

Uses of NPN compounds in Ruminants

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What are NPN Compounds ?

TOTAL PROTEIN = True Protein + Non-Protein Nitrogen (NPN)
(CRUDE PROTEIN)

1. True Protein:- Made up of amino acids

Estimated by “**Stutzer’s reagent**” (Copper sulphate, glycerol, sodium hydroxide)

2. NPN (Non-protein nitrogen):- Such compounds who supplies nitrogen other than in form of protein are called NPN compounds.

Examples- Urea is the most commonly used NPN compound .

➤ Biuret , ammonium acetate, Glycine etc

TABLE 2. - NONPROTEIN NITROGEN SOURCES FOR RUMINANTS

	Formula	Nitrogen Content	Protein equivalent ¹
		<i>Percent</i>	
Ammonium acetate	CH ₃ CO ₂ NH ₄	18	112
Ammonium bicarbonate	NH ₄ HCO ₃	18	112
Ammonium carbamate	NH ₂ CO ₂ NH ₄	36	225
Ammonium lactate	CH ₃ CHOHCO ₂ NH ₄	13	81
Biuret	NH ₂ CONHCONH ₂ H ₂ O	35	219
Dicyanodiamide	NH ₂ C(:NH)NHCN	67	419
Glutamine	NH ₂ CO(CH ₂) ₂ CHNH ₂ CO ₂ H	19	119
Glycine	NH ₂ CH ₂ CO ₂ H	19	119
Urea - pure	(NH ₂) ₂ CO	46.7	292
Urea - feed grade ²	-	42 - 45	262 - 281
Oilseed meals ³	-	5.8 - 8.0	36 - 50

¹ Nitrogen × 6.25. –

² Feed grade urea is diluted with varying amounts of materials to prevent lumps forming.

³ Includes cottonseed, soybean, linseed, coconut and similar meals from which the oil has been extracted.

Protein metabolism in Ruminants

- Ruminants have this unique ability to metabolise the dietary Nitrogen for synthesis of protein within the rumen.
- Protein provide the amino acids needed for maintenance functions.
- Feed Protein are degraded by microorganisms in Rumen via amino acid into ammonia (NH_3) and branched chain fatty acids.
- The rumen microbes convert this ammonia along with a carbohydrate source (energy source) into Microbial Protein .
- Microbial protein is further degraded down to free amino acid in small intestine.
- This amino acid is available for the use to animal .

