Unit 5

Nutrient Requirements and Ration Formulation

1. Balanced Ration and Its Characteristics
2. Nutrient Requirements and Methods
3. Feeding Practices for Cattle and Buffalo
4. Feeding Practices for Sheep and Goat
5. Use of NPN compounds in livestock feeding

1. Balanced Ration and Its Characteristics

Ration

A ration is the feedstuff offered for a given animal during a time period of 24 hours. The feedstuffs are give at a time or in proportions at intervals (diet)

A balanced ration is one that furnishes nutrients in such proportions and amount that it will properly nourish a given animal for 24 hours

Method of Ration Formulation

1. Pearson Square Method
(Single and double Pearson Square Method)
2. Algebraic Method
3. Thumb Rule Method
4. Linear Programming or Least-cost Feed Formulation or Computer Method
5. Hit and Trial Method

Computer-Formulated Rations: 'Least cost' ration/ Linear Programming:

'Least cost' ration:

- If a ration is balanced using a combination of ingredients with the lowest possible total cost, the resulting mixture is called a "least cost" ration.
- Linear Programming is the technique employed to calculate least- cost and profit-maximizing rations

Computation steps:

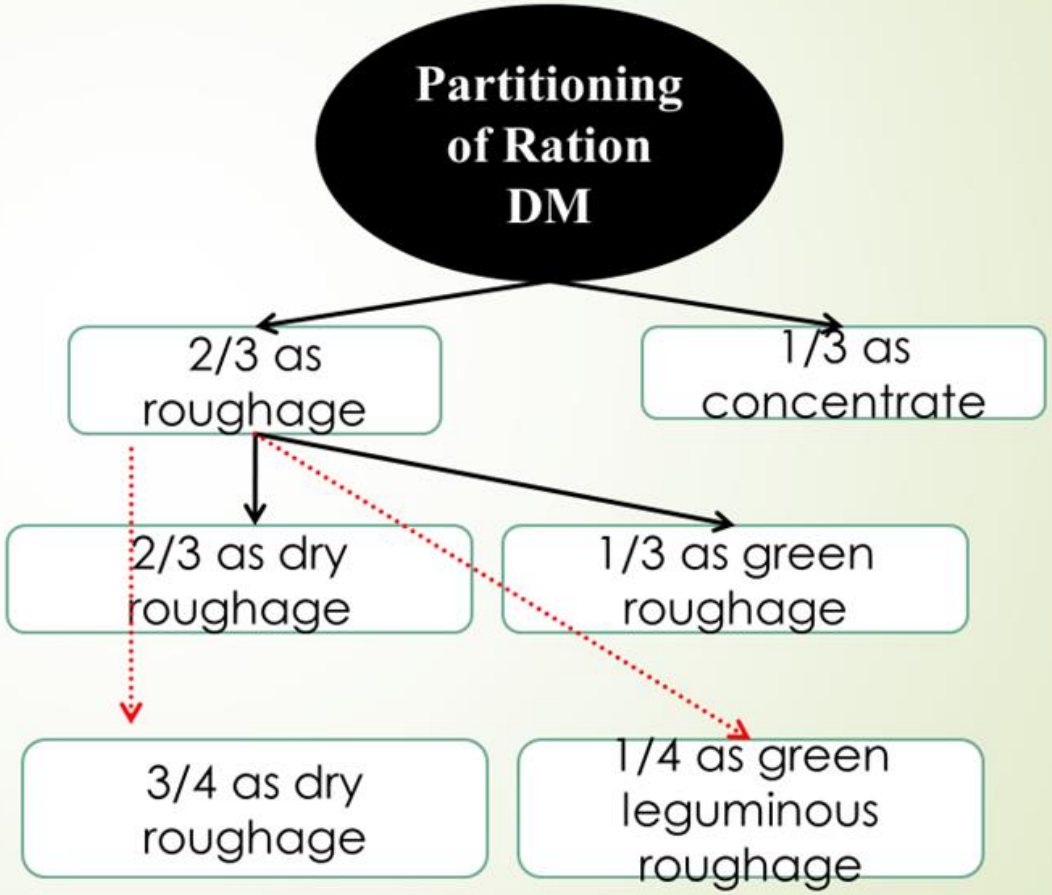
DMI calculation

Nutrient requirement calculation

Balance with available ingredient

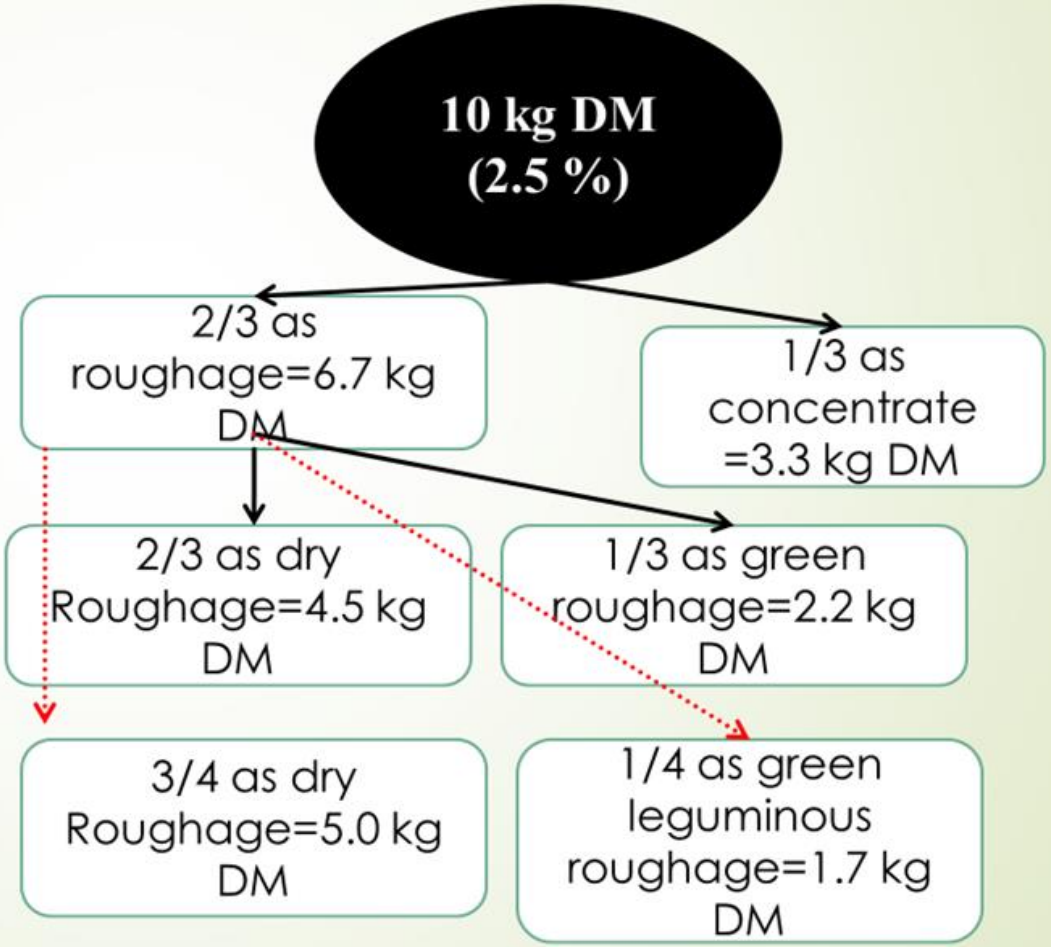
DMI Calculation

- DM requirement in indigenous cattle is 2-2.5 kg/100 kg BW (2-2.5 %).
