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AS PER NEP-2020 (2.0) SYLLABUS OF SHIVAJI UNIVERSITY, KOLHAPUR

Practical Handbook of

DOMESTIC AND PET ANIMAL FEED PREPARATION

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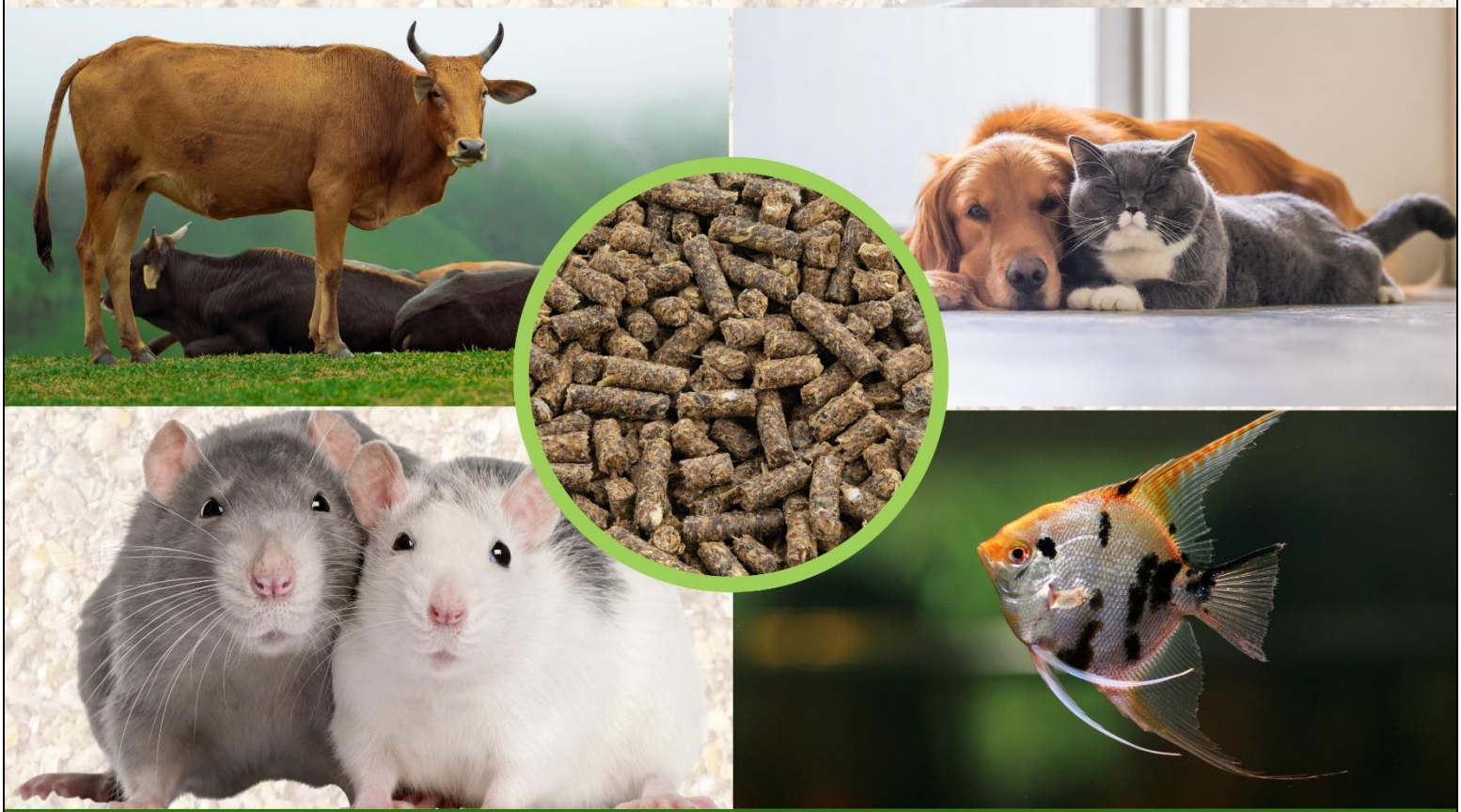

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(B. Sc. II Sem III)

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(IMPLEMENTED FROM JUNE 2025)

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PREFACE

The National Education Policy (NEP) 2.0 marks a significant shift in the Indian higher education landscape, emphasizing skill-based learning, interdisciplinary integration and employability. In keeping with this transformative vision, Shivaji University, Kolhapur has introduced a forward-looking curriculum for B.Sc. Part II, Semester III (Faculty of Science and Technology) under the Vocational Skill Course (VSC) – I (Major Specific) in Zoology, titled Domestic and Pet Animal Feed Preparation. This course is scheduled for implementation from June 2025.

Animal nutrition plays a pivotal role in the health, productivity and welfare of domestic and companion animals. With growing awareness around sustainable livestock management and the expanding pet care industry, the need for scientifically formulated and species-specific feed has become increasingly vital. This course aims to equip students with practical knowledge and hands-on skills in feed preparation, tailored to diverse animal categories.

The syllabus covers a comprehensive range of topics, beginning with the components of animal feed and progressing through the design and preparation of balanced diets for lactating and pregnant cattle and buffalo, goats, layer and broiler poultry ornamental and cultured fishes, pet dogs and cats and laboratory animals such as mice and rats. It also includes essential modules on microbial contamination testing and feed storage methods, ensuring students gain a holistic understanding of feed safety and quality control.

This handbook has been developed as a curriculum-aligned resource to support experiential learning and skill development. It integrates theoretical foundations with practical applications, fostering scientific thinking, ethical animal care and entrepreneurial readiness. Whether students aspire to careers in veterinary sciences, animal husbandry, aquaculture or agribusiness, this course provides a strong foundation for both academic and professional advancement.

We hope this handbook inspires learners to explore the dynamic field of animal nutrition with curiosity, compassion and scientific rigor, contributing meaningfully to the evolving landscape of animal welfare and sustainable agriculture.

- Authors

B. Sc. PART – II SEMESTER – III (NEP 2.0)

VOCATIONAL SKILL COURSE (VSC) – I (MAJOR SPECIFIC)

DOMESTIC AND PET ANIMAL FEED PREPARATION

Practicals:

1. Components of animal feed
2. Designing a balanced diet for lactating cow/ buffalo
3. Preparation of feed for pregnant cow/ buffalo
4. Designing a balanced diet for pregnant cow/ buffalo
5. Preparation of feed for lactating cow/ buffalo
6. Preparation of feed for goat
7. Preparation of feed for layer poultry fowl
8. Preparation of feed for broiler poultry fowl
9. Preparation of feed for ornamental fishes
10. Preparation of feed for cultured fishes (anyone fish)
11. Preparation of feed for pet dogs
12. Preparation of feed for pet cats
13. Preparation of feed for laboratory animals (mice/rats)
14. Test for microbial contamination in animal feed
15. Methods of storage of animal feed
16. Visit to animal feed formulation center and submission of report at the time of examination.

Animal Nutrition:

Animal nutrition is the science of providing the necessary nutrients in the correct amounts to animals to support their vital functions — including maintenance, growth, reproduction, lactation and immunity. It involves understanding the nutrient content of different feed ingredients and the specific requirements of various animal species to ensure optimal performance and well-being.

The primary nutrients required by animals include:

- **Carbohydrates** – main source of energy
- **Proteins** – for body building and repair
- **Fats** – concentrated energy and essential fatty acids
- **Vitamins** – regulate metabolic processes
- **Minerals** – for bone formation, enzyme activity and fluid balance
- **Water** – essential for life, involved in all body functions

Nutritional Requirements of Domestic and Pet Animals

Different animals have different nutritional needs based on species, age, weight, purpose (e.g., milk production, growth, companionship) and physiological status (pregnancy, lactation, etc.).

- **Domestic animals** (e.g., cattle, goats, poultry) require diets that support production goals like meat, milk or egg yield.
- **Pet animals** (e.g., dogs, cats, rabbits) need balanced diets to maintain good health, prevent disease and ensure a long, active life.

For example:

- A lactating cow requires high energy and protein for milk production.
- A growing puppy needs more protein and calcium for skeletal development.
- A laying hen needs adequate calcium for eggshell formation.

Feeding imbalances — whether underfeeding or overfeeding — can lead to poor growth, reduced productivity, reproductive issues or chronic health problems.