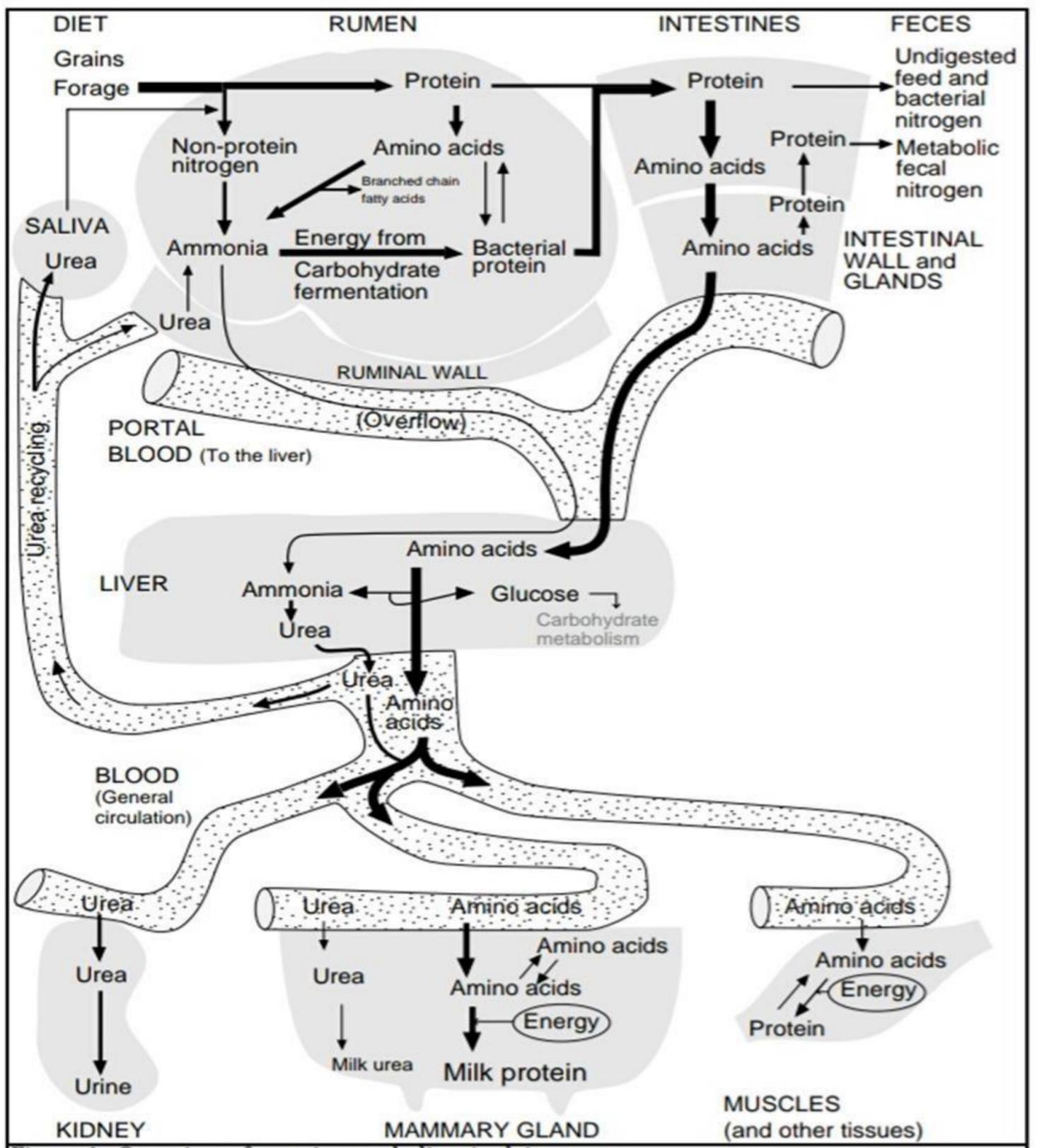
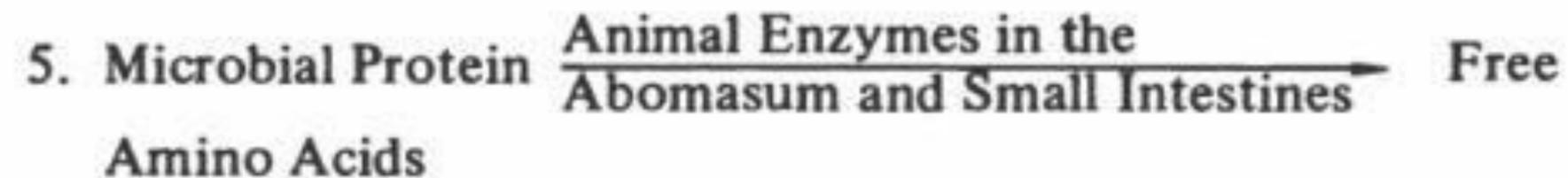
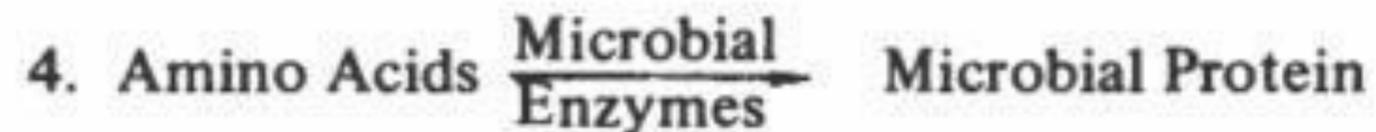
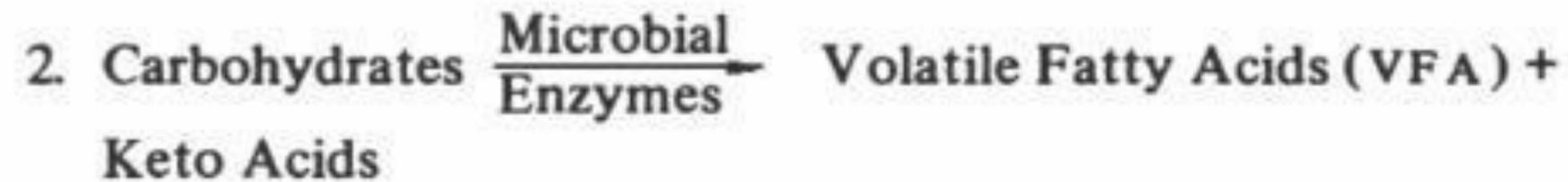
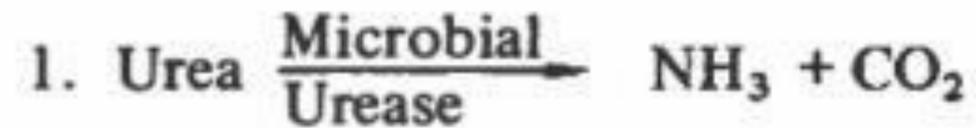


Figure 1: Overview of protein metabolism in dairy cows

Role of NPN in Ruminants nutrition

In ruminants, the central component for the synthesis of protein is NH_3 .