- DM requirement in buffalo/crossbred cattle/exotic cattle is 2.5-3.0 kg/100 kg BW (2.5-3.0%).



Question: Calculate DM from different components of ration for a 400 kg Gir cow?

- DM requirement in indigenous cattle is 2-2.5 kg/100 kg BW (2-2.5 %).



1) A method of determining the least-cost ration using a series of mathematical equations.
JKPSC-2020

A) Pearson Square method
B) Algebraic method
C) Linear Programming
D) Two by Two Matrix method

2) Arrange the following activities stepwise in formulation of ration for dairy cattle **JKPSC-2020**

1) Calculate nutrient requirements of animal according to its production
2) Choose available feed ingredients
3) Manipulate each ingredient to match the supply and requirement of nutrients
4) Know the nutrient content and inclusion levels of feed ingredients
5) Calculate the nutrients supplied by a set weight of feed ingredients

A) 1,2,4,5,3
B) 2,4,1,3,5
C) 1,2,5,3,4
D) 4,2,5,1,3

3. Which technique is employed in computer analysis to calculate least cost ration? Uppsc 2022

a. Linear programming
b. Nonlinear programming
c. Curvi-linear programming
d. Integer-linear programming

4. Consider the following statement regarding ration formulation: **JKPSC - 2019**

1) Age, Pregnancy, milk Product and Physical activity must considered when formulating ration

2) It should contain all essential vitamins and minerals

3) It should contain balance of protein carbohydrates and fats

Which of the statements given above are correct?