Importance of Feed Preparation

Feed preparation is the process of combining various ingredients in the right proportions to meet the animal's nutritional needs. This process plays a critical role in ensuring:

- Proper growth and development
- Efficient production (meat, milk, eggs, etc.)
- Improved reproductive performance

- Lower veterinary costs
- Better feed utilization and reduced wastage

Preparing feed at the farm or household level also allows for:

- Cost-effectiveness
- Use of locally available ingredients
- Flexibility in adjusting to the animal's changing needs

Importance of Formulated Feed in Animal Health

Formulated feed refers to scientifically developed mixtures of feed ingredients that are balanced for energy, protein, fiber, vitamins and minerals. These are particularly important for:

- Preventing nutritional deficiencies (e.g., rickets from calcium deficiency, anemia from iron deficiency)
- Boosting immunity and disease resistance
- Improving digestion and feed conversion efficiency
- Ensuring consistent performance in production animals
- Promoting healthy skin, coat and organ function in pets

Formulated feeds help avoid issues caused by feeding random or imbalanced diets — such as obesity, stunted growth, poor fertility or chronic digestive disorders.

Understanding animal nutrition and preparing balanced feed is essential for the sustainable management of both domestic and pet animals. Whether for productivity or companionship, proper feeding ensures optimal health, performance and welfare of animals. Feed formulation, when done correctly, serves as the foundation of effective animal care.

Vocational Skill Course (VSC) – I (Major Specific)

Domestic and Pet Animal Feed Preparation

This course, offered as part of the Zoology curriculum for B.Sc. Part–II, Semester–III under the NEP 2.0 framework, aims to develop vocational skills in Domestic and Pet Animal Feed Preparation. It provides students with practical knowledge of animal nutrition; feed ingredients and the formulation of balanced rations tailored to the needs of various domestic and pet animals. The course emphasizes understanding species-specific nutritional requirements, selecting suitable feed components and preparing affordable, health-supportive diets utilizing locally available materials. By combining theoretical concepts with practical training, the program enhances students' employability and fosters entrepreneurship opportunities in the fields of animal husbandry and pet care.

GENERAL TERMS WITH ABBREVIATIONS, FULL FORMS AND MEANINGS

Abbreviation	Full Form	Meaning
% CP	Percent Crude Protein	Percentage of protein present in total feed composition.
BCS	Body Condition Score	Visual measure of fat cover and nutritional status.
BW	Body Weight	Weight of animal used for ration and nutrient calculation.
CF	Crude Fiber	Indigestible cell wall fraction like cellulose and lignin.
CP	Crude Protein	Total protein content, true protein + non-protein nitrogen.
DCP	Digestible Crude Protein	Protein fraction digested and absorbed by animal body.
DE	Digestible Energy	Energy left after subtracting fecal energy from intake.
DM	Dry Matter	Nutrients left after removing all water from feed sample.
DMI	Dry Matter Intake	Total dry feed consumed daily by an animal.
EE	Ether Extract	Fraction of feed representing crude fat content measured chemically.
FCR	Feed Conversion Ratio	Quantity of feed needed for unit product output.
GE	Gross Energy	Total heat energy released after complete oxidation of feed.
ME	Metabolizable Energy	Energy available after deducting urine and gas losses.
MP	Metabolizable Protein	Protein available to animal from microbial and undegraded protein.
NE	Net Energy	Energy left after maintenance and metabolic losses.
NFE	Nitrogen Free Extract	Easily digestible sugars and starches present in feed.
RDA	Recommended Dietary Allowance	Suggested nutrient intake level to meet animal requirements.
TDN	Total Digestible Nutrients	Sum of all digestible carbohydrates, fats, proteins together.

1. COMPONENTS OF ANIMAL FEED

Aim:

To identify and understand the components used in formulating feed for domestic and pet animals and to formulate a balanced ration based on the type and weight of the animal.

Introduction:

Animal nutrition is a fundamental aspect of livestock and pet management. Proper feeding ensures optimal health, productivity and longevity of animals. Domestic animals (like cattle, goats, poultry) and pet animals (like dogs, cats, rabbits) have different nutritional requirements based on species, age, activity level and physiological status (growth, pregnancy, lactation). Feed formulation involves combining various ingredients to meet the required nutrients — energy, protein, vitamins and minerals — in the right proportions.

Principle:

Balanced feeding aims to provide all essential nutrients in appropriate quantities for maintenance, growth, reproduction and production without causing deficiencies or excesses. This practical involves identification of feed components, understanding their nutrient contributions and formulating rations based on body weight and species-specific requirements.

General Components of Animal Feed:

Sr. No.	Component Type	Function	Common Examples
1	Energy Sources	Provide calories for body functions	Maize, barley, wheat bran, molasses
2	Protein Sources	Tissue building, enzymes, hormones	Soybean meal, fish meal, groundnut cake
3	Fiber Sources	Aid digestion (esp. in ruminants)	Hay, silage, rice straw, alfalfa
4	Mineral Supplements	Bone health, metabolic processes	Bone meal, salt, limestone, mineral mix
5	Vitamin Supplements	Support immune & metabolic functions	Premixes, green forages, synthetic vitamins
6	Additives	Improve feed efficiency and health	Enzymes, probiotics, antioxidants
7	Water	Vital for all physiological processes	Clean drinking water

Common Feed Ingredients and their Approximate Composition:

Ingredient	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	Moisture (%)	Main Use
Grains					
Corn (Maize)	8-9	3-4	2-3	~10-12	Primary energy source
Soybean Meal	44-48	1-2	3-7	~10-12	Primary protein source
Wheat	12-13	1-2	2-3	~10-12	Energy source, often for poultry
Oats	11-12	4-5	10-12	~10-12	Energy source, fiber
Rice Bran	15-16	15-20	11-13	~10	Energy and fat source
Celluloses					
Alfalfa Hay	15-20	2-3	25-30	~10-12	Protein and fiber source
Oaten Hay	8-10	1-2	30-35	~10-12	Fiber source
Corn Silage	8-10	3-4	20-25	~65	Energy and fiber source for ruminants
Animal By-products					
Fish Meal	60-70	5-10	<1	~8-10	High-quality protein source
Meat and Bone Meal	45-50	8-12	<2	~8-10	Protein, calcium and phosphorus source
Other Ingredients					
Molasses	3-6	<1	<1	20-25	Energy source, improves palatability
Distillers Grains (DDGS)	28-30	10-12	8-12	~10-12	Protein and energy source

Materials Required for Feed Formulation:

- Sample ingredients (maize, soybean meal, wheat bran, etc.)
- Digital weighing balance
- Mixing trays or bowls
- Measuring cups/spoons
- Animal nutrition chart or nutrient requirement table
- Calculator
- Clean water (for moisture content checks or hydration)

2. PREPARATION OF FEED FOR LACTATING COW/ BUFFALO

Aim:

To calculate and prepare a balanced ration using available feed resources for a lactating cow or buffalo weighing 500 kg and producing 10 litres of milk/day.

Introduction:

Lactating animals require extra nutrients for maintenance, milk production and body condition. A balanced ration provides energy, protein, minerals and vitamins in proper proportion. Dry matter intake is calculated as a percentage of body weight, while additional requirements are added for milk yield. Proper roughage–concentrate ratio ensures optimum rumen function and milk production.

Principle:

A lactating cow or buffalo requires about 2.5% of its body weight as dry matter for maintenance, along with an additional 0.4–0.5 kg dry matter per litre of milk yield, mainly from concentrates. A balanced ration follows a 60:40 roughage-to-concentrate ratio, supplemented with mineral mixture and salt for essential micronutrients.

Requirements:

1. Weighing balance
2. Measuring scoops/containers
3. Feed ingredients: Green fodder (maize/berseem/napier), dry fodder (wheat/rice straw), concentrate mixture (oil cakes, cereal grains, bran), mineral mixture and common salt.
4. Notebook and observation sheet

Procedure

1. Record animal's body weight and daily milk yield.
2. Calculate maintenance DM requirement: Body wt.×2.5%
3. Calculate milk DM requirement: 0.5 kg DM per litre milk
4. Add both to get total DM requirement.
5. Fix roughage:concentrate ratio (60:40).
6. Split roughage into green fodder and dry fodder (≈70:30).
7. Convert DM requirement into as-fed basis using DM%.
8. Weigh ingredients, mix thoroughly and present in tabular form.

