Course Code: ANGB 116 **Course Title: Fundamental Nutrition (Practical)**	**Credit Hour: 1**	**Level: 1**	**Semester: I**
Rationale: This course is arranged to provide practical knowledge about laboratory equipment and techniques related to fundamental nutrition.			
Course Learning Outcomes: The major learning outcomes of this course are to- acquire knowledge about laboratory safety introduce with the laboratory equipment gather knowledge about different laboratory techniques related to animal nutrition identify and characterized different feeds and fodder			
Intended Learning Outcomes (ILOs) The students will able to-	**Course Content**	**Teaching-Learning Strategies**	**Assessment Strategies**
✓ assess the laboratory safety ✓ apply safety materials during emergency ✓ know the caution in laboratory	General laboratory safety	Lecture Interactive discussion Visual presentation Demonstration Hand on practice Group exercise Practical note book preparation	Quiz Short answer Demonstration performance Identification Practical note book Viva voce Class attendance
✓ explain the principles and procedure of sampling ✓ define sampling related terms ✓ know the coning and quartering procedure ✓ apply sample packing and transportation ✓ use the process for feed sample preparation	Sampling principles and procedures	Lecture Interactive discussion Visual presentation Demonstration Hand on practice Group exercise Practical note book preparation	Quiz Short answer Demonstration performance Identification Practical note book Viva voce Class attendance
✓ know the functions of laboratory equipment ✓ use the laboratory equipment	Identification of laboratory equipment	Lecture Interactive discussion Visual presentation Demonstration Hand on practice Group exercise Practical note book preparation	Quiz Short answer Demonstration performance Identification Practical note book Viva voce Class attendance
✓ explain the principles and procedures of proximate analysis of feedstuffs ✓ describe the merits and demerits of proximate analysis	Principles and procedures of proximate analysis of feedstuffs	Lecture Interactive discussion Visual presentation Demonstration Hand on practice Group exercise Practical note book preparation	Quiz Short answer Demonstration performance Identification Practical note book Viva voce Class attendance
✓ determine the moisture level of feed ✓ calculate the dry matter portion present in feed ✓ explain the use of hot air oven	Determination of moisture & dry matter in feed stuffs	Lecture Interactive discussion Visual presentation Demonstration Hand on practice Group exercise	Quiz Short answer Demonstration performance Identification Practical note book

		Practical note book preparation	Viva voce Class attendance
✓ calculate the N_2% present in feed ✓ determine the crude protein present in feed ✓ explain the use of kjeldahl machine	Determination of crude protein in feed stuffs	Lecture Interactive discussion Visual presentation Demonstration Hand on practice Group exercise Practical note book preparation	Quiz Short answer Demonstration performance Identification Practical note book Viva voce Class attendance
✓ find out crude fibre from the sample ✓ describe the use of fibre analyser ✓ explain the use of muffle furnace	Determination of crude fibre in feed stuffs	Lecture Interactive discussion Visual presentation Demonstration Hand on practice Group exercise Practical note book preparation	Quiz Short answer Demonstration performance Identification Practical note book Viva voce Class attendance
✓ calculate the ash% present in feed ✓ know the use of muffle furnace	Determination of ash in feed stuffs	Lecture Interactive discussion Visual presentation Demonstration Hand on practice Group exercise Practical note book preparation	Quiz Short answer Demonstration performance Identification Practical note book Viva voce Class attendance
✓ determine the ether extract ✓ explain the use of soxhlet apparatus	Determination of ether extract in feed stuffs	Lecture Interactive discussion Visual presentation Demonstration Hand on practice Group exercise Practical note book preparation	Quiz Short answer Demonstration performance Identification Practical note book Viva voce Class attendance
✓ calculate nitrogen free extract in feed stuffs ✓ describe the components of nitrogen free extract	Calculation of nitrogen free extract in feed stuffs	Lecture Interactive discussion Visual presentation Demonstration Hand on practice Group exercise Practical note book preparation	Quiz Short answer Demonstration performance Identification Practical note book Viva voce Class attendance
✓ identify the feeds and fodder ✓ characterize different feeds and fodder ✓ differentiate different types of feeds and fodder ✓ know the nutritive value of livestock feeds	Identification of feeds and fodder	Lecture Interactive discussion Visual presentation Demonstration Hand on practice Group exercise Practical note book preparation	Quiz Short answer Demonstration performance Identification Practical note book Viva voce Class attendance

Reference Books

A. Sahoo, S.K. Sankhyan, S.A. Karim. 2015. Techniques in Animal Nutrition Research. Satish Serial Publishing House. India.

D.V. Reddy. 2018. Principles of Animal Nutrition & Feed Technology. 3rd Edn. Oxford & IBH. India.

G.C. Banerjee. 1988. Feeds and Principles of Animal Nutrition. Oxford & IBH. India.