(A) 1 and 2 only

(B) 1 and 3 only

(C) 2 and 3 only

(D) 1, 2 and 3

5. The collection period for digestibility trial of large ruminant should be (J&K 2012)

(A) 7-10 days

(B) 10-14 days

(C) 5-7 days

(D) 20-22 days

6. The technique employed to calculate least cost and profit maximizing rations is called as Mppsc 2019

(A) Trial and Error method

(B) Pearson's Square method

(C) Linear Programming

(D) Algebraic method

9. For determining the digestibility of a feed by conducting digestion trial in ruminants, the optimum length of 'preliminary period' followed is: Opsc 2013 -14

(a) One week

(b) Two weeks

(c) Three weeks

(d) 60 days

10. The amount of feed an animal needs to maintain its body mass and composition without any weight loss or gain: Opsc 2021-22

(A) Balanced ration

(B) Ideal ration

(C) Maintenance ration

(D) Production ration

11. The feed allowed for a given animal during a day of 24 hours is called as Mppsc 2021

(A) Ration

(B) Diet

(C) Balanced feed

(D) Complete feed

2. Nutrient Requirements and Methods

A. Energy Requirement For Maintenance

Rubner: BMR varies with body size = metabolic body size = surface area law

•Scaling Exponents:While Rubner initially suggested a scaling exponent of 2/3 for the relationship between metabolic rate and body mass, subsequent studies (notably by Max Kleiber) found a scaling exponent closer to 3/4. This ongoing debate highlights the complexity of metabolic scaling across different species

For dairy cattle and buffalo:

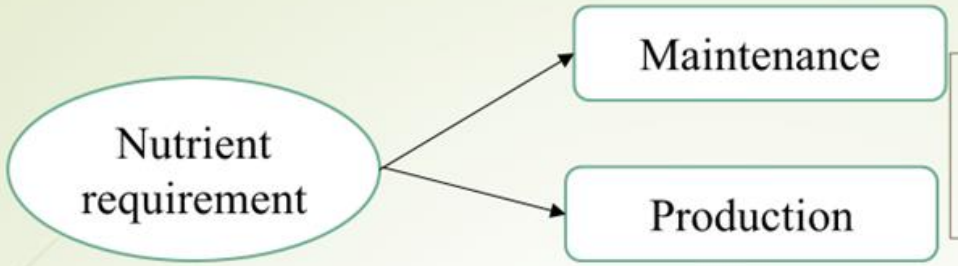
- NEm = 80 W0.75 (Kcal/day)
- MEm = 133 W0.75 (Kcal/day)
- TDNm = 35.2 W0.75 (g/day)

B. Protein Requirement For Maintenance

1. Feeding trial = minimum dietary protein to maintain body weight
2. Nitrogen balance method- equilibrium = minimum constant N-output
3. Factorial method = EUN+MFN

EUN mg/day = 146 W0.72 kg = Function of Body size

- Indian cattle = 0.020 g/kg BW
- Bos taurus = 0.289 g/kg BW
- Metabolic fecal nitrogen = MFN = Function of DMI
- Indian cattle = 0.35 g/100 g DMI
- Buffaloes = 0.34 g/100 g DMI



"Nutrient requirements of cattle and buffalo" (ICAR-2013)

Maintenance Requirement of cattle and buffalo

Body weight (kg)	DM (kg/day)	TDN (kg/day)	ME (Mcal)	CP (g/day)	Ca (g/day)	P (g/d)
400	8.64	3.27	11.82	436	18	8
450	9.72	3.58	12.94	476	20	9
500	10.8	3.88	14.04	515	23	10
550	11.88	4.18	15.10	553	25	11
600	12.96	4.47	16.15	591	27	12

Milk Production Requirement

Fat%	DM (kg/day)	TDN (kg/day)	ME (Mcal)	CP (g/day)	Ca (g/day)	P (g/d)
Cow						
4	0.510	0.330	1.20	96	3.2	1.8
Buffalo						
6	0.670	0.440	1.58	124	4.8	1.8

- Calculate nutrients requirement of a Sahiwal cow with 450 kg body weight and yielding 10 kg of milk having 4% milk fat?

