The AGRiliq range of products are scientifically developed, high density liquid protein and energy stock supplements ideal for inclusion in intensive feedlot and dairy rations or as a base for extensive pasture feeding.

AGRiliq Science of Stockfeeds

What is AGRiliq ?

The **AGRiliq** range of concentrated feed supplements have been developed by Gehrke Grains & Transport, with support from the Commonwealth Department of Agriculture, Fisheries and Forestry, to bring a new level of sophistication to matching the nutrient availability to its utilization rate in the rumen.

As a rule, the digestibility of a nitrogen source is strongly related to its solubility and to the complexity of the molecules it is bound in. This pattern is seen in how quickly a small molecule like urea is utilised by rumen microbes, compared to the indigestibility of the large polymers in overcooked distiller's grains (or DG) for instance. The nitrogen is not released from such complex molecules in a timely way for the rumen microbes to convert it to protein.

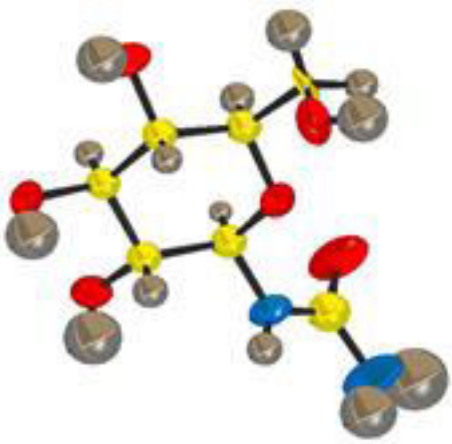
However, even though small molecules like urea are completely digestible, their utilisation rate by rumen microbes must compete with the uptake and excretion rates of the animals and protein value can again be lost.

Therefore, one of the keys to the efficient production of protein in rumens is to supply the nitrogen in a form where it is released at a rate suitable for the microbes to maximise its conversion. Molecules more complex than urea but smaller than the DG polymers are ideal.

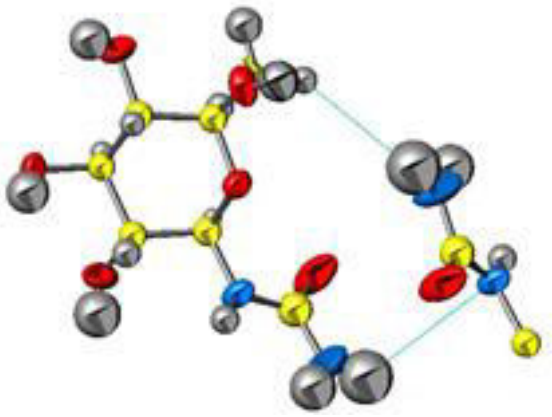
In the conventional thermal production of bound urea feeds, the nitrogen undergoes a series of Maillard reactions to form large complex molecules, much like in the DG products.

AGRiliq manufacture is not a thermal process and therefore does not promote the formation of these very large, indigestible molecules. The **AGRiliq** process instead produces a range of small nitrogenous carbohydrates (glucosyl ureide) and soluble amines. The rumen microbes can metabolise these molecules as a combined but moderated source of both protein and energy to minimise excretion loss.

AGRiliq products are based on a unique glucosyl ureide molecule and a glucosyl ureide – urea complex. The molecule is manufactured from molasses and urea. Part of the urea also undergoes complex reactions with the molasses to form nitrogen heterocycle compounds and formamide. **AGRiliq** is specifically designed to safely deliver non-protein nitrogen and glucose in a way matched to the demand of rumen microbes.



The molecular structure of ***AGRiliq* Basic**, a glucosyl ureide molecule.



The molecular structure of ***AGRiliq*** **Extra,**
a glucosyl ureide-urea complex.

The sugars in molasses are converted to glucose. This is the first step in manufacturing glucosyl ureide, but also significantly improves the energy value of **AGRiliq**, because of the more efficient utilization and uptake of energy products in the rumen. (The energy of molasses is approximately 11MJ/Kg DM. The energy of pure glucose is approximately 16MJ/Kg DM). In practical terms the energy of a molasses based urea blend with unconverted sugars is 7.5MJ/Kg DM. The energy of the same molasses based blend with sugars converted to glucose is 9.5 MJ/Kg DM (A 26% increase in energy value).

This allows for:

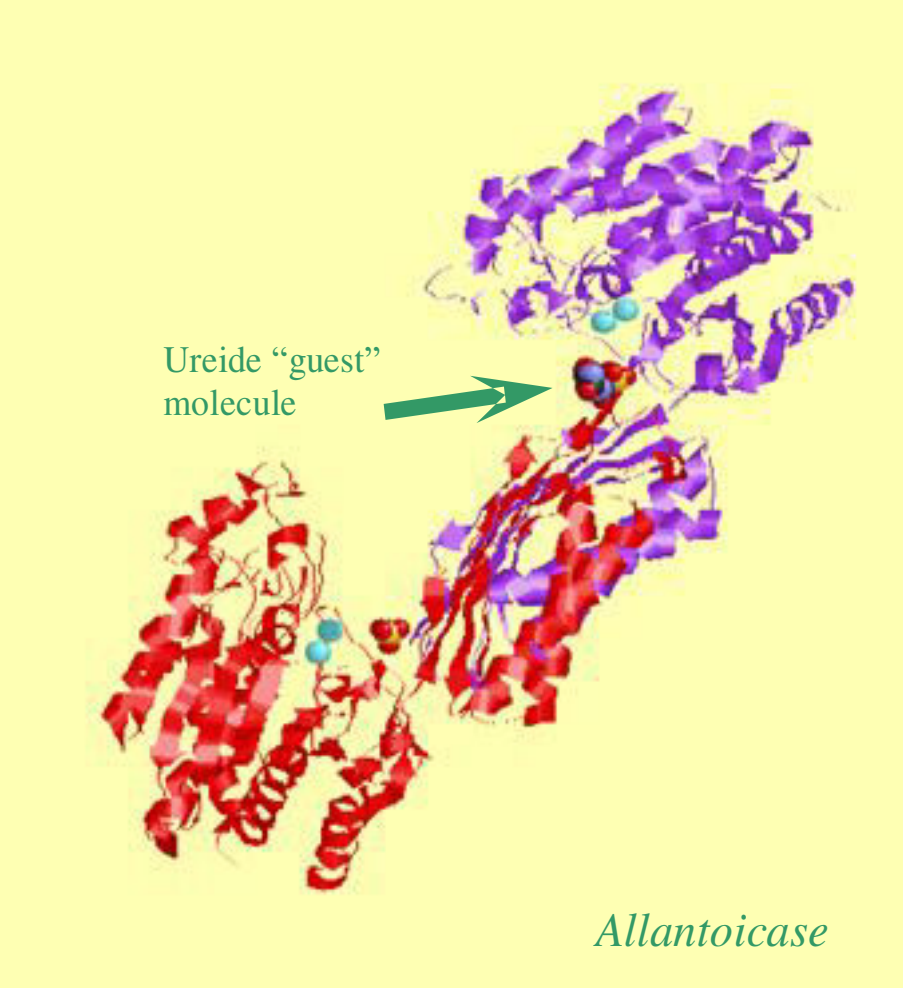
- Improved energy and protein density in the product. That is a more concentrated product;
- Better efficiency of use of energy with higher levels of propionic acid production in the rumen. Whilst the process is not fully understood, the outcome appears to be due to a slightly lower pH in the rumen (6.4 in animals fed on a diet of **AGRiliq** compared to pH 7.5 on a similar diet without **AGRiliq**) and a resultant reduction in methane producing micro-organisms which break down Propionic acid to acetic acid and methane. The lower pH is thought to be due to the more efficient utilisation of ammonia in the rumen caused by microbe populations being better adapted to the continual steady availability of ammonia from the slow continual breakdown of glucosyl ureide. Animals fed glucosyl ureide based **AGRiliq** products have shown a more efficient conversion of feed to total volatile

fatty acids (7% increase) and more importantly a 42% increase in the production of Propionic Acid in the rumen;

- Reduced Methane production.

The Biochemistry of AGRiliq ?

Non-protein nitrogen nutrition in ruminants proceeds via conversion to microbial protein by the rumen microbiota. The principal biochemical pathway for nitrogen utilisation is the degradation of urea to ammonia which is then utilised by other microbes to produce true protein.

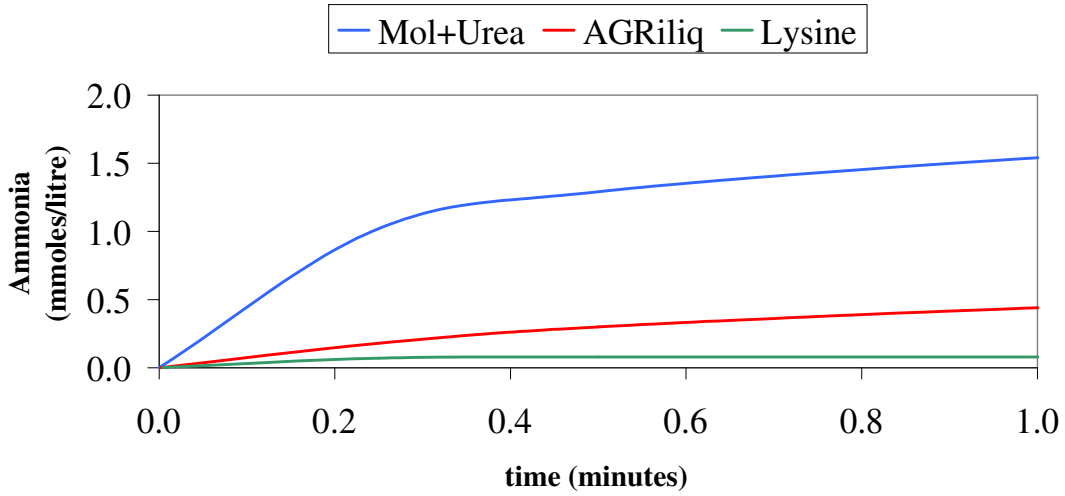


Urease is the most important enzyme utilised by rumen microbes to metabolise urea. However, this enzyme must firstly access the urea component from the **AGRiliq** *complex* before it can act. It subsequently experiences hindrance in processing the larger *ureide* component. The **AGRiliq** complex must first be cleaved to liberate ammonia. Another enzyme, *allantoicase,* pictured above hosting the *ureide* molecule must then come into play for further metabolism through the *urease* pathway.