P. McDonald, J.F.D. Greenhalgh, C.A. Morgan, R. Edwards, L. Sinclair and R. Wilkinson. 2012. Animal Nutrition. Pearson Education, UK.

T.M. Prabhu and K. Chandrapal Singh. 2013. Analytical Techniques in Animal Nutrition Research. New India Publishing Agency. India.

Experiment: 01
General laboratory safety

Laboratory safety:

- ✓ Importance of accuracy & precision of laboratory analyses.
- ✓ Importance of caution in the laboratory & follow the analytical principle.

Points of caution in the laboratory:

- ✓ A laboratory uniform or gown are appropriate appeared for use.
- ✓ Unfamiliar chemicals are hazardous.
- ✓ Laboratory equipment and glass ware should be stored cleanly.
- ✓ Reagents and laboratory equipment which are used in the laboratory must always be kept in the same place.
- ✓ When using the reagents always read the label. The reagents must not be contaminated with other chemicals.
- ✓ When explosive or flammable materials are used safety procedures must be followed.
- ✓ Hazardous materials should be handled with helping hand.
- ✓ Running experiment should not be leaved.
- ✓ When all equipment and machines are used the detailed instructions and safety procedures must be followed.
- ✓ Choose appropriate method to ensure that the experiment is carried out smoothly.
- ✓ Glassware used in the experiment should be washed appropriately, dried and kept in storage.
- ✓ The experimental process, results & suggestions should be recorded in a laboratory record book.
- ✓ When the experiment is finished, check the gas, electricity & equipment before placing them in the storage cabinet.
- ✓ Eating, drinking is restricted in the lab.
- ✓ Food and beverage storage in lab. Should be avoided.
- ✓ Using of mouth pipette should be avoided.

Prevention of accidents:

Many accidents occur in the laboratory when precaution or safety regulations are ignored. The causes of accidents are mainly from burns or chemical injuries and improper laboratory equipment or broken lab glassware. Accidents in the laboratory are mainly injuries, chemical, poisonings, fires, explosions and electrical shock.

Fire:

Most fires in the laboratory are coursed by flammable materials such as ether, benzene, acetone & alcohol. Because the danger of fires caused by these flammable materials in always high, caution is always needed & it is best not to be in direct contact with these materials. When fire occur, the following treatments must be carried out as quickly as possible-

- ✓ First save the life.
- ✓ Then the substance causing the fire must be removed and the flammable material placed for away.
- ✓ Fires can be extinguished quickly using fire extinguishers or sand or $NaHCO_3$ can be used in place of the fire extinguisher & it is best not to use water first if possible.
- ✓ It must be determined if there are victims and these victims must be given emergency treatment.

- ✓ If the fire is completely extinguished the windows should be opened for ventilation, while the debris is being removed, the damage should be investigated.

Explosions:

Explosions often occur when flammable materials are heated or when there are distilled materials present. These also occur when caustic reagents such as nitrogenous picric acid, Sodium metals, $kClO_4$ & H_20_2 are mixed with volatile solvents like ether, hydrogen, oxygen, methane, acetylene & carbon monoxide.

There is a great danger of explosions when empty containers or sealed containers are burned. Sudden explosions cannot be prevented from occurring but when there is a possibility of their occurrence. The damage can be reduced by using iron or concrete walls for protection & having appropriate safety glasses worn at all times.

Experiment: 02
Sampling principles and procedures

Ingredient quality is the foundation on which an animal ration is built. Correct sampling and sample evaluation enables the processor to make inferences about the quality of incoming grain, protein sources, micro-nutrients, and finished feed. When change in the quality or type of feed is observed or suspected, it should be resampled immediately and sent to the laboratory for testing.

Some Definitions

Sampling: The action or process of taking samples of something for analysis.
Sample: A relatively small quantity of material, or an individual object, from which the quality of the mass, group, species etc. which it represents may be inferred.
Sample size: The number of units in the sample is known as the sample size.
Feed sampling: It is a process used to check that a food is safe and that it does not contain harmful contaminants, or that it contains only permitted additives at acceptable levels.
Composite Sample: A sample formed by compositing or accumulating and combining a number of discrete samples; useful in determining the average composition of a large amount, such as a shipload, carload, or truckload.
Discrete Sample: A sample representing a specific, usually small, amount of material. It also is known as an individual spot or grab sample and is useful in determining variations within a lot, adequacy of mixing, and other attributes that may vary throughout a larger amount of product or ingredient.

To obtain maximum benefit from feed testing we should take our samples as follows. So samples will truly represent what is being fed to our herd.

Baled hay: A core sample should be taken for each of 12-20 bales selected randomly from various locations in the lot. It should be drilled into end of bales to full depth of sampler in loose bales and to half depth in tight bales.
The core samples should be combined from the same lot into a cone shaped pile. The pile should be flattened & divided into quarters. The opposite is saved and repeated the mixing, coning and quartering process until the volume of sample is reduced to about ¼ kg.