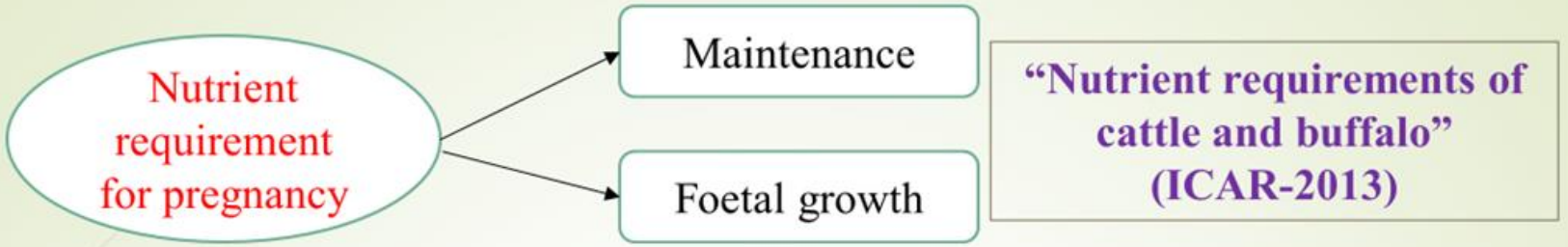
- Maintenance nutrients requirement of a Sahiwal cow with 450 kg body weight

Body weight (kg)	DM (kg/day)	TDN (kg/day)	ME (Mcal)	CP (g/day)	Ca (g/day)	P (g/d)
450	9.72	3.58	12.94	476	20	9

- Nutrients requirement for milk production (4% milk fat)

Fat%	DM (kg/day)	TDN (kg/day)	ME (Mcal)	CP (g/day)	Ca (g/day)	P (g/d)
Cow						
4	0.510	0.330	1.20	96	3.2	1.8

Body weight (kg)/fat %	DM (kg/day)	TDN (kg/day)	ME (Mcal)	CP (g/day)	Ca (g/day)	P (g/d)
Maintenance requirement						
450	9.72	3.58	12.94	476	20	9
Milk production						
For 1 kg milk with 4% fat	0.510	0.330	1.20	96	3.2	1.8
For 10 kg milk with 4% fat	5.10	3.30	12.0	960	32	18
Total						
	14.82	6.88	24.94	1436	52	**27**



Cow-Foetal growth

Month of gestation	DM (kg/day)	TDN (kg/day)	ME (Mcal)	CP (g/day)
6-7	0.85	0.64	2.30	169
7-8	0.99	0.74	2.67	216
8-9	1.13	0.84	3.05	263
Ca (upto 190 days=1 g/day; 190 days onwards=10 g/day)				
P (upto 190 days=1.5 g/day; 190 days onwards=6 g/day)				

Buffalo-Foetal growth

Month of gestation	DM (kg/day)	TDN (kg/day)	ME (Mcal)	CP (g/day)
6-7	1.0	0.80	2.76	203
7-8	1.2	0.90	3.21	259
8-9	1.4	1.0	3.66	316
9-10	1.5	1.1	4.11	373
Ca (upto 190 days=1 g/day; 190 days onwards=10 g/day)				
P (upto 190 days=1.5 g/day; 190 days onwards=6 g/day)				

2. Nutrient requirement for 7.5 months pregnancy

Month of gestation	DM (kg/day)	TDN (kg/day)	ME (Mcal)	CP (g/day)
7-8	0.99	0.74	2.67	216
Ca (190 days onwards=10 g/day)				
P (190 days onwards=6 g/day)				

DM (kg/day)	TDN (kg/day)	ME (Mcal)	CP (g/day)	Ca (g/day)	P (g/day)
10.71	4.32	15.61	6.92	29	15

Nutrient requirement for growth

"Nutrient requirements of cattle and buffalo" (ICAR-2013)

BW (kg)	Weight gain (kg/day)	DM (kg/day)	TDN (kg/day)	ME (Mcal)	CP (g/day)	Ca (g/day)	P (g/day)
70	0.2	1.6	1.04	3.76	263	<200 kg BW = 17	Young = 9
70	0.3	1.8	1.16	4.19	335		
70	0.4	1.8	1.28	4.63	406	200-300 kg BW =13	
100	0.2	2.9	1.33	4.78	288		
100	0.3	2.9	1.46	5.28	357		Adult=6
100	0.4	3.0	1.61	5.80	423	>400 kg BW = 8	
100	0.5	3.1	1.75	6.32	487		
100	0.6	3.1	1.90	6.84	549		

1. Read the following statements : **MPSC – 2019**

a. Energy is the most important nutrient to produce milk.

b. The energy needed depends upon the composition of milk.