- The ammonia can be derived from metabolism of feed Protein or directly from NPN compound
- Urea is the most commonly used NPN .
- The role of urea can be best explained as follow -



6. Free amino acids are absorbed from the small intestine and used by the host animal.

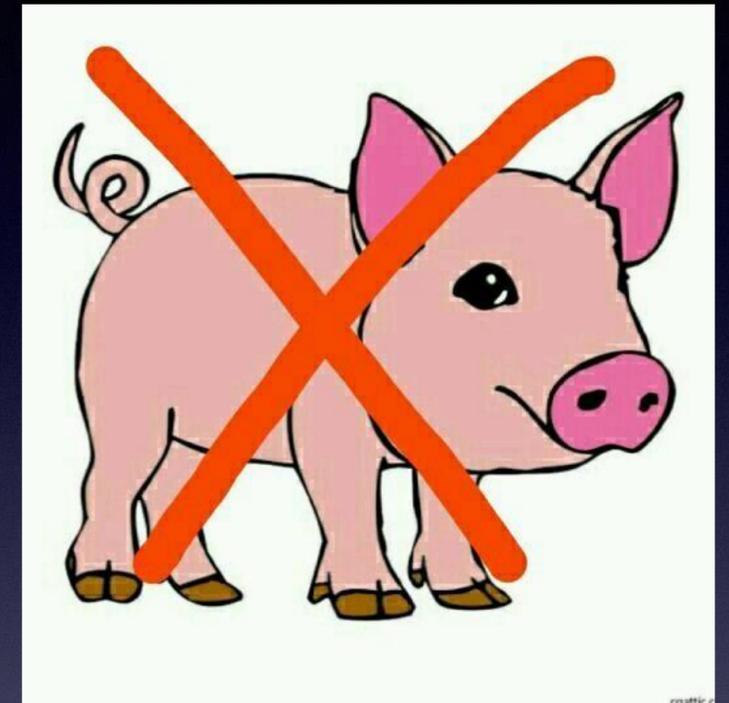
Feeding guidelines of NPN

- While NPN does serve as a cheaper alternate of protein for ruminants, it should also be kept in mind that NPN are not true protein.
- Alone NPN feeding can not replace the whole protein requirement.
- NPN feeding does require some of the guidelines to be followed strictly.

These are

- ✓ Add NPN with high energy feed such as grains/molasses and mix thoroughly.
- ✓ Introduce NPN ration slowly as 2-3 week period is necessary for rumen bacteria to achieve maximum utilisation of NPN.
- ✓ Use NPN only when additional protein is necessary in the ration . The crude protein should not be more than 12 percent in the ration.
- ✓ Add maximum 1% NPN in concentrate mixture.