Loose hay (long or chopped): The sampler is drilled in full depth in at least 12 random locations throughout the raw. The samples are should vertically and drilled at the spot where the hay is compressed by the weight of the operator.
Any weather damage surface layer is discarded that would not be included in the part being fed or sold. The sample volume is reduced by coning & quartering to about ¼ kg.

Silage and fresh forage: About 12-16kg of silage or forage should be collected. It should be dug from 12 to 20 different spots over the entire freshly exposed surface or face of the silage. In case of using mechanical unloading, the 12-16kg from random spots should be collected as the silage in fed. The sample is mixed thoroughly and the volume of the sample is reduced about to 4kg coning and quartering. "Fresh cut forage" samples are collected as it is fed or from random locations throughout the field.

Grains and other granular feeds: About 12 to 20 small samples are taken from bags or bulk store of the sample lot of fed with a sampling tube (of by hand) or grain probes or bag triers or

spatula can be combined to make up a sample. This sampling can be to a volume of about 0.5-1.0kg coning and quartering.

Coning and quartering procedure:
Pile sample into a cone
Flatten core into sample
Divided into quarter
Reduce volume by removing opposite quarters.

Sample packing and transportation:
The sample is placed in a plastic bag to prevent moisture loss (wrap sample in second bag to make it more airtight) & then it is places inside the suitable containers for shipping. Samples of silage, fresh forage and other feeds with less fresh than 80% dry matter will begin to decompose in the sample bag. So they should be mailed early in the week to avoid sitting over the weekend. Otherwise they should be delivered to the laboratory as soon as possible after sampling, if there must be a delay after sampling, before mailing or delivering, the samples of feed must be kept in refrigerator.

PREPARATON OF SAMPLES FOR CHEMICAL ANALYSIS

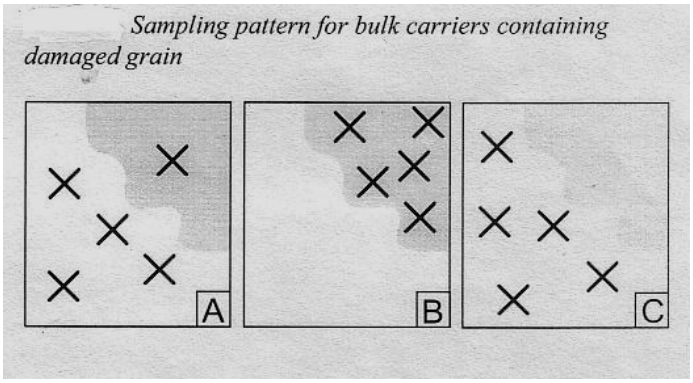
It has been experienced that chemical changer's occurs during oven drying because of the direct effect of high temperature or of enzymatic or bacterial changes during the early stage of drying or less of volatile constituents. Feeds contain molasses should be ground in a mortar.

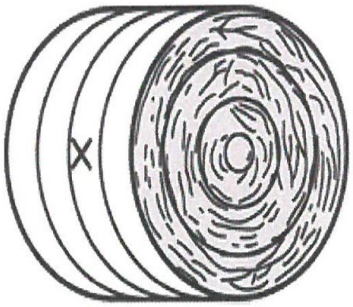
Dried materials should be ground to pass 1mm sieve. It is usually recommended in the case of samples those are expected to lose moisture drying the treatments are usually pre-dried.

If wet samples are used directly in the assay, a sufficient large quantity has to be weighed out in the first stage, roughages about 250-1000 g are used, somewhat dependent upon homogeneity and moisture content of the wet material.

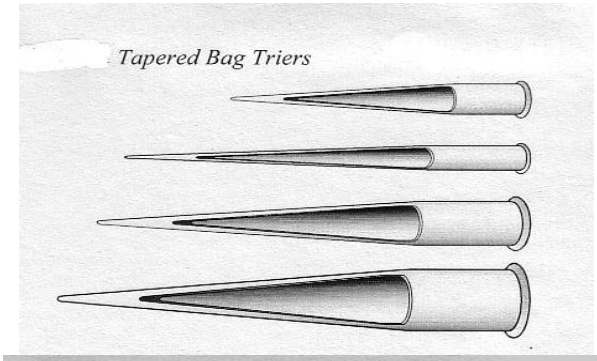
These samples are weighed into trays and dried in draft over at 60^0-70^0c. The dry samples are then again weighed, to give the moisture content. The trays are then left to equilibrate in air at room temperature for 2 days before second reweighing of the trays with sample. Then the matter is milled and filled into an airtight container & labeled as dry samples.