Now state whether :

(1) Both the statements are correct

(2) Statement a is correct, but statement b is not correct

(3) Statement b is correct, but statement a is not correct

(4) Neither of the statements is correct

2. Dry matter intake of dairy animals should be Uppsc 2022

(a) 1% of body weight per day

(b) 0.5% of body weight per day

(c) 4% of body weight per day

(d) 10% of body weight per day

3. The dry matter requirement for cattle per 100 kg body weight is **Kerala PSC – June 2023**

a) 1.5 - 2.0 kg

b) 2.5 - 3.0 kg

c) 2.0 - 2.5 kg

d) 3.0 - 4.0 kg

4. Dry matter requirement for a cow weighing 400 kg, giving 10 liters of milk having 4-5% fat is **MPPSC 2023**

[A] 2 kg
[B] 4 kg
[C] 10 kg
[D] 20 kg

5. Maintenance D. M. total requirement of 400 kg crossed breed cows require: **OPSC 2018-2019**

(A) 5-7 kg
(B) 8-10 kg
(C) 11-13 kg
(D) 13-15 kg

3. Feeding Practices for Cattle and Buffalo

Feeding of calves

Best feeding practice for rearing a calf is to start feeding from the last **trimester of pregnancy** then in the pre-ruminant **period** and **post ruminant period**

- Colostrum: within 2 hours @ 1/10th BW (17% protein, IgM, IgA, IgG)

Importance of Colostrum feeding

- Provide passive immunity
- Laxative effect hence avoid constipation
- Excellent source of Vit A, D, & E

FEEDING SCHEDULE OF COW CALVES (0-3 months): WHOLE MILK+ SKIM MILK+ CALF STARTER

Age(days)	Colostrum (lit)	Milk(lit)	Skim milk(lit)	Calf starter(g)
1-3	$1/10^{th}$ B.wt	-	-	-
4-7		$1/10^{th}$ B.wt		-
8-14		$1/10^{th}$ B.wt		-
15-21		$1/10^{th}$ B.wt		Little
22-35	-	$1/15^{th}$ B.wt	-	100
upto 60 days		$1/20^{th}$ B.wt	$1/25^{th}$ B.wt	250
61-90		$1/25^{th}$ B.wt	$1/15^{th}$ B.wt	500

Calf starter-

- solid feed consisting of ground grains, oil cakes, animal protein supplement, brans, dried skim milk, soymeal, whey, mineral mix, and butyrate.
- For accelerated growth and early weaning of the calves.
- **contain 23-26% CP, 18-19.5% DCP and 75% TDN**
- Started at 7-10 days (14 days)
- for proper rumen development

Challenge feeding/steaming up

- Feeding/supplying extra nutrient in high yielding animals to challenging them to produce at their maximum potential is known as challenge feeding.
- Challenge feeding starts 2 weeks prior to the expected date of calving.
- Feeding of extra concentrate at 500 g/day and increase it gradually to a level of 500-1000 g/day/100 kg BW.
- Challenge feeding will condition digestive system for the increased quantity of feed to provide sufficient nutrients to initiate lactation on a higher plane.

Thumb rule

Feed stuffs	Zebu / indigenous cow	Crossbred cow/ buffaloes
Straw	4.00 kg	4.00-6.00 kg
Concentrates mix		
Maintenance	1.25 kg	2.00 kg
Pregnancy (last trimester)	1.25 kg	1.75 kg
Lactation	1.00 kg/ 2.5 kg MY	1.00 kg/ 2.0 kg MY

- 1 kg Concentrate mix = 10 kg green fodder
- Concentrate mixture = 20% CP, 65% TDN, 0.5-0.7% Ca and 0.3-04% P

BIS SPECIFICATIONS FOR COMPOUNDED FEEDS FOR CATTLE

S.No.	Characteristic Requirement	Type 1	Type 2
1	Moisture (max)	11	11
2	Crude protein (min)	22	20
3	Crude fat (min)	3.0	2.5
4	Crude fibre (max)	7	12
5	Acid insoluble ash (max)	3.0	4.0