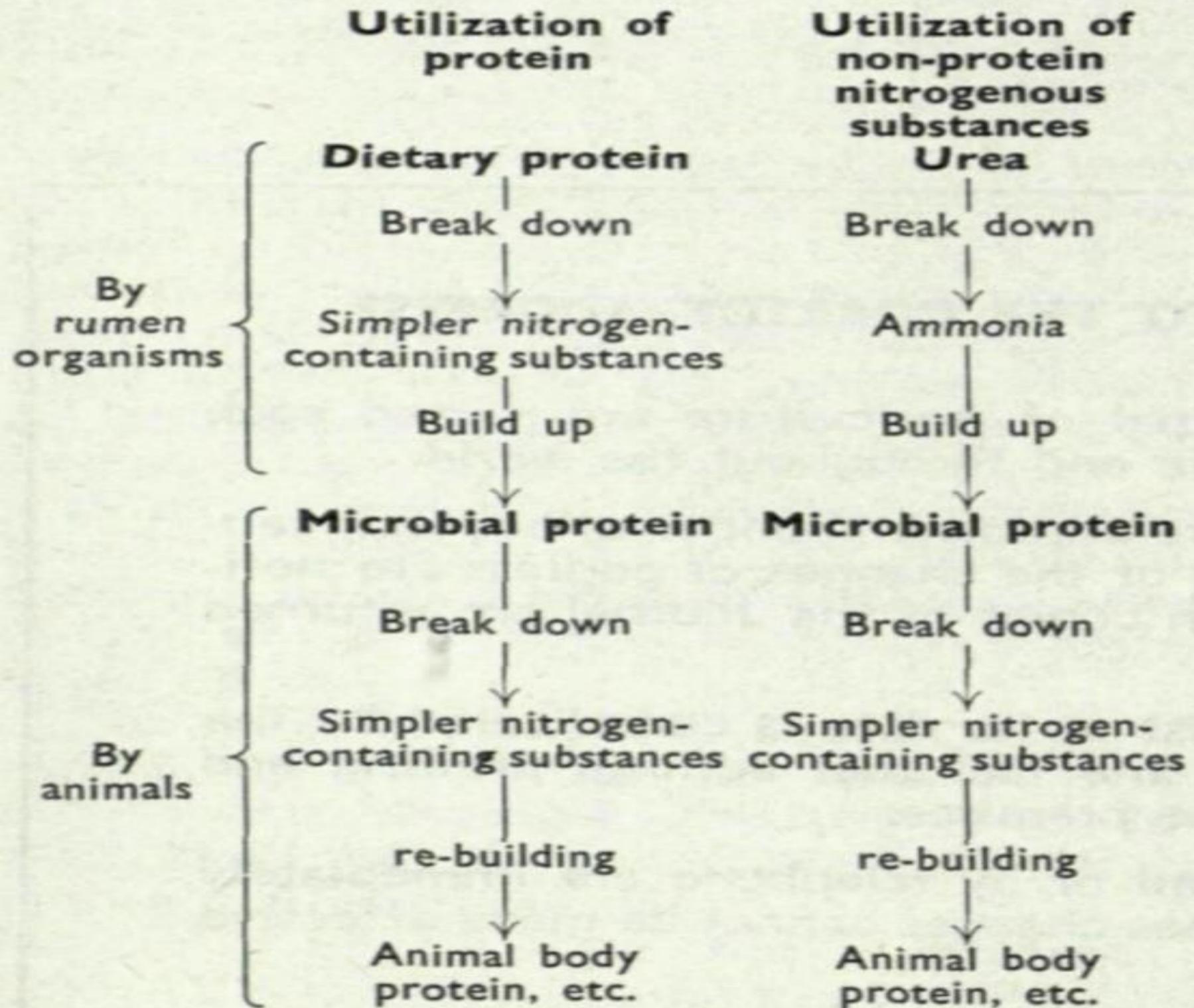
- ✓ Make sure that no more than 1/3rd of the total ration protein equivalent comes from NPN.
- ✓ NPN should not be given to monogastric animals like pigs , poultry etc.
- ✓ NPN should not be fed to calves below 6 months of age because of under developed rumen.
- ✓ Ensure adequate amount of water during NPN feeding.



UREA



- Urea was discovered in 1773 by Rouelle and its composition was established by Prout in 1818.
- It's a white compound with bitter taste for Ruminants.
- Having 46% Nitrogen.
- One kilogram of urea can furnish as much as 2.92kg of protein.
- When Urea enters the rumen it is rapidly dissolved and hydrolyzed to ammonia by bacterial urease.
- $\text{Urea} \rightarrow \text{NH}_3 + \text{CO}_2$



Factors affecting Urea utilization

The efficiency with which urea is utilized and the amount of protein that can be replaced by urea have been found to depend on -

1. **Effect of level of protein:** On low protein ration (Less than 12%) , urea can be utilized as a substitute for dietary protein.
2. **Effect of carbohydrates:** Urea is well utilized when it is fed with starch or cereal grains, as it provides energy to the bacteria.
3. **Level of Sulphur: N:S:: 10:1**

Methods of urea feeding

1. Urea in concentrate mixture

- ✓ level of urea should not exceed 1% in concentrate mixture
- ✓ urea can replace 1/3rd of protein on Nitrogen basis.

2. Urea treatment of wheat straw

- ✓ urea treatment enhances the digestible crude protein content of wheat straw upto 3% .

Method of urea -ammoniation:

4 kg urea dissolved in

40 litre water

Spray uniformly over 100 kg straw or bhusha

**Preserve the treated material under air tight condition
using plastic sheets**

For

3 weeks in hot season

4-5 weeks in cold season.

Benefits of Urea-Ammoniation:

Increases the protein content

Rice straw	9%
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wheat Bhusha	10%
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- Improves the palatability of straw
- Improves the digestibility of straw
- Better rumen degradability
- Preservation of high moisture material preventing mould attack.
- Relative inexpensive

3.Uromol

- ✓ It is prepared by boiling urea with Molasses in the ratio of 1:3 for 30 minutes.
- ✓ It contains 36% DCP and 70% TDN .