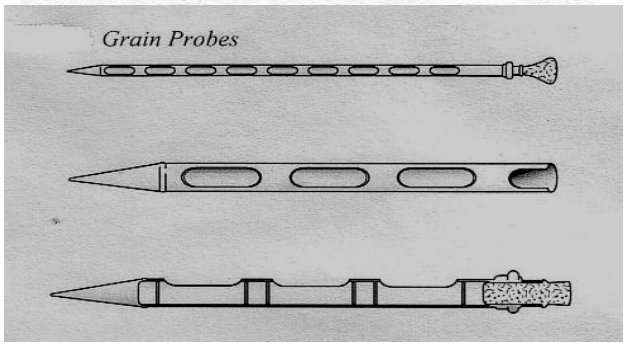
A series of experiments have been conducted to demonstrate the effect of mode of preparing & drying the sample on the chemical constituents.

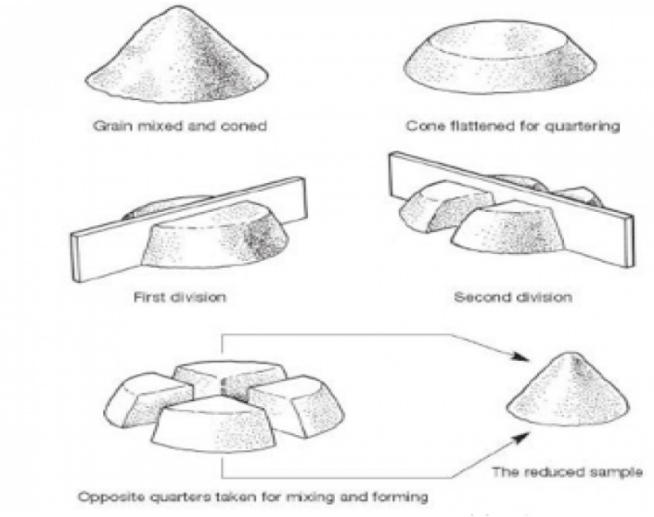

Sampling pattern for bulk carriers containing damaged grain
A
B
C

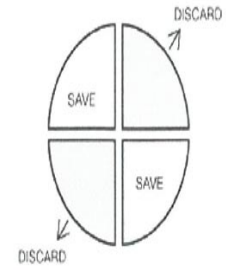


Baled Hay


Tapered Bag Triers


Grain Probes





QUARTERING A SAMPLE
(TOP VIEW)

Coning and quartering

Experiment: 03
Identification of laboratory equipment

1. Hot air oven
   - Picture is already captured by students
   - Functions are discussed in class

2. Electric digital balance (.001g to 200g)
   - Picture is already captured by students
   - Functions are discussed in class

3. Muffle furnace
   - Picture is already captured by students
   - Functions are discussed in class

4. Desiccator
   - Picture is already captured by students
   - Functions are discussed in class

5. Spatula
   - Picture is already captured by students
   - Functions are discussed in class

6. Metal tongue
   - Picture is already captured by students
   - Functions are discussed in class

7. Digital water bath
   - Picture is already captured by students
   - Functions are discussed in class

8. Kjeldahl apparatus
   - Picture is already captured by students
   - Functions are discussed in class

9. Soxhlet apparatus
   - Picture is already captured by students
   - Functions are discussed in class

10. Laminar air flow cabinet
    - Picture is already captured by students
    - Functions are discussed in class

11. Automatic crud fibre analyzer
    - Picture is already captured by students
    - Functions are discussed in class

Experiment: 04
Principles and procedures of proximate analysis of feedstuffs

"Hennerberg" and “Stohmann” working at the Weende Agricultural experimental station in Germany in 1865 and devised a scheme for the routing description of animal feed stuffs. It is now commonly known as the Weende Analysis or The proximate analysis.

In this system of analysis various nutrients that have common properties were grouped together and analyzed. These nutrients are known as proximate components or fractions. Feed stuffs are analyzed in six fractions or components.

- ✓ Moisture
- ✓ Crude protein (CP)
- ✓ Crude fibre (CF)
- ✓ Nitrogen free extract(NFE)
- ✓ Ether extract (EE)
- ✓ Ash

Carbohydrate can be grouped into two parts-

- Crude fibre (CF)
- Nitrogen free extract (NFE)

MOISTURE

The determination of dry matter in feed stuffs involved the estimation of water of the sample by heating in an oven at 103±1 ^{0}c temperature up to constant weight for a period of 4 hours or more. The loss of weight of the sample during heating was considered as the amount of water moisture and the remaining residue left was the dry matter (D.M)

EE

One portion was used to determine crude fat or ether extract by ether extraction. This was a combination of sample fat, fatty acid, esters, natural fat, sterols, pseudo fat (Vit-A,D,E,K) waxes and carotene. Fat was estimated by extraction with di-ethyl ether in a soxhlet apparatus. After extraction is completed the difference in the weight of empty collection flask and the flask containing extracts was considered as crude fat.

CP

The second portion of the sample was used to determine crude protein (C.P) by kjeldahl digestion method where organic matter was digested. By heating is concentrated H_2SO4. From the Nitrogen containing organic molecules, ammonium sulphate was formed. The amount of NH_3 was estimated by distillation and them titrated against standard acid solution in order to get N content of sample. This amount of N was multiplied by the factor 6.25 to estimate crude protein content. The factor 6.25 is based on the assumption that all proteins contain 16% Nitrogen where the determination of N content of the feed sample is considered.