Observations:

Step 1: Calculate DM Requirement

- Maintenance = 500 × 0.025 = **12.5 kg DM**
- Milk = 10 L × 0.5 = **5.0 kg DM**
- **Total = 17.5 kg DM/day**

Step 2: Convert into Ingredients (As-fed basis)

Ingredient	DM%	Required DM (kg)	Formula (DM ÷ DM% × 100)	As-fed Quantity (kg)
Green fodder (maize/napier)	20	7.4	7.4 ÷ 20 × 100	37.0
Dry fodder (wheat straw)	90	3.1		
Concentrate mixture	90	7.0		
Mineral mixture	–	–		
Salt	–	–		
Total	–	**17.5**		

Note:

- **Dry Matter (DM%):** This shows how much solid feed remains after removing water. For example, green fodder has only 20% dry matter (80% is water), while wheat straw and concentrate have about 90% dry matter.
- **Required DM (kg):** This is the actual dry matter that the animal needs from each feed ingredient to meet its daily nutrient requirement.

Example: Formulation of 100 kg Batch

***Formula:**

$$\text{Ingredient in 100 kg batch} = \frac{\text{Ingredient quantity in 48 kg daily ration}}{48} \times 100$$

Ingredient	Daily Ration (kg)	Calculation	For 100 kg Batch (kg)
Green fodder	37.0		
Wheat straw	3.4		
Concentrate mixture	7.8		
Mineral mixture	0.05		
Salt	0.03		
Total	48.3 ≈ 48		

Result:

A 100 kg of feed for lactating cow/buffalo contains _____kg green fodder, _____ kg of dry fodder, _____ kg of concentrate mixture and _____ kg of mineral mixture.

3. DESIGNING A BALANCED DIET FOR A LACTATING COW/BUFFALO

Aim:

To design a balanced feed ration for a lactating cow or buffalo (weighing 500 kg) to meet its nutrient requirements for milk production.

Introduction:

Lactating animals require extra nutrients, especially energy and protein, to support milk production while maintaining their health. The feed ration should be balanced in terms of dry matter, crude protein, energy (Total Digestible Nutrients, TDN) and minerals. By calculating the nutrient content of available feeds, a balanced diet can be formulated.

Principal:

Feed formulation is based on matching the animal's nutritional requirements with the nutrient supply from feed ingredients. For a 500 kg lactating cow/buffalo producing 8–10 liters of milk per day, the dry matter intake (DMI) and required protein, energy and minerals must be calculated and a suitable combination of feed ingredients must be chosen to meet these requirements.

Requirements:

- Nutrient composition chart of feed ingredients
- Calculator or ration balancing worksheet
- Sample feed ingredients (maize, wheat bran, green fodder, etc.)
- Weighing balance
- Measuring containers
- Mixing tray

Percentage of Feed Ingredients in the Ration:

Ingredient	Percentage in Ration (%)
Green Fodder	40%
Maize (Energy Source)	20%
Wheat Bran	15%
Soybean Meal	12%
Groundnut Cake	10%
Mineral Mixture	2%
Salt	1%

Steps for Feed Formulation:

Step 1: Estimate Dry Matter Intake (DMI)

Dry Matter Intake (DMI) = 2.5–3% of body weight

- For a 500 kg cow/buffalo:
    - DMI = 500 × 0.025 to 0.03 = 12.5 to 15 kg/day

Step 2: Determine Nutrient Requirements

Nutrient	Requirement (approximate)
Crude Protein	12–16% of DMI → ~1.8–2.4 kg/day
Energy (ME)	~60–70% TDN → ~45,000–55,000 kcal/day
Calcium & Phosphorus	~0.6% and 0.4% of DMI, respectively

Feed Calculation for Lactating Cow/Buffalo

Assumption:

- Body Weight = 500 kg
- Milk Production = 8–10 Liters/day
- Estimated Dry Matter Intake (DMI) = 15 kg/day

Feed Calculation Table

Sr. No.	Feed Ingredient	% in Ration	Formula (DMI × % in Ration / 100)	Calculated Quantity (kg/day)
1	Green Fodder	40%	**15 x 40/100**	**6.00 kg**
2	Maize	20%		
3	Wheat Bran	15%		
4	Soybean Meal	12%		
5	Groundnut Cake	10%		
6	Mineral Mixture	2%		
7	Salt	1%		
	Total	**100%**		

Observation:

The calculated feed quantities match the daily dry matter intake requirement of the lactating animal.

Result:

A balanced feed ration of 15 kg was successfully formulated using standard feed ingredients, fulfilling the nutritional requirements of a 500 kg lactating cow/buffalo producing 8–10 liters of milk per day.

4. PREPARATION OF FEED FOR PREGNANT COW/BUFFALO

Aim:

To calculate and prepare a balanced ration using available feed resources for a pregnant cow or buffalo weighing 500 kg.

Introduction:

Balanced ration formulation for a 500 kg pregnant cow or buffalo ensures the health of both mother and foetus. Feed resources differ in moisture, protein and energy, so dry matter intake is calculated. Crude protein, TDN and mineral supplementation guide proper ingredient selection to meet physiological and micronutrient requirements.

Principle:

Proper nutrition during pregnancy supports maternal health and foetal growth. Since feeds vary in moisture, protein and energy, dry matter intake is calculated. Crude protein and TDN values guide feed selection and quantity, while mineral supplementation ensures essential micronutrient supply, fulfilling physiological requirements of pregnant cows or buffaloes.

Requirements:

1. Weighing balance
2. Measuring containers/scoops
3. Feed ingredients: (Green fodder (maize/berseem/napier), Dry fodder (wheat straw/rice straw), Concentrate mixture, Mineral mixture, Common salt
4. Notebook and observation sheet

Procedure:

1. Record the body weight of the animal (here: 500 kg pregnant cow/buffalo).
2. Estimate daily dry matter (DM) requirement at 2.5% of body weight.
3. Fix the roughage: concentrate ratio (≈70:30).
4. Divide roughage into green fodder and dry fodder (≈80:20).
5. Convert DM requirement into as-fed quantities using DM%.
6. Add mineral mixture and common salt.
7. For a batch preparation, scale values to the desired total (e.g., 50 kg).
8. Mix all ingredients thoroughly.
9. Record in tabular form.

Observations:

Feed Requirement (500 kg Pregnant Cow/Buffalo)

Dry Matter (DM) Intake ≈ 2.5% of body weight of animal

i.e. 500 x 0.025 = 12.5 kg DM/day

Conversion of DM into As-fed Quantities

Ingredient	DM%	Required DM (kg)	Formula (Required DM ÷ DM% × 100)	As-fed Quantity (kg)
Green fodder (maize/napier)	20	7.0	7 ÷ 20 × 100	35.0
Dry fodder (wheat straw)	90	1.75		
Concentrate mixture	90	3.75		
Mineral mixture	–	–		
Salt	–	–		
Total	–	**12.5**		**41.00**

Note:

- **Dry Matter (DM%:** This shows how much solid feed remains after removing water. For example, green fodder has only 20% dry matter (80% is water), while wheat straw and concentrate have about 90% dry matter.
- **Required DM (kg):** This is the actual dry matter that the animal needs from each feed ingredient to meet its daily nutrient requirement.

Result:

A 500 kg pregnant cow/buffalo requires approximately 41 kg of feed daily (as-fed basis), consisting of green fodder 35 kg, wheat straw 2 kg, concentrate mixture 4.2 kg, mineral mixture 50 g and salt 30 g.

Example: Formulation of 50 kg Batch

If a 50 kg feed batch is to be prepared instead of daily ration, scale down the quantities proportionally:

*Formula:

$$\text{Ingredient in 50 kg batch} = \frac{\text{Ingredient quantity in 41 kg daily ration}}{41} \quad \text{X } 50$$

Ingredient	**Ingredient quantity in 41kg daily ration (kg)**	**Calculation (Use *Formula here)**	**Quantity in 50 kg Batch (kg)**
Green fodder	35.0		
Dry Fodder	1.9		
Concentrate mixture	4.2		
Mineral mixture	0.05		
Salt	0.03		
Total	41.2		

Result:

A 50 kg of feed for pregnant cow/buffalo contains _____kg green fodder, _____ kg of dry fodder, _____ kg of concentrate mixture and _____ kg of mineral mixture.

5. DESIGNING A BALANCED DIET FOR PREGNANT COW/BUFFALO

Aim:

To calculate and prepare a balanced ration using available feed resources for a pregnant cow or buffalo weighing 500 kg.

Introduction:

Pregnancy, especially the last trimester, is a critical phase in the life cycle of dairy animals like cows and buffaloes. During this stage, the nutrient requirements increase due to fetal growth, preparation for calving and the onset of lactation. Providing a well-balanced diet is essential to maintain maternal health, ensure proper fetal development, prepare the udder for milk production and prevent metabolic diseases like milk fever and ketosis. Feed formulation involves calculating the required amounts of energy, protein, fiber, minerals (especially calcium and phosphorus) and dry matter using locally available feed resources.