NUTRIENT COMPOSITION OF COMMON FEEDSTUFFS

Ingredient	ME (Kcal/kg)	CP (%)	CF (%)	EE (%)	Ca (%)	P (%)
Maize	3309	9.2	3.0	3.8	0.25	0.40
Bajra	2950	12.7	4.0	3.0	0.13	0.72
Rice polish	2837	12.7	12.0	16.0	0.27	1.37
Wheat bran	1286	17.2	10.9	3.0	0.19	1.12
Soybean meal	2300	45.0	6.0	1.0	0.36	0.90
Groundnut ext.	2128	40-42	11.2	1.0	0.31	0.67
Fish meal	1834	43.1	2.5	6.0	7.16	2.5

Feeding high yielders:

- Energy: Feeding bypass fat
- Protein: Feeding bypass protein

  UDP = 8% of total diet protein%
- Fiber: 28-32% NDF
- Mineral mixture: 10g MM/ kg of milk production.
- Challenge feeding: steaming up (2 weeks prior to calving)

DCAD salt in pre-partum transition period = (-100 to -140 meq/kg DMI) maintain Ca homeostasis and help in avoiding milk fever

1. Crude protein and TDN content of calf starter should be **MPPSC 2022**

(1) 23 - 26 %, 75% (3) 13 -15 %;. 70 %

(2) 18 - 20 %, 70% (4) 6 - 8 %, 75 %

2. In high yielding animals, the important amino acid source for post rumen digestion is now considered as **MPSC 2011**

(1) Microbial protein (2) Microbial protein-non-ammonia-N

(3) Undegradable protein **(4) All the above**

4 Calf reared on milk in first and second week requires milk in amount: **UTTARAKHAND VO – 2024**

a) 1/10 body weight

b) 1/15 body wight

c) 1/20 body weight

d) 1/25 body weight

5 . The amount required as dry roughage (with sufficient legumes) for a cross bred cow weighing 400 kg is **JKPSC - 2019**

(A) 10 kg
(B) 6.5 kg
(C) 3.5 kg
(D) 4.9 Kg

7. From which day of age 'Hay' can be given to newborn calves ? Uppsc 2022
(a) 10th day
(B) 155 day
(c) 20th day
(d) 1 month

8. According to the thumb rule, 1 kg of concentrate mixture is required for every kg of milk yield in cows. Opsc 2013 -14
(a) 2.0
(b) 2.5
(c) 3.0
(d) 1.5

9. What should be the recommended crude protein content (%) in calf starter? PUNJAB 2022

a) 5
b) 10
c) 15
d) 22

10. Colostrum is fed to calves at the rate of RPSC 2019

(1) 20% of BW
(2) 15% of BW
(3) 10% of BW
(4) 5% of BW

11. Feeding colostrum within first two hours of the birth of new born is essential because **RPSC 2019**

(1) It is iron rich.
(2) It is Vitamin B Complex rich.
(3) It is rich in copper.
(4) Immunoglobulins

12. New born calf should get first colostrum from its dam within **PUNJAB 2021**

(A) 30 minutes after birth
(B) 12 hours after birth
(C) 24 hours after birth
(D) 48 hours after birth

4. Feeding Practices for Sheep and Goat

Comparative feeding behavior and digestive physiology in goats and sheep

Sno.	Characteristics	Goats	Sheep
1	Activity	Walk longer distance	Walk shorter distance
2	Feeding pattern	Browser, more selective	Grazer, less selective
3	Variety in feed	preferential	Less preferential
4	Salivary secretions	Greater	Lesser
5	Recycling of urea in saliva	Greater	Lesser
6	DMI for Meat	3%of BW	3%of BW
7	DMI for lactation	4-6% of BW	3%of BW
8	Digestion of coarse roughage Higher	Higher	less
9	Retention time	Longer	Shorter
10	Water intake/unit DMI	Lower	Higher

Dry Matter Intake:

- DMI = 70 g /kg $W^{0.75}$ (3.2% of BW)
- Meat goats: 3% of BW
- Dairy goats: 4-6% of BW

Maintenance:

- ICAR has taken 76 g/kg $W^{0.75}$ as DMI
- Nutrient requirement per kg metabolic body size are DCP 3.0 g and TDN 30 g