CF

The last portion of sub-sample in order to determine CF and ash was boiled for 30 minutes with 1.25% H_2SO4 and they filtered. The residue was boiled for 30 minutes with 1.25% NaOH and filtered. The residue was dried, weighed and ignited at 600^{0}c temperature. As a result the loss of weight was drooled as crude fiber and the residue was ash.

In the Weendes system of analysis insoluble organic residues is devoted as crude fibre (a coarse fibrous fraction)
It is composed of
Cellulose
Variable proportion of hemicelluloses
Highly variable proportions of lignin along with some minerals.

NITROGE4N FREE EXTRACT (NFE)
It is composed of water soluble vitamins, Monosaccharide (Pentose, hexose), oligosaccharides (Compound sugar) and polysaccharides (starch). It is determined by subtraction values of all fractions, i.e., water. C.P, E.E, C.F and Ash from 100. Nitrogen free extract is calculated using the following formula:
For fresh sample, %FFE= 100 - %of (Moisture +CP+EE+Ash)
For dry sample, % of NFE= 100-% of (CP+CF+EE+ Ash)

COMPONENTS OF DIFFERE4NT FRACTION IN THE PROXIMATE ANALYSIS OF FEED STUFFS:

Fraction	Components
(1) Moisture	Volatile acids and bases of present
(2) Ash	Essential elements: Major elements-Ca, P, Na, Mg, S, Cl, K Trace or minor – Fe, Mn, Cu, Co, I, Zn. Mo, Se, Cr, Si, Sn, As, Ni Non-essential elements- Ti, Al, Bo, Ni
(3) Crude fat (EE)	Fats oils, pigments, steroid. Fat soluble vitamins, waxes, organic acids,
(4) Crude protein (CP)	Proteins, amino acids, amines, nitrates, glyco lipids, B-vitamins, nucleic acids
(5) Crude fibre (CF)	Cellulose, hemi-cellulose and lignin
(6) Nitrogen free extract (NFE)	Cellulose, hemi-cellulose, fructan, tannin, water soluble vitamins, starch, pectin, organic acids, lignin, sugar etc.

MERITS OF PROXIMATE ANALYSIS:
Proximate analysis is the only method by which we can easily analyze the chemical composition of feed, faces, body tissues etc. From the chemical composition of feed faces we can calculate the digestibility and utilization of feed stuffs to arrive the nutritive value.
The determination of proximate component is frequently the starting point more detail analysis for specific nutrients.
The chemical analysis helps to elaborate understanding of the nutritional phenomena in feeding and metabolism experiments.
This is the method which required less cost involvement than any other method.
This is the only method which has not sophisticated instruments.
It is the common basis for feed purchasing and ration formulation.

DEMERITS OF PROXIMATE ANALYSIS:
Ether extract determined by this method contains not only true fat but also fat like substances, such oil waxes, pseudo lipids (Vit-A,D,E,K) etc. Here ether extract is being multiplied by 2.25 for obtaining energy but among those fat and fat like substances only true fat gives energy and the others do not. As a result the energy value of a feed is over estimated by this method.

This method estimates total nitrogen not estimate protein nitrogen and not-protein nitrogen separately. Again it estimates CP from the total nitrogen. We multiply this value by 6.25 assuming that all protein contain 16% N which is not correct because protein contains 14-18%N. So It may over estimate or under estimate the protein content of a feed.
We can't determine the vitamins by this method .
During the estimation of crude fibre of a sample when acid-alkali boiling, the hemicelluloses are partially destroyed. So we cannot get correct value of crude fibre.
There is no direct method for estimation nitrogen free extract (NFE) content of a sample. So we cannot get the correct value of NFE.