Principle:

Proper nutrition during pregnancy is essential for the health of the mother and the developing foetus. Feed ingredients vary in moisture, protein and energy content. Calculating dry matter intake ensures the animal receives adequate nutrients despite varying moisture content. Crude protein and energy (TDN) values guide the selection and quantity of feed to meet physiological needs. Mineral supplementation is essential to fulfil micronutrient requirements during pregnancy.

Requirements:

Animal Details (assumed or provided):

- Body weight: ~500–550 kg
- Physiological stage: Last trimester of pregnancy

Nutrient	Requirement per day
Dry Matter (DM)	2.0–2.5% of body weight
Crude Protein (CP)	10–12% of DM
Total Digestible Nutrients (TDN)	60–65% of DM
Calcium	~40–50 g
Phosphorus	~25–30 g

Procedure:

1. Assume a cow or buffalo weighing 500–550 kg in the last trimester.
2. Calculate DM requirement = 2.5% × body weight.
3. Distribute total DM as: ~60% roughages (green + dry), ~40% concentrates.
4. Select appropriate ingredients (green fodder, straw, wheat bran, etc.).
5. Calculate total DM, CP, TDN, Ca and P based on ingredient contribution.

6. Adjust quantities to meet all nutrient requirements.
7. If needed, add mineral mixture and salt to correct deficiencies.

Feed Ingredient Table (Nutrient Composition):

Feed Ingredient	DM (%)	CP (%)	TDN (%)	Ca (%)	P (%)
Green fodder (Napier)	20	8	55	0.5	0.3
Wheat straw	90	3	42	0.3	0.1
Wheat bran	90	15	70	0.7	1.0
Mustard cake	90	35	70	0.7	1.1
Mineral mixture	100	0	0	20	12

Proposed Ration Plan (As-fed Basis)

Feed Ingredient	As-fed Amount (kg)
Green Fodder	25 kg
Wheat Straw	3 kg
Wheat Bran	3 kg
Mustard Cake	1.5 kg
Mineral Mix + Salt	0.1 kg (100 g)
Total As-fed	32.6 kg

Table of formulas for calculating each nutrient from animal feed:

Nutrient	Formula	Units/Notes
Dry Matter (DM)	$\text{DM (kg)} = \text{Feed amount (kg)} \times \frac{\text{DM \%}}{100}$	Feed amount = as-fed weight
Crude Protein (CP)	$\text{CP (kg)} = \text{DM (kg)} \times \frac{\text{CP \%}}{100}$	Nutrient % on dry matter basis
Total Digestible Nutrients (TDN)	$\text{TDN (kg)} = \text{DM (kg)} \times \frac{\text{TDN \%}}{100}$	Energy content on dry matter basis
Calcium (Ca)	$\text{Ca (g)} = \text{DM (kg)} \times \frac{\text{Ca \%}}{100} \times 1000$	Convert % to grams (1% = 10 g/kg)
Phosphorus (P)	$\text{P (g)} = \text{DM (kg)} \times \frac{\text{P \%}}{100} \times 1000$	Convert % to grams (1% = 10 g/kg)

Calculate Nutrient Contribution

Feed/Nutrient	DM (kg)	CP (kg)	TDN (kg)	Ca (g)	P (g)
Green Fodder	25×20% = **5.0**	5.0×8% = **0.40**	5.0×55% = **2.75**	5.0×0.5% = **25 g**	5.0×0.3% = **15 g**
Straw					
Wheat Bran					
Mustard Cake					
Mineral Mix					
Total					
Requirement	**12.5 kg**	**1.5 kg**	**7.5 kg**	**40–50 g**	**25–30 g**

Evaluation

Parameter	Feed Value	Required Amount	Give your observation that nutrient availability from given feed is Slightly High / Low / Sufficient
DM		12.5 kg	
CP		1.5 kg	
TDN		7.5 kg	
Calcium		40–50 g	
Phosphorus		25–30 g	

Result:

A balanced ration was successfully formulated for a 500 kg pregnant cow/buffalo using locally available feed ingredients. The feed meets the daily requirements of DM, CP, TDN, Ca and P for the last trimester of pregnancy.

6. PREPARATION OF FEED FOR GOAT

Aim:

To prepare a balanced and cost-effective feed formulation for goats meeting their nutritional requirements for maintenance, growth, reproduction and lactation.

Introduction:

Goats require energy, protein, minerals and vitamins for maintenance, growth, reproduction and milk production. Concentrate feeds complement roughage to supply adequate nutrients. Using available ingredients such as maize, wheat bran, groundnut cake, rice bran, mineral mixture, salt and molasses ensures a balanced ration that is cost-effective and promotes health and productivity.

Principle:

Daily dry matter intake for goats is calculated based on body weight (~4% for maintenance). Energy is supplied mainly by maize, wheat bran and rice bran, protein by groundnut cake. Roughage-to-concentrate ratio varies with physiological stage, while mineral mixture, salt and optional molasses ensure micronutrient balance and palatability, with DM% guiding as-fed quantities.

Requirements:

1. Weighing balance
2. Measuring scoops/containers
3. Ingredients: Maize, wheat bran, groundnut cake, rice bran, mineral mixture, salt and optional molasses
4. Notebook and observation sheet

Procedure:

1. Record goat's body weight and physiological status (maintenance, growth, reproduction, lactation).
2. Decide daily feed requirement (DM intake ≈ 4% of body weight).
3. Decide roughage:concentrate ratio (e.g., 70:30 for maintenance).
4. Calculate total DM needed from the concentrate mixture.
5. Fix proportion of each ingredient in concentrate mixture as Maize 40%, wheat bran 25%, groundnut cake 25%, rice bran 5%, mineral mixture 3%, salt 1% and optional molasses 1%.
6. Calculate as-fed quantity for each ingredient using DM%.
7. Weigh, mix thoroughly and store in dry conditions.

Observations (Example: 30 kg Goat, Maintenance)

Step 1: Total DM Requirement

- DM = 30 × 0.04 = **1.2 kg/day**
- Concentrate = 30% of DM = 0.36 kg/day

Step 2: Ingredient-wise DM Split

Ingredient	DM%	Proportion in Mix (%)	DM Required (kg)	Feed Quantity (kg)*
Maize	88	40	0.36 × 0.40 = 0.144	0.144 ÷ 0.88 ≈ 0.16
Wheat bran	90	25		
Groundnut cake	90	25		
Rice bran	90	5		
Mineral mixture	–	3		
Salt	–	1		
Molasses (optional)	75	1		
Total	–	100		

Example: 7-Day Batch Preparation

Ingredient	Daily Feed (kg)*	7-Day Batch (kg)	Total Feed (kg)
Maize			
Wheat bran			
Groundnut cake			
Rice bran			
Mineral mixture			
Salt			
Molasses (optional)			
Total			

Result:

The 7-day batch feed formulation provides a total of _____ kg feed for the goat, with _____ kg maize, _____ kg wheat bran, _____ kg groundnut cake, _____ kg rice bran, _____ kg mineral mixture, _____ kg salt and optional molasses**.**

7. PREPARATION OF FEED FOR LAYER POULTRY FOWL

Aim:

To formulate and prepare a balanced feed for layer poultry fowls that ensures optimal egg production, health and productivity.

Introduction:

Layer poultry require energy, protein, minerals and vitamins for maintenance, egg production and eggshell quality. Adequate calcium is essential for eggshell formation; insufficient calcium leads to depletion of body reserves. Balanced feed introduced at 18 weeks supports proper onset of laying and optimal productivity.

Principle:

Layer poultry requires a balanced diet with the right proportions of energy, proteins, minerals (especially calcium) and vitamins to support continuous egg laying. A standard layer feed must contain appropriate amounts of grains, oil cakes, mineral mixtures and additives to meet the nutritional needs at different stages of laying.

Requirements:

1. Weighing balance and measuring containers
2. Ingredients: Maize/broken rice, soybean meal/groundnut cake, wheat bran/rice bran, limestone, dicalcium phosphate, mineral & vitamin premix, salt, amino acids (Lys, Met, Thr, Trp), toxin binder/feed additive, optional molasses.
3. Mixing container or feed mixer
4. Notebook for observations

Procedure:

1. Decide batch size: 80 kg total feed.
2. Weigh ingredients accurately according to specified amounts.
3. Mix energy and protein sources first (maize, soybean, fishmeal, bran).
4. Gradually add lime for calcium distribution.
5. Incorporate premix, amino acids and toxin binder last to ensure even distribution.
6. Check homogeneity of the mixture.
7. Optional: Add molasses for palatability.
8. Store feed in a cool, dry place until use.