4.UMMB

- ✓ UMMB stands for Urea Molasses Mineral Block .
- ✓ UMMB is a method for slow releasing urea , which checks the proper amount of urea given per day .

- ✓ In this method the urea is fed in the form of licks to the cattle .
- ✓ The primary objective of UMMB licks is to provide supplementary nutrition to the dairy animals kept in the village on straw and crop residue .



Ingredients	Example I (%)	Example II (%)
Molasses	45	40
Urea	15	5
Mineral mixture	15	3
Salt	8	2
Calcite powder	4	-
Bentonite	3	-
Cottonseed meal	10	-
Deoiled mahua seed cake	-	10
Wheat bran	-	20
Crushed maize	-	20

Precaution of urea feeding:

- Never feed to young animals below 6 months of age.
- Never cross the limit of 116 gram of urea for adult cattle and 10 g for sheep.
- Provide sufficient drinking water
- Uniform mixing of urea is essential to avoid urea toxicity.
- Avoid dietary inclusion of urea suddenly.
- Provide sufficient amount of soluble carbohydrate for efficient utilization of urea (e.g Molasses)

Urea Toxicity:

- ❖ Urea degrades to ammonia
- ❖ Ammonia utilized by rumen microbes to synthesize microbial protein.
- ❖ Microbial protein digested in small intestine to provide protein for animal use.
- ❖ Optimum ammonia concentration: **5-8 mg per 100 ml rumen liquor**
- ❖ Increased production of ammonia, it comes in blood and leads to ammonia toxicity.
- ❖ Above this level blood ammonia level rises
- ❖ **1mg ammonia/100ml blood (1mg/dl or 1mg%)- toxic**
- ❖ **3 mg ammonia/100ml blood(3mg/dl or 3mg%)- lethal**

Ammonia toxicity / Urea toxicity

Reasons:

- ✓ Feeding of urea at high level
- ✓ Poor mixing of feed
- ✓ Errors in calculating the amount of urea to add in ration
- ✓ Accidental over consumption of urea or urea containing products
- ✓ Lack of adequate amount of water
- ✓ Lack of soluble carbohydrate source

- ✓ Due to increased production of ammonia , it comes in blood and leads to ammonia toxicity.
- ✓ Usually 3 mg/dl ammonia in blood is considered lethal for the animal .
- ✓ Maximum amount of Urea to be given per day should not exceed 126 grams.
- ✓ In case of ammonia toxicity Glacial Acetic acid is given to lower the rumen PH .

Urea Toxicity:

Symptoms:

- ✓ Bloat
- ✓ Excessive salivation
- ✓ Respiratory difficulty
- ✓ Bellowing
- ✓ Convulsion

Treatment:

Drenching of 20-40 litre cold water (inhibit ureolytic activity)

Drenching of 4-5 litre of 10% acetic acid (binds ammonia).

Glacial Acetic acid is given to lower the rumen PH .

EXERCISE

A. Fill in the blanks -

- 1) central component for the synthesis of protein is ____ .
- 2) one kg of pure urea furnishes ____ kg of protein.
- 3) ____ is the most commonly used NPN compound.
- 4) Bacterial _____ acts on urea to degrade it in rumen.
- 5) Urea contains ____ % of nitrogen.

B. Write true or false against each statement

- 1) Ration high in digestible energy results in good urea utilisation .
- 2) Urea should not be fed to the calves below 9 months of age .
- 3) In ammonia toxicity the PH of rumen decreases .
- 4) Urea feeding can replace protein in monogastric.
- 5) Concentrate mixture contain 1% level of Urea .

C. Choose the correct answer

1.urea treatment enhances the digestible crude protein content of wheat straw upto-

a) 4% b) 3% c) 1% d) 5%

2. NPN compounds should not be fed to

a) pigs b) poultry c) Horse. d) all

3.Uromol is prepared by boiling urea with Molasses in the ratio of

a) 1:3. b) 1:2 c) 1:1 d) 3:1

4. NPN should be given in ration having crude protein content

a) 30% b) 12 % c) 40 % d) none

5.Total ration protein equivalent coming from NPN should not be more than

a) 2/3rd b) 1/3rd c) 1/4th d) none

Answers

A.

1. NH_3 , 2. 2.92 ,3. Urea , 4. Urease , 5. 46

B.

1.True , 2. False , 3. False , 4. False , 5. True

C.

1-b,2-d,3-a,4-b.5-b

**Thank
You**