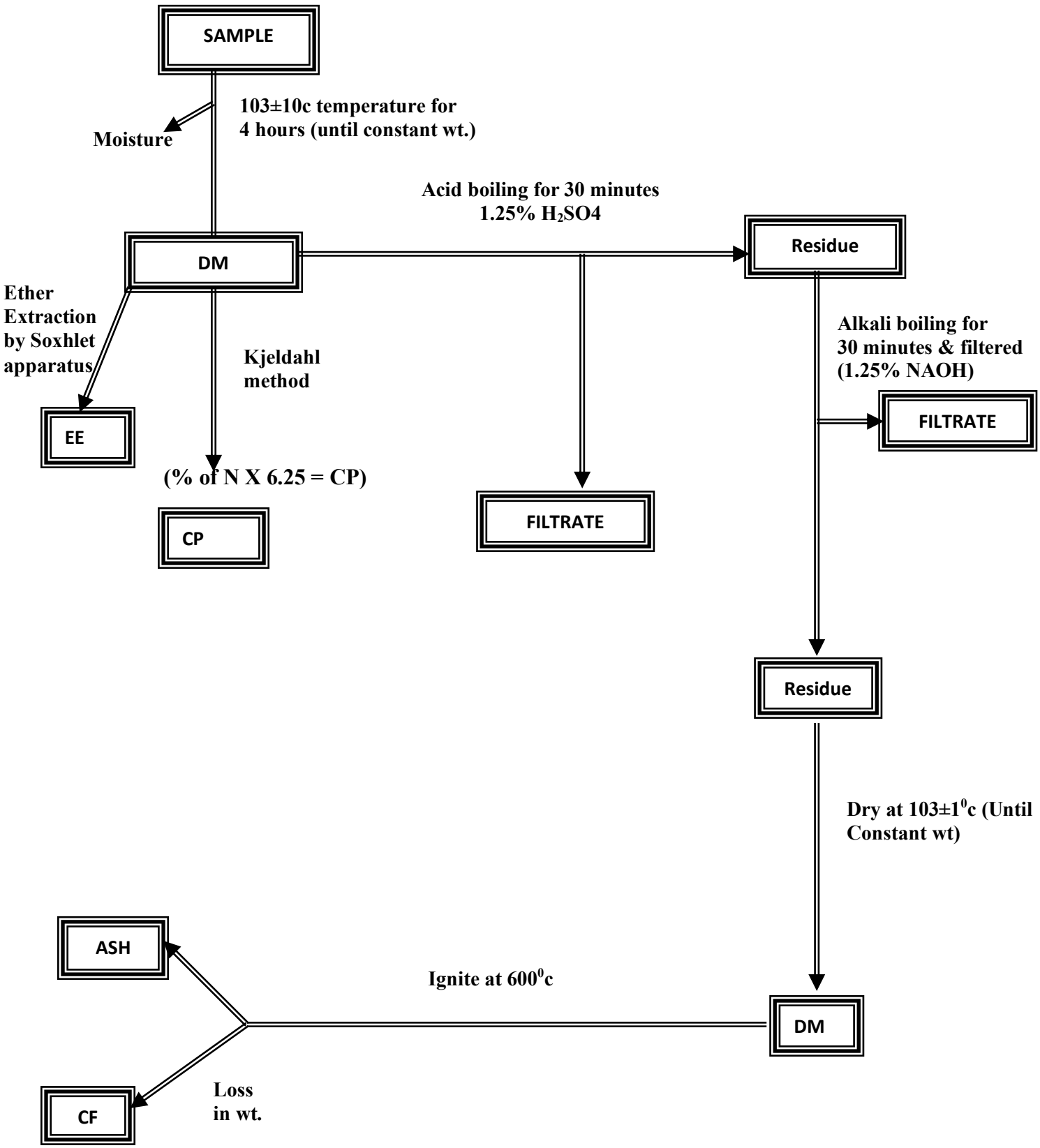


Figure: Flow Chart or Schematic Diagram of Proximate Analysis or Weende Analysis (1865)

Experiment: 05
Determination of moisture & dry matter in feedstuffs

PRINCIPLE:

The determination of dry matter of a feed sample is involved the elimination of moisture of the sample by heating it in the over at a temperature of 103 ± 1^0c until constant heat. The loss of weight of this sample during heating is considered as the amount of water or moisture and the remaining residue left is the dry matter and the heating period is usually 4 hours.

PEQUIREMENTS:

Crucible
Balance
Oven
Metal tong
Desiccator
Spatula
Feed sample

PROCEDURE:

The crucible was dried in the oven and then it was cooled and weighed. The crucible was handled with the metal tong.
About 3-5 grams of sample (for light materials about 3g) was taken or weighed into a previously weighed empty crucible or enamel.
Then the crucible was kept with sample into an oven at 103 ± 1^0c for a period of 4 hours.
After getting constant weight the crucible was removed on the oven and then it was cooled in the desiccators for half an hour.
Then weighing the sample.
Then put the sample again in oven for half an hour (there was no further loss in weight) then cool in desiccators for half an hour.
Then weighing the sample again, if the present wt. and previous wt. is similar then calculates the dry matter.
The dry matter was calculated by the following formula.

$$\% \text{ DM} = \frac{\text{Wt of the sample after drying}}{\text{Wt of the dample befor drying}} \times 100$$

RESULT: The dry matter of the supplied sample was ---------% and the moisture ----------%

Experiment: 06
Determination of crude protein in feedstuffs

Principle:

The determination of crude protein actually involves the determination of total nitrogen content of the supplied sample which is then multiplied by the factor 6.25, assuming that most protein content 16% nitrogen (14-18%), the material is digested with concentrate H_2SO_4 which convert all nitrogen into $(NH_4)_2SO_4$. The solution is cooled and NaOH is added to make the solution alkaline and volatile ammonia is distilled into a weak acid, boric acid. The ammonia from this solution is then entrapped as ammonium borate by distillation and quantified by titration against decinormal HCl.