Observation:

Standard Layer Feed Ingredient Proportions

Ingredient	Standard % Range	Mean % (Average)	Purpose
Maize / Broken rice	50–55%	52.5%	Energy source
Soybean meal / Groundnut cake	20–25%	22.5%	Protein source (growth & egg formation)
Wheat bran / Rice bran	8–12%	10%	Fibre and additional energy
Limestone	3–4%	3.5%	Calcium for eggshell formation
Dicalcium phosphate	1–1.5%	1.25%	Phosphorus source
Mineral mixture & Vitamin premix	1–2%	1.5%	Micronutrients and vitamins
Salt	0.5–1%	0.75%	Sodium and chloride source
Amino acids (Lys, Met, Thr, Trp)	0.1–0.3%	0.2%	Essential amino acids
Toxin binder / feed additive	0.05–0.1%	0.075%	Anti-nutritional / mycotoxin control
Optional: Molasses	0.5–1%	0.75%	Palatability and energy

DCP (Digestible Crude Protein) of Layers Feed:

DCP is the portion of protein in feed that is actually digestible and available for metabolism by the animal after digestion in the gut. Unlike total crude protein, DCP accounts for the protein that the animal can absorb and use for growth, maintenance, reproduction and production. In layers, DCP is critical for egg formation (albumen and yolk proteins).

Example:

To calculate the Digestible Crude Protein (DCP) of a 100 kg layer feed batch and assess if it meets the 16–18% requirement for laying hens.

Ingredients and Approximate Crude Protein (CP) Content

Ingredient	Weight (kg)	Approx CP %	Digestibility %
Maize / Broken rice	52.5	8	80%
Soybean meal / Groundnut cake	22.5	44	85%
Wheat bran / Rice bran	10	12	70%
Fishmeal (optional)	8	60	90%
Limestone, premix, salt, amino acids, molasses	7	0	–

Formulas:

1. Digestible Crude Protein (DCP):

DCP (kg) = Feed Weight (kg) × Crude Protein (CP%) (decimal) × Digestibility % (decimal)

2. Total DCP (kg)= ∑DCP of all ingredients

3. DCP % =Total Feed (kg) / Total DCP (kg) × 100

Step-by-step Explanation:

1. Feed Weight (kg): Amount of that ingredient in the total feed batch.
2. Crude Protein (CP %): Protein content of the ingredient (as a decimal, e.g., 44% = 0.44).
3. Digestibility %: Fraction of CP that is actually digestible by the animal (as a decimal, e.g., 85% = 0.85).

Calculate DCP for Each Ingredient:

Ingredient	Calculation by Formula	Total
Maize / Broken rice	52.5 × 0.08 × 0.8	3.36
Soybean meal / Groundnut cake		
Wheat bran / Rice bran		
Fishmeal (optional)		
Limestone, premix, salt, amino acids, molasses		
	Total DCP (Sum of All)	

Calculate DCP % of Feed =

Result:

The DCP % of the feed is _____ %, which is **within / lower / higher** than the recommended 16–18% range for laying hens.

8. PREPARATION OF FEED FOR BROILER POULTRY FOWL

Aim:

To calculate and prepare a balanced ration for broiler poultry fowl using available feed ingredients to meet growth, energy, protein and mineral requirements.

Introduction:

Broiler chickens require a high-energy, protein-rich diet for rapid growth and meat production. Balanced rations are formulated using energy sources (maize, rice bran), protein sources (soybean meal, groundnut cake, fishmeal) and minerals/vitamins. Proper formulation ensures efficient feed conversion ratio (FCR), healthy weight gain and economic returns to farmers in broiler production systems.

Principle:

A broiler ration is prepared considering nutrient needs at different growth stages. Energy is mainly provided by cereals, protein from oilseed cakes and fishmeal, while vitamins and minerals regulate metabolism. Dry matter intake, crude protein (CP) and digestible energy values guide formulation, ensuring broilers receive adequate nutrients for fast growth and healthy performance.

Requirements:

1. Weighing balance
2. Measuring containers/scoops
3. Feed ingredients: Maize/broken rice, soybean meal/groundnut cake, fishmeal (optional), wheat bran/rice bran, vegetable oil, mineral mixture & vitamin premix and salt.
4. Notebook and observation sheet

Procedure:

1. Record the requirement of the broiler group (starter/grower/finisher stage).
2. Decide the batch size to prepare (e.g., 100 kg feed).
3. Select ingredients based on nutrient roles (energy, protein, minerals).
4. Fix the percentage of ingredients (e.g., Maize 55%, Soybean 30%, Bran 7%, Fishmeal 5%, Oil 1.5%, Minerals & Salt 1.5%).
5. Weigh ingredients separately.
6. Mix thoroughly to prepare a uniform ration.
7. Present formulation in tabular form.

Observation (Standard Broiler Feed Formulation – Finisher Stage)

Ingredient	% in diet	Quantity (kg for 100 kg feed)
Maize	55%	55.0
Soybean meal	30%	30.0
Wheat bran	7%	7.0
Fishmeal	5%	5.0
Oil (veg.)	1.5%	1.5
Minerals + Salt + Premix	1.5%	1.5
Total	**100%**	**100.0**

Formula for Calculation

$$\textbf{Weight of ingredient (kg)} = \text{Total Feed (kg)} \times \frac{\text{Ingredient \%}}{100}$$

Example

Prepare a 75 kg broiler feed batch using the same formulation.

Ingredient	% in diet	Quantity (kg for 100 kg feed)
Maize		
Soybean meal		
Wheat bran		
Fishmeal		
Oil (veg.)		
Minerals + Salt + Premix		
Total		**75**

Result:

A balanced broiler ration was prepared containing _____kg of maize, _____kg of soybean meal, _____kg of wheat bran, _____kg of fishmeal, _____kg of oil and _____kg of mineral-salt premix, ensuring sufficient energy, protein and micronutrients for optimum broiler growth and feed efficiency.

9. PREPARATION OF FEED FOR ORNAMENTAL FISHES

Aim:

To formulate and prepare a balanced ornamental fish feed that supports growth, coloration and health.

Introduction:

Ornamental fish feed must supply energy, proteins, vitamins and pigments while being water-stable to avoid tank pollution. Unlike commercial food fishes ornamentals require feed that enhances body coloration (carotenoids), immunity (vitamins/minerals) and palatability. Balanced feed ensures growth, survival and market value of ornamental fish.

Principle:

Fish require proteins for tissue growth, lipids for energy, carbohydrates for limited energy, vitamins/minerals for metabolism and pigments for coloration. Ornamental fish feed is formulated from animal and plant ingredients, mixed, pelleted and dried. Water stability is crucial so that nutrients are not lost before consumption.

Requirements (for 100 kg feed):

Ingredient	Proportion (%)	Purpose
Fishmeal	25	Animal protein, amino acids
Soybean meal / Groundnut cake	20	Plant protein
Rice bran / Wheat bran	15	Carbohydrate & energy
Corn flour	15	Binder & energy source
Shrimp meal / Spirulina powder	10	Protein, pigment, growth
Vegetable oil (fish/cod liver)	5	Lipids, omega-3 fatty acids
Vitamin–mineral premix	5	Immunity, bone development
Carotenoids (marigold/paprika)	2	Colour enhancement
Gelatin / Tapioca starch	3	Binder for water stability
Total	**100**	

Procedure:

1. Weigh the ingredients according to formulation.
2. Grind dry ingredients into fine powder.
3. Mix protein, carbohydrate, pigment and binder thoroughly.
4. Add oil and water gradually to make a dough.
5. Pass dough through pelletizer or extruder to make small pellets.
6. Dry pellets under shade or in oven at low temperature (50–60 °C).
7. Store in airtight container.

Example:

Calculate crude protein from the feed ingredeints for ornamental fish (for 100 kg feed)

Formula:

$$\text{Protein contributed (kg)} = \text{Ingredient weight (kg)} \times \frac{\text{CP\% of Feed}}{100}$$

Ingredient	**% (kg)**	**Approx. CP %**	**Protein contributed (kg)**
Fishmeal	25	60	25 × 0.60 = **15.0**
Soybean meal / Groundnut cake	20		
Rice bran / Wheat bran	15		
Corn flour	15		
Shrimp meal / Spirulina	10		
Vegetable oil	5		
Vitamin–mineral premix	5		
Carotenoids	2		
Gelatin / Tapioca starch	3		
Total Crude Protein (Sum of all Protein contributed in kg)			

Calculate Crude Protein Percentage

Formula:

$$\text{CP \% of feed} = \frac{\text{Total crude protein from all ingredients (kg)}}{100} \text{ X } 100$$

Result:

The formulated feed contains _____ kg crude protein in a 100 kg batch, i.e., _____ % CP.

