

Hydroponic forages can feed the rumen

by Alvaro Garcia

EVERY successful ruminant nutritionist knows that a healthy rumen is the key to animal well-being and high productivity. The axiom “feed the rumen first, then the cow” is a key tenet of cattle nutrition.

There are two critical interacting components to maintain rumen health: rumen contents and motility. Contents include ingested feed in various degrees of degradation, gases of fermentation, and a liquid medium teeming with microorganisms. Rumen motility are the constant contractions that mix the contents, send rough feed forward to be re-chewed (rumination), and allow a soup of broken-down particles, nutrients, and microorganisms to continue back in the digestive tract.

Working in a symbiotic relationship, contents also supply gases and rough fibrous material that stimulate the contractions for rumen motility. Adequate contractions, in turn, allow for movement of the contents and much needed saliva through chewing that buffers the solution. How can the mix of forages be adjusted to enhance this process?

Hydroponic cultures

Feeding and rations continue to evolve. With that in mind, let's compare the composition of hydroponic forage to grass pasture and alfalfa hay (see table). The rapid degradable protein and carbohydrates supplied by hydroponic forages can provide beneficial microbial growth in the rumen. Their availability to the microorganisms is as follows: protein and sugars first, followed by starch, and then degradable structural carbohydrates.

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Hydroponic forage looks visually just like a grass pasture sample that is in exceedingly early, vegetative growth. If we compare their chemical composition, however, it would be like comparing corn grain to corn silage! In addition, farmers never allow their cows to graze pastures at this stage of development, because it would damage the stand irreparably.

Since the plants are only six days old when harvested, they have been accumulating energy-yielding nutrients for later growth. Its concentration in sugars and starch are three and six times higher than pasture, respectively.

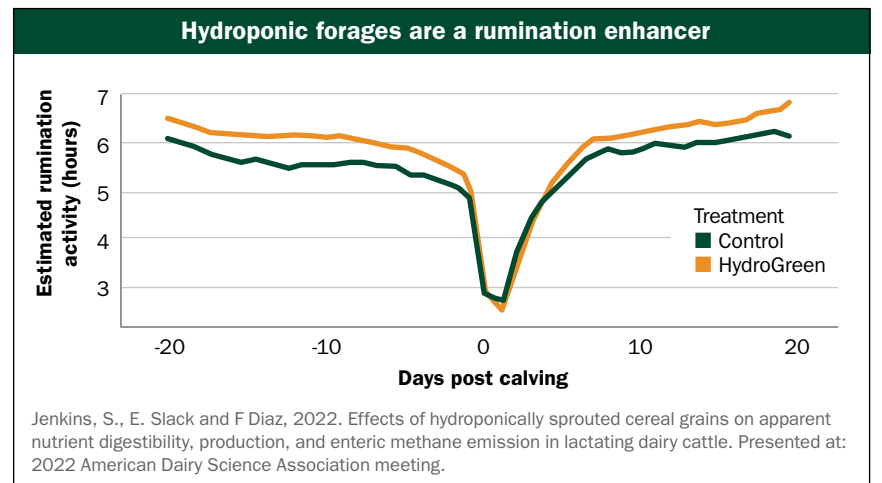
The opposite happens to its concentration on the less digestible structural carbohydrates represented by acid detergent fiber (ADF), and neutral detergent fibers (NDF). Furthermore, because of its early developmental stage, the digestibility of the fiber fraction is also higher.

Not just a feedstuff

Hydroponic forage is a rumination enhancer that exerts a positive effect on the rumen environment (see figure). The high concentration in rapidly degradable protein and carbohydrates increases the growth rate of the microbial population, which in turn improves the degradation of comparatively less digestible feedstuffs.

University of Illinois' researchers observed that the highest microbial protein yield occurred when a rapidly digestible protein source accompanied a rapidly digestible carbohydrate source. Earlier research at West Virginia University also showed that as the nonstructural carbohydrate (NSC) to rumen degradable crude protein ratio widened from 1.9 to 8.9, microbial yield fell curvilinearly from 34.2 to 10.3 grams of bacterial nitrogen per kilogram of digested dry matter.

Fiber degradability, microbial pro-



Composition of hydroponic forage, fresh forages, and alfalfa hay (%)

	Protein	Sugars (WSC)	Starch	ADF	NDF
Hydroponic forage	17.8	39.8	19.8	9.9	21.9
Alfalfa hay	20.8	6.9	1.4	33.4	42.9
Grass pasture*	21.0	9.6	3.4	28.5	49.1

*Highest observed values for protein, sugars, and starch, lowest values for ADF and NDF.

tein synthesis, energy absorption, and rumen pH can increase with the inclusion of sugars in a diet balanced for starch. With dietary inclusion of hydroponic forage at 15% of the dietary dry matter (DM), a dairy cow eating 57 pounds of dry feed consumes approximately 9 pounds of hydroponic forage (DM basis). From the composition in the table, the amounts of protein, sugars, and starch contributed by the 9 pounds of hydroponic forage are approximately 712 grams, 1,592 grams, and 792 grams, respectively.

A dairy cow ration consumed at 57 pounds of dry matter, with 16% protein of 60% degradability, adds to the diet 2,500 grams of degradable protein. Overall, 9 pounds of hydroponic forage can supply 2,384 grams of NSC (1,592 + 792); the remaining 49 pounds of the 57-pound ration contain approximately 25% NSC (sugars + starch) or 5,500 grams. The 49 pounds of the ration plus the contri-

bution of the 9 pounds of hydroponic forage represent 7,884 grams of non-structural carbohydrates (2,384 + 5,500). The ratio of NSC to degradable protein is then 7,884/2,500, or roughly 3.2. These results are remarkably close to the findings by University of Illinois' researchers of the optimum ratio necessary to maximize rumen microbial yield production, which is 1.9.

The inclusion of hydroponic forage at 15% of the diet dry matter improves intake and rumination as a result of the maximized microbial yield optimized by the NSC/degradable protein ratio. Because of its effects on modulating microbial growth and, in turn, fiber digestion, hydroponic forages have the effect of a rumination enhancement additive. 🐄

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