Lecture 7

NON-PROTEIN NITROGEN (NPN) MATERIALS

The NPN part of the feed includes amides, nitrates, nitrites, Urea (feed and fertilizer grades), uric acid and a number of other ammonia compounds. Thus, NPN could be defined as nitrogenous feed nutrient that are not bound together by peptide bonds and are found within or outside the animal's body system. They may be found in forage plant especially when immature pasture is fed to the animals. In developing countries, crop residues are fed as supplements to ruminant animals with traces of urea and ammonium sulphate. All NPN's generate ammonia in the rumen which enters the liver and finally converted to urea.

RUMEN AMMONIA POOL

Ammonia is derived from most of the NPN feedstuffs and also when the proteins in feed stuffs are metabolized by ruminants. The level of nitrogen in the rumen builds up progressively and it is determined by the solubility of the nitrogen source. In most cases, it reaches a peak at about 3 hrs post-feeding. Experiments have also shown that nucleic acids are converted to ammonia in the rumen. This ammonia which all together now form a pool inside the rumen is usually lost through the following channels:

1. By incorporation into microbial cells to generate microbial protein which will pass out of the rumen
2. By absorption through the rumen wall
3. Some are freely lost into the rumen fluid.

The rumen ammonia pool under normal condition is very small but it turns over rapidly. The quantity of ammonia entering the rumen is dependent on the following:

1. The degradability of the protein source.
2. The solubility of the protein source
3. The method and extent of supplementation of the feed.

It has been established over the years that very small amount of ammonia flows out of the rumen. By implication therefore, most of the ammonia will normally be absorbed by the reticulo-rumen wall while the excess will be incorporated into the microbial protein. Thus, to

sustain the ruminant animal, there will be the need to ensure that urea is continually made available in the rumen. The various forms of urea supplementation for animals on low quality diet include:

1. By spraying urea solution on the feed
2. By using urea blocks
3. By oral administration - this could be in liquid form put in a bowl and allow the animals to drink over a period of time (maximum 3 days).

Some of the ammonia produced in the rumen may also be absorbed in the abdomen/small intestine but ultimately, ammonia is sent to the liver where it is converted to urea. Excess of its post-metabolism would be sent out of the system as urine. In maintaining the ammonia level in the rumen, saliva plays a key role because;

1. It receives urea from the liver and
2. Such urea is recycled back into the mouth and back to the rumen.

It should be noted however, that urea derived from saliva may not be enough to sustain the animals hence the need for supplementation from time to time. Urea is also recycled into the blood and when quantified, it is called Blood – Urea level and this is normally used in assessing the quality of a feedstuff. Studies have shown that when animals are on low quality straw-based diet, it becomes meaningful to supplement with urea. In supplementing with urea, possible benefits include:

1. Increasing level of feed intake
2. Improved nitrogen balance value
3. Availability of protein or nitrogen in the rumen
4. Improved nutrient digestibility.
5. Improved general productivity of the animals.

The urea in the rumen is mostly recycled via the blood and saliva. The blood for instance, passes back an equivalent of about 0.5 – 2.3g of N per day while saliva recycles only about 0 – 0.5g/day. In the case of long time feed deprivation and consistent intake of low quality diet, the urea recycled from the saliva becomes unimportant because it is unable to sustain the animal. This therefore, calls for urea supplementation.

UREA UTILIZATION IN LIVESTOCK FEEDING

It has been known for quite a long time that urea can be recycled and used as a source of nitrogen for the rumen microorganisms.

(1) Urea is used in ruminant feeding both as fertilizer grade as well as feed grade. It can be administered through feed along with other feed ingredients in a compounded ration

(2) Urea can also be given as liquid nitrogen i.e. it could be dissolved in H_20 and offered as drinking water to the animals.

(3) It could also be constituted as urea-molasses multi-nutrient feed block held together by a binder. The animal by abrrection licks off urea from the block. Experiment over the years have shown that urea could be utilized as whole ingredient to feed at levels between 1% - 5% which defines a save utilization level. Although, some other studies recommended higher levels. For instance, Onwuka and Akinsoyinu (1989) recommended 10% level of urea while Leng and Preston (1980) recommended 10 – 15% level. When urea is used as a component of feed block, the level of urea may be as high as 40%.