10. PREPARATION OF FEED FOR CULTURED FISHES (COMMON CARP)

Aim:

To formulate and prepare a balanced feed for common carp using locally available feed ingredients and estimation of approximate Metabolizable Energy (ME) of a feed from its nutrients.

Introduction:

Common carp is an omnivorous freshwater fish requiring a balanced diet for rapid growth, reproduction and good health. Feed formulation involves combining protein, energy, minerals and vitamins in proper ratios. Protein (25–30%), carbohydrates, lipids and minerals must be balanced to ensure efficient feed utilization and improve survival and production.

Principle:

Fish growth depends on the quality of feed and nutrient composition. Crude protein, energy and digestibility determine the suitability of feed ingredients. For common carp, plant proteins (soybean meal, groundnut cake) and energy sources (rice bran, maize) are combined with animal proteins (fishmeal). Vitamins and minerals are added for immunity and bone development.

Importance of ME in Fish Feed

1. **Primary Energy Source** – Fish need energy to swim, breathe, digest, maintain body functions and grow. ME measures the energy that is actually available to the fish after digestion.
2. **Protein Sparing Effect** – Adequate ME ensures fish use carbohydrates and fats for energy, sparing expensive dietary protein for growth and tissue building instead of burning it as fuel.
3. **Growth & Feed Efficiency** – Correct ME levels improve the Feed Conversion Ratio (FCR), meaning less feed is needed for each kg of fish growth.
4. **Balance with Protein (P:E Ratio)** – ME must be balanced with dietary protein. Too much energy → fat deposition and poor fillet quality. Too little energy → protein wastage and stunted growth.
5. **Species-Specific Requirement** – Carnivorous fish (like trout) need higher protein but moderate ME, while omnivorous/herbivorous fish (like carp) rely more on carbohydrates and require a carefully balanced ME.

For common carp, the recommended Metabolizable Energy (ME) range in feed is: **2,500 – 3,000 kcal/kg diet**

- Lower than this leads to poor growth, protein wasted for energy.
- Higher than this leads to excessive fat deposition, reduced protein utilization.

Requirements:

- Weighing balance
- Measuring scoop/containers
- Mixer or clean tray for mixing
    - Feed ingredients: Fishmeal, Groundnut cake, Rice bran, Maize / Broken rice, Vegetable oil (fish oil optional), Vitamin-mineral premix, Binder (Guar gum / Tapioca starch)

Procedure:

1. Record the target species and growth stage (Common carp, grow-out stage).
2. Decide the protein requirement (~28% CP for common carp).
3. Select suitable feed ingredients.
4. Fix the proportion of protein sources and energy sources.
5. Weigh each ingredient according to the formulation.
6. Mix all ingredients thoroughly.
7. Add binder and oil, pelletize or make dough feed.
8. Dry the feed pellets under shade and store in airtight containers.

Observation Table (Example for 100 kg feed batch):

Ingredient	**% in feed**	**Weight (kg)**	**Approx. CP %**	**Protein contributed (kg)**
Fishmeal	20	20	60	12.0
Groundnut cake	25	25	44	11.0
Rice bran / Wheat bran	25	25	12	3.0
Maize / Broken rice	20	20	9	1.8
Vegetable oil	3	3	0	0
Vitamin–mineral premix	5	5	0	0
Binder	2	2	0	0
Total	**100**	**100**	—	**27.8**

Calculation:

Formula for Energy Contribution

Energy Contributed from each ingredient (kcal/kg feed) = %in feed / 100 x Approx. ME

Total ME (kcal/kg feed) = ∑Energy contributed from all ingredients

Example (100 kg feed for Common Carp)

Ingredient	% in feed	Approx. ME (kcal/kg)	Energy contributed (kcal/kg feed)
Fishmeal	25	2,800	(25 ÷ 100) × 2800 = **700**
Soybean meal / Groundnut cake	20	2,600	
Rice bran / Wheat bran	15	3,000	
Corn flour	15	3,200	
Shrimp meal / Spirulina	10	2,700	
Vegetable oil	5	8,000	
Vitamin–mineral premix	5	negligible	
Carotenoids	2	negligible	
Gelatin / Tapioca starch	3	3,000	
	100	**Total ME (kcal/kg feed)**	

Result:

The formulated feed for common carp contains _____kcal/kg ME meeting the requirement for grow-out stage culture. The feed also provides adequate energy and micronutrients for healthy growth.

11. PREPARATION OF FEED FOR PET DOGS

Aim:

To formulate and prepare a balanced and cost-effective feed for pet dogs, meeting their daily nutritional requirements for maintenance, growth and health.

Introduction:

Dog nutrition requires a balanced supply of protein, fat, carbohydrates, vitamins and minerals to support growth, energy, immune function and overall health. Properly prepared feed improves longevity, skin and coat condition and activity levels. Balanced homemade rations can substitute commercial feeds when carefully formulated with varied ingredients.

Principle:

Dogs are omnivores and need protein for growth and repair, fats for energy and skin health, carbohydrates for digestible energy and minerals and vitamins for metabolic functions. Feed formulation balances nutrient proportions, ensuring daily energy and protein requirements are met while preventing deficiencies or excesses that affect health and performance.

Requirements

- Weighing balance
- Measuring scoops/containers
- Cooking utensils (if feed is cooked)
- Feed ingredients: Cereals (rice /wheat /maize), protein sources (meat /fish /eggs /soybean), vegetables, fats/oils, minerals and vitamins

Procedure

1. Record the weight and activity level of the dog (maintenance, growing, pregnant/lactating, active/working).
2. Calculate the daily requirement:
    - Energy: **~110 kcal ME per kg body weight^0.75**
    - Protein: **18–25% of diet**
3. Select appropriate ingredients from energy, protein and vitamin/mineral sources.
4. Fix rough proportion: Carbohydrates 40–50%, Protein 25–30%, Fat 10–15%, Vegetables 10–15%, Minerals/vitamins 1–2%.
5. Weigh ingredients separately.
6. Mix and cook ingredients as needed (meat, cereals, some vegetables).
7. Serve fresh or store for short-term use.

Observation (Daily Requirement for a 20 kg Adult Dog)

- Energy requirement ≈ 1,100 kcal/day
- Protein requirement ≈ 50–60 g/day

Ingredient	% in diet	As-fed (gm) for 20 kg dog
Rice/Wheat/Maize	40	400 gm
Meat/Fish/Eggs	25	250 gm
Soybean meal	5	50 gm
Vegetables	15	150 gm
Oil/Fat	10	100 gm
Mineral mixture	3	30 gm
Salt & vitamins	2	20 gm
Total	100	1,000 gm (=1 kg)

Exercise:

Formulate a balanced daily ration for A 15 kg dog

Calculation:

Step 1: Calculate energy requirement

Formula

$$\textbf{ME (kcal/day)} = 110 \times (\textbf{Body weight of dog in kg})^{0.75}$$

where,

1. **ME (kcal/day):** Metabolizable energy requirement per day
2. **110:** Constant factor (average energy needed per unit of metabolic body wt.) for dogs
3. **Body weight (kg):** The dog's actual weight in kilograms.
4. **Exponent 0.75:** This is the **metabolic weight exponent**, based on Kleiber's law.
    - It means pets need energy based on body size, not full weight — bigger animals use energy more slowly.

Step 2: Convert ME into into Daily Ration (Standard ration: 1,000 g feed = ~1,200 kcal)

Formula:

$$\textbf{Daily feed required (gm)} = \frac{\textbf{ME (kcal/day)}}{\textbf{1200}} \quad \textbf{X 1000}$$

Step 3: Convert % to weight (for each ingredient in feed):

Formula:

$$\textbf{Ingredient weight (gm)} = \frac{\textbf{Percentage of ingredient}}{\textbf{100}} \textbf{ x Total daily feed (gm)}$$

Solve it for each ingredient as per % given in below table:

Daily feed required (gm)

Ingredient	% in diet	Feed for 15 kg dog/day
Rice/Wheat/Maize	40	
Meat/Fish/Eggs	25	
Soybean meal	5	
Vegetables	15	
Oil/Fat	10	
Mineral mixture	3	
Salt & vitamins	2	
Total	100	

Result:

A balanced feed of _____**kg/day** provides _____ **kcal/day energy** for a 15 kg adult dog, fulfilling maintenance needs.