BW (kg)	DMI (g)	DCP (g)	TDN (g)	Ca (g)	P (g)
15	500	23	240	1.1	0.7
25	730	34	350	1.6	1.1
35	940	44	450	2.1	1.4
45	1125	53	540	2.5	1.7
55	1315	62	630	2.9	1.9

Growth:

For Growth- DCP req 0.34 g/g BW gain, TDN- 1.61g/g gain

BW (kg)	ADG (g)	DMI (g)	DCP (g)	TDN (g)
15	50	510	33	330
	100	645	43	420
	150	785	53	510
25	50	760	44	440
	100	915	54	530
	150	1070	64	620

Pregnancy

1.For pregnancy:

- DMI-92 g/kg W $^{0.75}$
- DCP requirement -5.55 g/kg W $^{0.75}$
- TDN requirement is -50.5 g /kg W $^{0.75}$

BW (kg)	DMI (g)	DCP (g)	TDN (g)	Ca (g)	P (g)
15	700	42	385	2.1	1.4
25	1025	62	564	3.1	2.1
35	1320	80	725	4.0	2.7
45	1590	96	875	4.8	3.2
55	1850	112	1018	5.5	3.7

2. For Lactation

- DCP requirement -45 g/kg FCM Over and above maintenance req
- TDN requirement is 345 g /kg FCM Over and above maintenance req
- FCM (3.5% fat): [(0.35 ×kg of milk) + (18.57 x kg of fat)]

BW (kg)	Milk yield (kg)	DMI (g)	DCP (g)	TDN (g)	Ca (g)	P (g)
25	0.5	968	56	523	4.8	3.2
	1.0	1290	79	695	6.4	4.3
35	0.5	1155	66	623	5.8	3.9
	1.0	1470	89	795	7.3	4.9
45	0.5	1320	75	713	6.6	4.4
	1.0	1640	98	885	8.2	5.3
55	0.5	1490	84	803	7.4	4.9
	1.0	1805	107	975	9.0	6.0

Feeding of Kids

- within 1 hour the kids should get colostrum continued for 3 days.
- After the 3rd day up to weaning, feed them with milk at 2 to 3 times a day ($1/6^{th}$ BW up to 1 month and then $1/8^{th}$ of BW in the 2nd month and 1/10th-$1/12^{th}$ BW during the 3rd month).
- At 1 month of age: Young ones should be provided with concentrate mixture (starter feed)

Creep Feeding

- for nursing kids for rapid growth
- accelerated growth or early weaning management program
- palatable and easily digestible concentrate mixture
- If grasses and cereal fodder—DCP 18% & TDN 75%
- If leguminous fodder –DCP 12% and TDN 70%
- Offer feed @ 50-100gm/animal/ day, and as gradually they eat more, reduce the milk allowance.
- Creep feed started from 10^{th} day up to 90 days of age or pre-weaning period for faster gain

Feeding Schedule for a Kid from Birth to 90 days

Age of kids	Dam's milk or cow milk (ml)	Creep feed (g)	Forage, green/day (g)
1-3 days	Colostrum 300 ml, 3 feedings	-	-
4-14 days	350 ml, 3 feedings	-	-
15-30 days	350 ml, 3 feedings	A little	A little
31-60 days	400 ml, 2 feedings	100-150	Free choice
61-90 days	200 ml, 2 feedings	200-250	Free choice

FEEDING OF SHEEP

Maintenance

- DCP: 2.97g / kg $W^{0.75}$
- TDN: 27.3 g / kg $W^{0.75}$

- **Nutrient Requirement for Maintenance**

BWt	DCP (g)	TDN (g)
20	28	258
40	48	434
60	65	588

DM requirement- 3.0-3.5% Bwt, DMI decrease as the animal matures

Flushing:

•The practice of increasing the nutrient intake of ewes and improving body condition prior to and during breeding.

•In this 25% more nutrients above maintenance needs has to be given 2-3 weeks prior to breeding season
Purpose – to increase ovulation rate and hence the lambing rate

Pregnancy:

- Nut req slowly increases during first 15 weeks of pregnancy as embryo grows and req during final 6 weeks of pregnancy are elevated.

- Breeding ram and pregnant ewes (last 6 weeks) should be provided with 50% more nutrients than the maintenance needs.