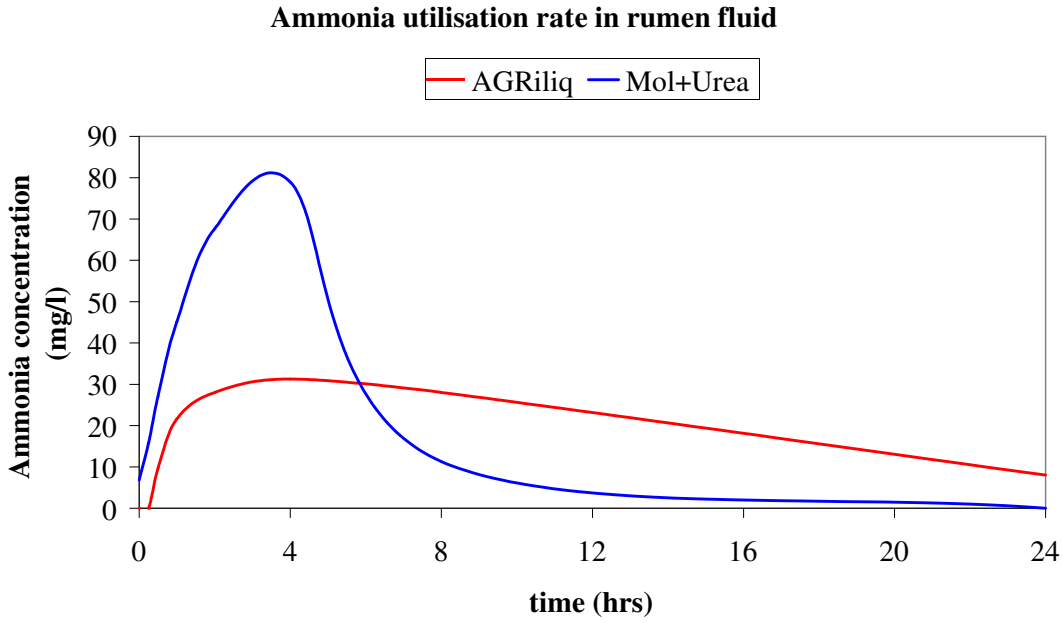
In high urea diets, the high ammonia levels produced as a result of rapid urease activity will actually inhibit these enzymes. Poor enzyme efficiency leads to poor nutritional efficiency. Therefore, a balance between ammonia production rate and its utilisation rate must be maintained in the ruminal ecosystem, in order to prevent urea toxicity.
Urea concentrations and urea delivery methods in ruminant feeds must be carefully controlled so as to avoid surges in urease activity. Simple admixtures with other nutrients in feed mixes do not fundamentally control ammonia production rates. As the graph following shows, urea in molasses is almost completely reacted within a minute.

When the urease-urea reaction rate is slowed to the point where the ammonia is utilised as it is produced within the rumen, then the risk of toxicity is negated. Since the urease enzyme is selective for the molecule, its activity can be effectively controlled by modifying the molecular structure of urea, as in **AGRiliq**. The graph following illustrates how ammonia production rate from **AGRiliq** has been moderated to more closely follow the behaviour of a true protein component (*i.e.* the amino acid lysine). As the graph below shows, these more complex sources of nitrogen are metabolised over a period of hours rather than minutes.

Urease activity plot showing AGRiliq's optimised ammonia production rate, matching true amino acid performance in contrast to that of urea in molasses.



The rate of ammonia production in rumens is ideally matched to its utilisation by the resident microbes. The graph following shows how the ammonia production rate by rumen microbes fed a molasses/urea blend outruns its utilisation rate, resulting in a sharp spike and risking urea toxicity. In contrast, **AGRiliq** gives a steadier ammonia production rate much better matched to the rumen's ability to use it, rather than excrete it. **AGRiliq** continues to provide rumen microbes with a steady feed supply over extended periods, which gives it a distinct cost benefit over other products.



In the same vein, glucose is liberated with the urea, providing the necessary energy matched to these biochemical process demands. The microbial protein conversions of the liberated urea and ammonia are therefore made more effective and excretion losses will be lower. The animal makes more efficient use of the nutrient value when its availability is matched to its utilisation rate.

Animals fed **AGRiliq** products for 6 months showed:

- No build up of microflora capable of rapid break down of **AGRiliq**, ensuring they were not adapting to it;
- A rumen population that was more efficient at the utilization of urea, thought to be due to the stable "homeostatic" nature of the rumen;
- Qualitative increases in beneficial Volatile Fatty Acids (VFA's).

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Australian Government
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