12. PREPARATION OF FEED FOR PET CATS

Aim:

To formulate and prepare a balanced and palatable feed for pet cats, meeting their daily nutritional requirements for maintenance, growth and reproduction.

Introduction:

Cats are obligate carnivores, requiring high-quality protein, fat and specific amino acids like taurine for health. Balanced homemade feed ensures adequate energy, protein, fats, vitamins and minerals, supporting growth, reproduction and immune function. Properly formulated feed prevents deficiencies, supports healthy skin and coat and maintains overall well-being.

Principle:

Cats need nutrients in the correct balance: high protein and fat, moderate energy and essential micronutrients. Taurine, arachidonic acid and vitamin A are critical. Feed formulation calculates protein, fat and energy based on body weight and activity, while ensuring palatability and safety. Minerals and vitamins prevent deficiency and support physiological functions.

Requirements:

- Weighing balance and measuring containers
- Mixing utensils or bowl
- Ingredients: Meat/fish/chicken, eggs, rice/wheat/corn, vegetable oils, mineral mixture, salt and vitamin supplements
- Notebook and observation sheet

Procedure:

1. Record the cat's body weight and physiological stage (kitten, adult, pregnant/lactating).
2. Decide daily feed quantity based on energy requirements
3. Choose ingredients to meet protein (30–40%), fat (20–30%), carbohydrate (10–20%) and fiber (5–10%) needs.
4. Weigh each ingredient according to the calculated proportion.
5. Cook cereals lightly for digestibility if used.
6. Mix meat, eggs and cereals thoroughly.
7. Add oil, minerals, vitamins and taurine.
8. Store feed properly or serve fresh.

Observation (Feed Requirement for 4 kg Adult Cat)

Ingredient	% in diet	As-fed (gm/day)
Meat/Fish/Chicken	40%	112 gm
Eggs	10%	28 gm
Rice/Wheat/Corn	20%	56 gm
Oil	15%	42 gm
Vegetables	10%	28 gm
Mineral & Vitamin	5%	14 gm
Total	**100%**	**280 gm**

Example

Calculate protein requirement and feed composition for a 2 kg kitten

Step 1: Calculate energy requirement

Formula

$$\textbf{ME (kcal/day)} = 110 \times (\textbf{Body weight in kg})^{0.75}$$

Note: Since kittens are growing, requirement is about 2 times i. e. ME x 2

Final ME = ME x 2

Energy needed (ME) = _____ kcal/day

Step 2: Convert ME into into Daily Ration (Standard ration: 1000 g feed = ~1000 kcal)

Formula:

$$\textbf{Daily feed required (gm)} = \frac{\textbf{ME (kcal/day)}}{\textbf{1000}} \quad \textbf{X 1000}$$

Step 3: Convert % to weight (for each ingredient in feed):

Formula:

$$\textbf{Ingredient weight (gm)} = \frac{\textbf{Percentage of ingredient}}{\textbf{100}} \textbf{ x Total daily feed (gm)}$$

Solve it for each ingredient as per % given in below table:

Daily feed required (gm)

Ingredient	% in diet	Quantity (g/day)
Meat/Fish/Chicken	45%	
Eggs	15%	
Rice/Wheat/Corn	15%	
Vegetables	10%	
Oil/Fat	10%	
Minerals & Vitamins	5%	
Total	100%	

Result

A **2 kg kitten** requires about **_____g feed/day**, providing _____**kcal/day** energy for a proper growth and health.

13. PREPARATION OF FEED FOR LABORATORY ANIMALS (MICE/RATS)

Aim:

To prepare a balanced feed that provides optimum protein for laboratory mice and rats, ensuring proper growth, reproduction and reliability in experimental studies.

Introduction:

Mice and rats are widely used in research due to their rapid growth, short reproductive cycle and genetic similarity to humans. Balanced nutrition is crucial for their survival, health and reproducibility of experiments. Feed must supply adequate protein, energy, vitamins and minerals to avoid nutritional bias in research results.

Principle:

Laboratory animal feed must ensure consistent nutrient supply with minimal variation. Protein supports tissue growth; energy fuels activity and vitamins/minerals maintain physiological functions. Feed is usually prepared in pelleted form for easy intake, uniformity and reduced wastage. Proper balance prevents stress, improves survival and ensures validity of experimental outcomes.

Requirements

- Weighing balance and measuring containers
- Mixing utensils or bowl
- Ingredients: Cereal grains, soybean meal/groundnut cake, fishmeal/skim milk powder, vegetable oil, green leafy vegetable powder, mineral–vitamin premix and salt.
- Notebook and observation sheet

Procedure

1. Weigh ingredients in required proportions.
2. Grind cereals and protein sources finely.
3. Mix thoroughly with oil, salt and premix, add water and prepare dough.
4. Pelletize the dough and dry under shade, store in airtight container for use.

Standard Feed Composition (Typical %)

Ingredient	% in Diet	Source of
Cereal grains (maize, wheat, oats)	50–55%	Carbohydrate & energy
Soybean meal / groundnut cake	20–25%	Protein
Fishmeal / skim milk powder	5–10%	Animal protein, growth
Vegetable oil	3–5%	Essential fatty acids
Green leafy vegetables (dried powder)	5%	Fiber & vitamins
Mineral–vitamin premix	2–3%	Minerals & vitamins
Salt	0.5–1%	Electrolyte balance

Example:

To calculate Crude Protein (CP) contributions of feed ingredients for a balanced diet of laboratory mice/rats

Ingredient	% in Diet (Mean)	Weight (gm/100 gm feed)	Approx. CP %	Protein Contributed (gm)
Cereal grains (maize, wheat, oats)	52.5%		8	
Soybean meal / groundnut cake	22.5%		44	
Fishmeal / skim milk powder	7.5%		55	
Vegetable oil	4%		0	
Green leafy vegetables (powder)	5%		18	
Mineral–vitamin premix	2.5%		0	
Salt	1%		0	
Total	**100%**	**100**		

Formula:

$$\textbf{Protein Contributed (gm)} = \frac{\textbf{Weight of Ingredient (gm) x Approx. CP \%}}{\textbf{100}}$$

Result:

The feed contains approximately _____ **gm crude protein**, meeting the recommended range for healthy growth and reproduction of mice/rats.

14. TEST FOR MICROBIAL CONTAMINATION IN ANIMAL FEED

Introduction:

Animal feed can be contaminated with bacteria, molds and yeasts, which may compromise its quality and safety. Such contamination can cause feed spoilage, reduce nutrient availability and negatively impact the health and productivity of livestock, poultry and laboratory animals.

Regular testing of feed for microbial contamination helps identify the presence of harmful microorganisms before feeding. It ensures the feed meets hygiene standards, prevents disease outbreaks and maintains consistent nutritional value. By monitoring microbial load, feed producers and animal caretakers can take corrective measures, such as improving storage conditions or using preservatives, to safeguard animal health.

Necessity of Testing:

1. Ensures feed safety and prevents disease outbreaks.
2. Detects spoilage and reduces economic loss.
3. Prevents mycotoxin contamination from molds and yeasts.
4. Maintains consistency and reliability for experimental and production purposes.

Types of Tests for Microbial Contamination

1. **Total Plate Count (TPC):** Measures total viable bacteria present in the feed. Indicates overall microbial load.
2. **Coliform Test:** Detects coliform bacteria, which signal potential fecal or environmental contamination.
3. **Salmonella Test:** Specifically identifies Salmonella spp., a harmful pathogen affecting animals and humans.
4. **Mold and Yeast Count:** Measures molds and yeasts that can produce toxins, affecting animal health and feed quality.

Safe Ranges (CFU/gm):

Feed Type	Total Plate Count (TPC)	Coliform
Livestock/poultry feed	$\leq 1 \times 10^6$ CFU/g	$\leq 1 \times 10^3$ CFU/g
Compound/premix feed	$\leq 5 \times 10^5$ CFU/g	$\leq 5 \times 10^2$ CFU/g
Pet food / lab animal feed	$\leq 1 \times 10^5$ CFU/g	$\leq 1 \times 10^2$ CFU/g

TOTAL PLATE COUNT (TPC)

Aim:

To detect and estimate the microbial contamination (bacteria and fungi) in animal feed samples.

Principle:

The test detects and counts microbes in animal feed by diluting the sample and growing bacteria and fungi on culture media. Each microbe forms a colony, which can be counted to estimate contamination levels.