Nutrient Requirement for Pregnancy

BW (kg)	DCP (g)	TDN (g)
25	80	580
45	135	903
60	155	1121

1. What is the recommended milk feeding schedule for kids during the 2nd month of age?

a) 1/6th BW

b) 1/8th BW

c) 1/10th BW

d) 1/12th BW

2. At what age should kids be provided with a concentrate mixture (starter feed)?

a) At birth

b) 2 weeks

c) 1 month

d) 90 days

3. What is the purpose of creep feeding in kids?

a) To reduce milk intake

b) To promote rapid growth and rumen development

c) To reduce forage intake

d) To replace milk completely

4. What is the DCP requirement for a finisher goat?

a) 10%

b) 5-6%

c) 7-8%

d) 12%

5. How much concentrate mixture should a lactating goat producing 2 liters of milk be given?

a) 200 g

b) 300 g

c) 400 g

d) 500 g

6. Which amino acid is the first limiting for wool growth and weight gain in sheep?

a) Methionine

b) Lysine

c) Arginine

d) Cysteine

7. When should flushing be done for ewes/does?

a) During early lactation

b) 2-3 weeks before breeding

c) After weaning

d) At the end of pregnancy

8. What is the DMI requirement for meat-producing goats?

a) 2% BW

b) 3% BW

c) 4% BW

d) 6% BW

9. Dry matter intake in Indian breeds of goats varies between RPSC 2019

(1) 10-25 g/w0.75 kg

(2) 20-40 g/w0.75 kg

(3) 35-80 g/w0.75 kg

(4) 100-140 g/w0.75 kg

10. How much more nutrients than the maintenance needs should be provided to breeding rams during breeding season ? RPSC 2019

(1) 30%

(2) 40%

(3) 50%

5. Use of NPN compounds in Livestock feeding

- **less expensive and readily available**

Non-protein Nitrogen Sources for Ruminants

- Urea (most widely used NPN compound in the ruminant diet)
- Ammonium acetate
- Ammonium bicarbonate
- Biuret
- Dicyandiamide
- Glutamine
- Glycine
- Oilseed meals

Urea as the Primary Source of NPN for ruminants:

- **most common**
- 100% degradability in rumen & contains 46.7% nitrogen
- **cheapest solid nitrogen source**.
- yielding up to 29.2 kg of protein per 100g of urea.

- only 1/3rd requirement of protein can be spared by urea
- Add NPN with high-energy feed such as grains/molasses
- Use NPN only when crude protein in the ration is below 13%
- 116 grams of urea for adult cattle and 10 g for sheep per day.
- Uniform mixing of urea is essential to avoid urea toxicity.

1. What is the primary nitrogen-containing compound used as a non-protein nitrogen (NPN) source for ruminants?
    - **a) Urea**
    - b) Ammonium bicarbonate
    - c) Biuret
    - d) Glycine
2. How much nitrogen does urea contain, making it an effective NPN compound in ruminant diets?
    - a) 20.5%
    - **b) 46.7%**
    - c) 32.5%
    - d) 12.8%
3. Which of the following should NOT be fed with NPN compounds like urea?
    - a) Cattle over 6 months
    - b) Dairy cows
    - **c) Preruminant calves and monogastric animals**
    - d) Ruminants consuming low-protein diet

1. How much urea should not be exceeded in adult cattle per day to prevent urea toxicity?
    - a) 50 grams
    - b) 90 grams
    - **c) 116 grams**
    - d) 150 grams
2. What is a symptom of urea toxicity in ruminants?
    - a) Lameness
    - b) Lack of appetite
    - **c) Bloat**
    - d) Excessive drinking
3. Which substance is commonly used to treat urea toxicity by lowering rumen pH?
    - a) Sodium bicarbonate
    - **b) Glacial acetic acid**
    - c) Magnesium sulfate
    - d) Calcium carbonate

1. How does the "Urea Molasses Mineral Block" (UMMB) method help in urea feeding?
    - a) Increases the energy content of the diet
    - **b) Provides a slow release of urea to prevent toxicity**
    - c) Prevents water loss in ruminants
    - d) Enhances protein digestibility of straw alone
2. What is the recommended proportion of urea in the Urea Molasses Mineral Block (UMMB)?
    - **a) 15%**
    - b) 5%
    - c) 25%
    - d) 10%
3. Which feed is essential for maximizing the utilization of urea in the rumen?
    - a) High-fiber feed
    - **b) High-energy feed like grains or molasses**
    - c) Low-energy roughage
    - d) Silage
4. What is the ideal nitrogen to sulfur ratio (N) to improve the utilization of urea in ruminant diets?

- a) 5:1
- b) 8:1
- **c) 10:1**
- d) 12:1