Assumption

1. All N_2 percent in the sample is protein
2. All protein contain 16% N_2

Apparatus:

1. Kjeldahl flask
2. Digestion chamber
3. Distillation set
4. Conical flask
5. Measuring cylinder
6. Burette with stand
7. Balance
8. Nitrogen free paper
9. Pipettes
10. Hand gloves

Reagents:

1. Conc. H_2SO_4
2. 2% H_3BO_3 (Boric Acid)
3. 40% NaOH solution
4. 0.1 N (Deci-normal) HCl solution
5. Mixed indicator/Tashiro's Indicator (2g Methyl red+1g Methyl blue+1000ml alcohol [95%])
6. Zn and glass pieces
7. Catalizer mixer (100g K_2SO_4+10g$CuSO_4$+1g Selenium)

Procedure:

A) Digestion:

1) 1g of the prepared sample was weighedout on a N_2 free paper and placed it into a kjeldahl flask.
2) About 2g of catalizer mixture and 20ml conc. H_2SO_4 were added to the content of the flask.

3) The flask was secured on the heater of the digestion chamber and heated until a clear colourless solution was obtained. The flask was turned occasionally during digestion period.
4) After completion of digestion, the flask was removed; cooled and 100ml of distilled water was added.

B) Distillation:

1) 20 ml of 2% boric acid solution was taken in a conical flask and 2-3 drops of mixed indicator was added and placed on the collection arm of the distillation apparatus.
2) 90 ml of 40% NaOH solution was poured into the kjeldahl flask and also few Zn and glass pieces were added. The flask was then placed quickly on the distillation set and fitted with the condenser.

C) Titration:

1) About 90-100ml of the distillate was collected in the conical flask containing H_3BO_3 solution.
2) The conical flask was removed with the distillate and titrated against standard 0.1N HCl solution.

Calculation:

Total CP= N X A X 0.014 X 6.25

N= Normality of the HCl acid

A= ml. of HCl required during titration

W= wt. in grams of the material taken for the test

0.014= Mili equivalent wt. of N

% N= [{Titration value×0.014×normality of HCl (0.1N)} ÷ sample weight (DM)] ×100

%CP= %N×6.25

Result: The supplied sample contained……. % CP

Experiment: 07
Determination of crude fibre in feedstuffs

PRINCIPLE

Crude fibre is the portion of carbohydrate which is not dissolve in dilute acid or alkali and is resistance to usual enzymes produced by the animals. Crude fibre includes cellulose, Hemicellulose, Lignin etc.

APPARATUS

Balance
Crucible
Oven
Flask (Round bottle)
Beaker
Heater or digestion set
Muffle furnace
Desiccator
Litmus paper
Filtering cloth

REAGENTS:

1.25% H_2SO4 Solution
1.25% NaOH Solution
Distilled water

PROCEDURE:-

Two g of sample was weighed
The sample was then taken into a beaker & was added 125 ml 1.25% H_2SO4 solution and was filled to the condenser and was placed a heater. The sample was boiled for 30 minutes of constant volume of solution. The content was shaken every 5 minutes. After 30 minutes of boiling the beaker was removed from the heater and the sample was washed with the water through a filter cloth until it is free from acid.
The acid free sample was then transferred into another beaker and was added 125ml of 1.25% NaOH solution into the beaker and was fitted to the condenser. The sample was boiled for exactly 30 minutes at a constant volume of solution. The sample was filtered and the filtrate was washed with the water for free from alkali.
The washed filtrate was then transferred into a previously weighed empty crucible. It was placed on an oven at 103 ± 1^0c for removal of water from the sample. The crucible was removed and was placed it on a desiccator for cooling.
The crucible was removed from the desiccator & weighed and then ignited by the muffle furnaces at 550^0c-600^0c for 5-6 hours. Loss in weight due to ignition is the crude fiber content of the sample.

Result: CF% of the sample was=

Experiment: 08
Determination of ash in feedstuffs

PRINCIPLE:

Ash includes the inorganic or mineral components to feed sample which is obtained by ignition of the sample at 600^0c for five (5) hours. The ash content of a sample gives indication of total mineral matter not specific.

EQUIPEMENTS:

Electronic balance
Crucible
Muffle furnace
Spatula
Metal tong
Electric heater
Desiccator
Feed sample

PROCEDURE:

Dry crucible was placed in a muffle furnace for one hour. Then it was cooled in desiccator and weighed out of the crucible.
5-10 g of sample was taken into the previously weighed dried crucible and marked it and then it was placed in an electric heater to burn till the smoke was removed.
The crucible with its content was transferred inside the muffle regulated 600^0c for 5 hours.
After ignition the crucible was removed from the muffle furnace and was cooled in a desiccator and weighed.
Calculation of ash was done in the following formula

$$\% \text{ Ash} = \frac{\text{wt of the ingited sample}}{\text{wt ot the orginal sample}} \times 100$$

RESULT:

The percentage of ash in the supplied sample was ----------%

Experiment: 09
Determination of ether extract in feedstuffs

PRINCIPLE:

Crude fat includes all the portion of a feed that are soluble in ether. Hence crude fat has commonly referred to as ether extract (EE). Crude fat includes mostly fat but may also other ether soluble materials such as fat soluble vitamins, Carotene, Chlorophyll, Steroid, Phospholipids, waxes etc.