UREA TOXICITY

The use of urea as a nitrogen source is not without its adverse effects. Abuse of urea leads to production of excess ammonia which usually ellicit neurological symptoms which result in the derangement of brain metabolism. Excess consumption of urea can be caused by:

1. Insufficient mixing of urea in compounded feed
2. Licking of urea in feed trough which lead to high concentration at the base.
3. Excessive consumption of urea from feed lots already exposed to rain water because the urea block is soften and dissolves in water. The inability of ruminant animals to handle urea can be trace to animal dysfunctional liver. Animal which have been fasted for long time also manifest urea toxicity. Note that urea on its own is not toxic. Its metabolic product (NH_3) is responsible for the observed toxicity. Additionally, at pH of rumen, urea diffuses very quickly via the rumen wall from where it is sent to the liver and excess of it excreted as urine. When the level of NH_3 that goes to the blood is high, it passes from there to the brain and therefore, various symptoms of ammonia toxicity manifest. The recent explanation for this is that when ammonia concentration is high in the rumen,

some proportion diffuses into the abdominal cavity and from there via the lymph drainage goes to the jugular vein. In effect, the liver is by-passed and the brain is affected resulting in brain derangement. Urea toxicity is reflected as:

1. Reduced growth
2. Reduced lactation- although, this does not usually produce clinical symptoms
3. Reduced feed intake.

Despite these adverse effect, the reasons why urea utilization is still being encouraged in ruminant feeding system include :

1. The reduced cost of urea as nitrogen source. This is mainly because little quantity of it is required unlike the conventional feed ingredient.
2. The readily soluble nitrogen it produces.
3. It results in increased feed intake, nutrient degradation as well as increased productivity of the animal.
4. The ease with which urea can be used and administered to the animal.
5. The ease with which rumen microbes are able to degrade urea.

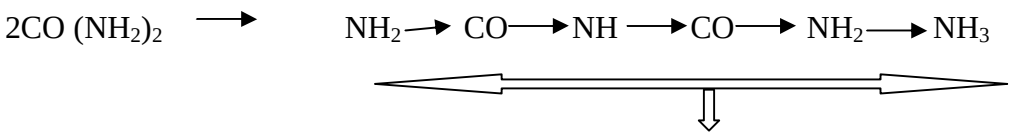
ANTIDOTES TO UREA TOXICITY

When the negative effect of urea toxicity sets in, the different curative and preventive measure to use are:

1. Infusion of dilute acid into the rumen which helps to reduce the rumen $_{P}$H.
2. Inclusion of sulphur in urea based diets/ feed stuffs.
3. Ensure that urea is properly mixed in urea containing feed.
4. Ensure that urea is intermittently supplied as urea solution
5. Adhere to the use of low levels of urea alwals (1-5% level)

BIURET

Another form of NPN which has some merit in ruminant feeding is biuret. It is a compound derives from the condensation of two urea molecules. It has some merit over most other source of NPN because of its solubility and slow rate of degradation. It is an ammonium salt source which readily releases ammonia for microbial action in the lumen.



Since, it is slowly degraded in the rumen; it is able to bring about a slow but continuous source of ammonia. It is non-toxic. So, large amount of it can be safely consumed by animal without complication. Degradation of biuret in the animal's body system is brought about by an enzyme **biuretase**. However, when soluble carbohydrates are mixed and fed along with biuret, the energy is inefficiently utilized. Some disadvantages of biuret as nitrogen source are,

1. Biuret is quite expensive costing as much as 8 times equivalent quantity of urea.
2. The biuretase enzyme needed for biuret degradation is not authomatically built up in animals system. Sometimes, it may require up to 6 months for a young ruminant to build up biuretase.
3 When the young animal grows up, the biuretase so built up still requires about 6 months to stabilize.

POULTRY DROP LITTER

Poultry litter as NPN is very readily available in poultry producing areas where at times it may constitute a nuisance to the environment. In such areas, the ammonia given out is usually pungent and the odour is well recognized. The efficacy of poultry litter as NPN source depends on the quantity and quality of the bedding materials. Where the poultry litter is undiluted and collected directly, it tends to be supportive of the ammonia (NH_3) production, and is usually higher than when wood shaving or straws are used. Poultry litter mainly consists of URIC ACID which is degraded by rumen microbes to yield ammonia (NH_3) and it could be a very rich source of ammonia for both livestock and industrial utilization. There are however, health considerations as to why a product (faeces) of one species of livestock should be used to feed another livestock.