Requirements:

- Animal feed sample -10 g of feed (e.g., grains, pellets or mash)
- Sterile peptone water- 90 ml
- Plate count Agar (PCA)- sterile plates
- Incubator- set at 370C

Procedure:

1. **Sample preparation**: Weigh 10 g of feed into sterile container.
2. **Serial dilution**: Add 90 ml of peptone water to the feed sample (10^{-1} dilution). Mix well.
3. **Further dilutions:** Prepare a serial dilution (eg. 1:100, 1:1000) using peptone water.
4. **Plating**: Inoculate 1 ml of each dilution onto PCA plates.
5. **Incubation:** Incubate plates at 37^0C for 24-48 hours
6. **Counting:** Count colonies on plates after incubation

Calculation: CFU (Colony Forming Unit)

$$\textbf{CFU/gm} = \frac{\textbf{Number of colonies X Dilution factor}}{\textbf{Volume plated (in ml)}}$$

Observation Table:

Sample	Dilution	No. of Colonies	CFU/g Feed	Remarks
Feed A				
Feed B				

Result:

The total viable bacterial count in the feed sample is _____ CFU/g, which is within/above the acceptable safe range, indicating that the feed is hygienic and safe / potentially unsafe for animal consumption.

COLIFORM TEST

Aim:

To detect and estimate the presence of coliform bacteria in animal feed, indicating potential fecal or environmental contamination.

Principle:

Feed samples are diluted and inoculated on selective media (e.g., MacConkey agar). Coliforms ferment lactose producing acid and/or gas, which is visible as pink colonies or gas bubbles. Counting colonies allows estimation of coliform load in CFU per gram of feed, indicating the level of contamination.

Requirements:

- Feed sample
- Peptone water or saline
- MacConkey agar plates
- Sterile pipettes and spreaders
- Incubator (37°C), Autoclave, Test tubes

Procedure

1. **Sample Preparation:** Weigh 10 g of feed and mix in 90 ml peptone water (10^{-1} dilution).
2. **Serial Dilution:** Prepare further dilutions (10^{-2}, 10^{-3}) if needed.
3. **Plating:** Pipette 1 ml of each dilution onto MacConkey agar plates. Spread evenly.
4. **Incubation:** 37°C for 24–48 hours.

Observation:

- Pink/red colonies indicate lactose-fermenting coliforms.
- Gas production in enrichment broth (if used) also confirms coliform presence.

Calculation: CFU (Colony Forming Unit)

$$\textbf{CFU/gm} = \frac{\textbf{Number of colonies X Dilution factor}}{\textbf{Volume plated (in ml)}}$$

Observation Table:

Sample	Dilution	No. of Colonies	CFU/g Feed	Remarks
Feed A				
Feed B				

Result:

The total coliforms count in the feed sample is _____ CFU/g, which is within/above the acceptable safe range, indicating that the feed is hygienic and safe / potentially unsafe for animal consumption.

SALMONELLA TEST

Aim:

To detect the presence of *Salmonella* spp. in animal feed, ensuring feed safety and preventing foodborne infections in animals.

Principle:

The test involves pre-enrichment, selective enrichment and plating on selective media. Pre-enrichment allows stressed bacteria to recover. Selective enrichment suppresses non-Salmonella bacteria. Colonies are confirmed via characteristic morphology, biochemical tests and sometimes serological tests. Presence indicates contamination, requiring corrective measures.

Requirements:

- Feed sample (10 g)
- Peptone water (pre-enrichment)
- Selective enrichment broths (e.g., Rappaport–Vassiliadis, tetrathionate broth)
- XLD (Xylose Lysine Deoxycholate) or BGA agar plates
- Incubator (37–42°C)
- Sterile pipettes, test tubes, spreaders

Procedure

1. **Pre-enrichment:** Mix 10 g feed with 90 ml peptone water (10^{-1} dilution). Incubate at 37°C for 18–24 hours.
2. **Selective enrichment:** Transfer 1 ml of pre-enrichment broth to selective enrichment broth. Incubate at 42°C for 24 hours.
3. **Plating:** Streak a loopful of enrichment onto XLD or BGA agar plates. Incubate at 37°C for 24–48 hours.

Observation:

Look for characteristic *Salmonella* colonies: red colonies with black centers on XLD.

Observation Table:

Sample	Medium	Colony Morphology	Result (Presence/Absence)
Feed A	XLD or BGA	Red with black center	
Feed B		No typical colonies	

Result:

The feed sample _____ (is / is not) contaminated with *Salmonella* spp., indicating feed safety / need for corrective action.

MOLD AND YEAST COUNT

Aim:

To determine the presence and quantity of molds and yeasts in animal feed to assess feed quality and safety.

Principle:

Feed samples are diluted and plated on selective agar (e.g., Potato Dextrose Agar, Sabouraud Dextrose Agar). Molds and yeasts grow as visible colonies, which can be counted after incubation. The colony-forming units per gram (CFU/g) indicates the microbial load and feed hygiene.

Requirements:

- Feed sample (10 g)
- Sterile peptone water or saline
- Potato Dextrose Agar (PDA) or Sabouraud Dextrose Agar plates
- Sterile pipettes, spreaders
- Incubator (25–28°C), Autoclave, Test tubes

Procedure:

1. Weigh 10 g of feed and mix with 90 mL sterile peptone water (10^{-1} dilution).
2. Prepare serial dilutions (10^{-2}, 10^{-3}) as needed.
3. Plate 1 mL of each dilution onto PDA or SDA plates.
4. Spread evenly with a sterile spreader.
5. Incubate at 25–28°C for 3–5 days.

Observations: Count mold and yeast colonies.

Calculation: CFU (Colony Forming Unit)

$$\textbf{CFU/gm} = \frac{\textbf{Number of colonies X Dilution factor}}{\textbf{Volume plated (in ml)}}$$

Observation Table:

Sample	Dilution	No. of Colonies	CFU/g Feed	Remarks
Feed A				
Feed B				

Result:

The feed sample showed _____ CFU/g of molds and yeasts, indicating that the feed is safe / potentially unsafe due to microbial contamination.

15. METHODS OF STORAGE OF ANIMAL FEED

Introduction:

Proper storage of animal feed is essential to maintain its nutritional quality, prevent spoilage and protect against pests, mold and microbial contamination. Domestic and pet animals require clean, safe and palatable feed. Effective storage ensures consistent feed availability, reduces waste and supports optimal growth, health and productivity of the animals.

Methods:

1. Bag Storage

- Feed packed in jute, polypropylene or polyethylene bags.
- Stack on pallets to prevent moisture and rodent access.
- Suitable for dry pellets, kibbles and concentrates.
- FIFO (First-In, First-Out) ensures older feed is used first.
- Regular inspection prevents spoilage and pest infestation.

2. Trough or Bin Storage

- Feed stored in metal or plastic bins/troughs for easy access.
- Prevents scattering, moisture and pest contamination.
- Ideal for small-scale feeding of domestic animals.
- Bins must be cleaned regularly to maintain hygiene.

3. Cool and Dry Storage

- Feed kept in ventilated rooms with low humidity.
- Protects feed from mold, insects and nutrient loss.
- Suitable for kibbles, pellets and dry treats.
- Use racks or shelves to avoid direct contact with the floor.

4. Pellet or Block Form Storage

- Compressed feed reduces bulk and increases shelf life.
- Minimizes feed spillage and wastage.
- Easy to store and handle at home.
- Store in cool, dry areas to maintain nutrient quality.

5. Refrigerated or Frozen Storage

- High-moisture feed, wet food or perishable ingredients stored under low temperature.
- Slows microbial growth and preserves nutrients.
- Avoid repeated thawing to prevent spoilage.
- Suitable for wet pet food, raw meat diets or homemade feed.

6. Silage (for backyard/domestic livestock)

- Anaerobic storage of green fodder in pits or bags.
- Fermentation preserves nutrients for cattle, goats or rabbits.
- Proper sealing and compaction prevent mold.
- Useful for year-round availability of fresh feed.

Benefits of Proper Feed Storage:

- **Maintains Nutritional Quality:** Prevents nutrient loss, ensuring animals receive balanced diets.
- **Prevents Microbial Contamination:** Reduces growth of bacteria, molds and yeasts.
- **Reduces Feed Wastage:** Protects feed from pests, moisture and spoilage.
- **Ensures Animal Health:** Minimizes diseases caused by contaminated feed.
- **Cost-Effective:** Preserves feed for longer periods, saving money on frequent purchases.
- **Consistency in Feeding:** Guarantees regular availability of quality feed for domestic and pet animals.
- **Enhances Productivity:** Supports growth, reproduction, lactation and overall animal performance.

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