by cattle or had reduced intakes, indicating that these flavours negatively influenced the palatability of the feed. Numerous authors have reported the relation between sweet feedstuffs and increased intake in ruminants.

Ruminant animals also have the ability to associate flavours with post-ingestive consequences.

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Ruminant animals have the ability to associate flavours with post-ingestive consequences. Such associations with a certain flavour can ultimately cause the formation of feed preference or aversions. In many studies, when feed was flavoured and paired with a toxin, animals rejected the flavour even when it was no longer paired with the toxin. In one study, sheep were fed feed flavoured with orange or aniseed with or without a toxin. Aversion to the flavour paired with toxin persisted up to 60 days after the final administration of the toxin. In another study, sheep that had previously been administered LiCl, a non-lethal poison, with a feed containing a specific flavour avoided that flavour even when it was no longer paired with LiCl. On the other hand, when a certain flavour was infused with additional energy, lambs consumed more of the same feed even when it was no longer laced with the additional energy. Similarly, when paired with a certain flavour with a positive nutritional consequence, such as a large amount of starch, lambs would consume high amounts and that preference for that flavour persisted even when there was no longer a nutritional benefit and the starch content had decreased.

Based on the above studies, combining palatability additives with rumen modifying additives could offer a great opportunity to modulate and improve DMI in dairy cows and other ruminants. Palatability additives would provide improvement in the sensory characteristics of the ration, while rumen modifiers would improve and optimise rumen function and fibre digestion sending positive post-ingestive signals and re-enforcing the positive effect on DMI. This idea of working simultaneously on palatability using flavour enhancers or GIT modifiers can contribute greatly to improving intake when changes in the ration are introduced or when novel feeds and/or relatively unpalatable feeds are used.

In a recent study, the effect of adding Aroma Fruity or Gusti-Plus (Nutriad's specialty flavours for dairy cows) to pelleted compound feed fed in the milking robot at three farms was evaluated. The experiment consisted of three phases, the first phase of four weeks was considered as the blank measurement with no flavour added to the pellet, the second phase of eight weeks, flavour additive was added (at 350 g/tonne feed) to the pelleted feed fed in the robot, and the third phase of four weeks was considered as the post aroma period. Average 305 milk yield at those farm ranged from 9,000 to 10,000 kg/cow, and cows were fed a maize-based ration (>60 per cent maize silage in the basal ration). The results showed that in phase two, when Aroma Fruity or Gusti-Plus were added to the compound feed fed in the robot, the number of milkings per cow increased from 2.4 to 2.8 times per day. This 15 per cent increase in milking number led to 0.9 kg increase in milk yield per cow per day and 6 per cent improvement in feed efficiency. In another study, the effect of adding Nutri-Ferm Prime (Nutriad's specialty DFM) to different rations based on alfalfa and grass hay or grass and maize silage led to seven to ten per ent improvement in NDF and OM digestibility and six per cent improvement in feed efficiency. ■