APPARATUS AND REAGENT:

Soxhlet apparatus
water bath
Thimble
Oven
Round bottom flask
Weighing balance
Crucible
Metal tong
Diethyl ether
Feed sample

PROCEDURE:

About 2 gm of dried sample was weighed out into an extraction thimble having porosity permitting rapid passes of ether.

2 .The thimble was placed in the soxhlet flask. It was made sure that the top to the thimble was above the siphon tube. The top of the thimble was covered with a piece of filter paper to prevent the ether dripping down from the condenser and splattering sample out of the thimble.

3. An extraction flask was weighted out accurately and it was fit with the condenser. It was placed in the water bath adjusted at 50^0-60^0 C and the ether was poured.

4. The flask was checked under soxhlet that it was ¾ full of ether. It was made sure that water was running through the condenser. Extraction period may vary from 4 hours at a condensation rate of 2-3 drops/second and 8 hours at a rate of 1-2 drops/second.

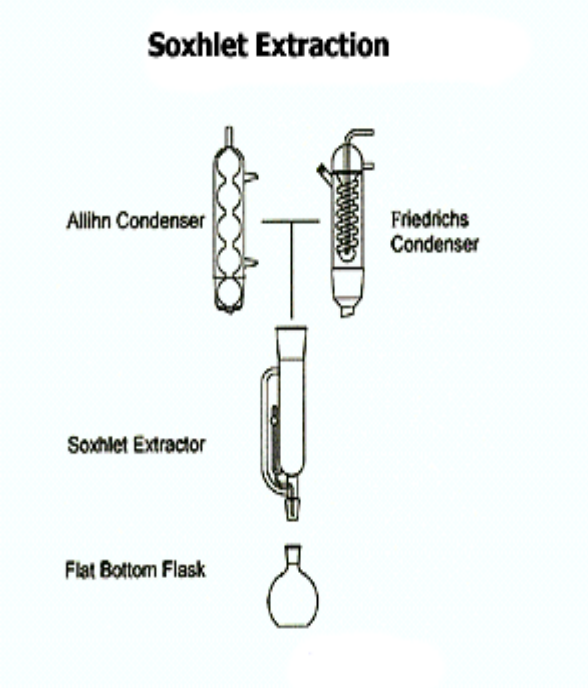
5. After 8 hours of extraction the thimble was removed from the soxhlet and also the flask was removed which contain ether.

6. The flask was dried by placing in an oven at 103^0c to eliminate ether.

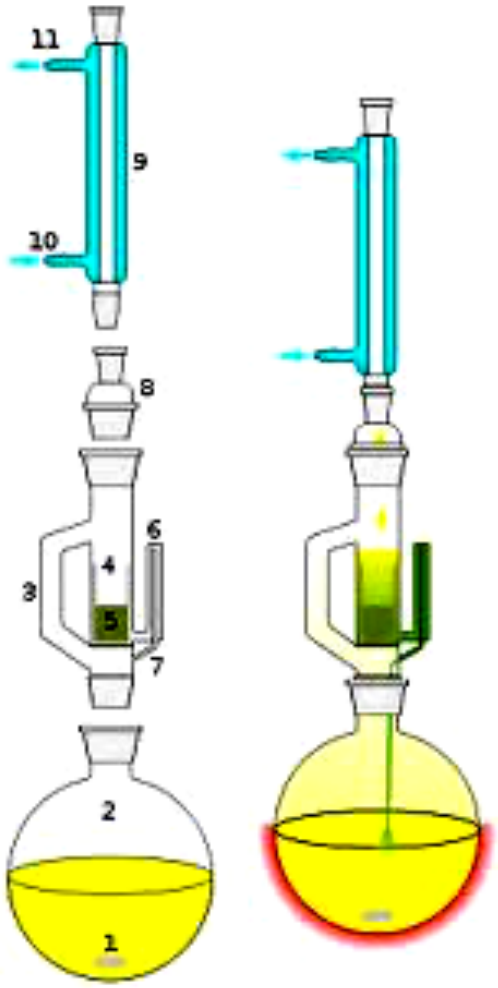
The flask was heated at the constant weight. The residue remained in the flask after drying in the oven was the fat and fat like substances that was ether extract.

$$\% \text{ of Ether extract or crude fat} = \frac{\text{wt. of the ether extract}}{\text{wt. of the sample}} \times 100$$

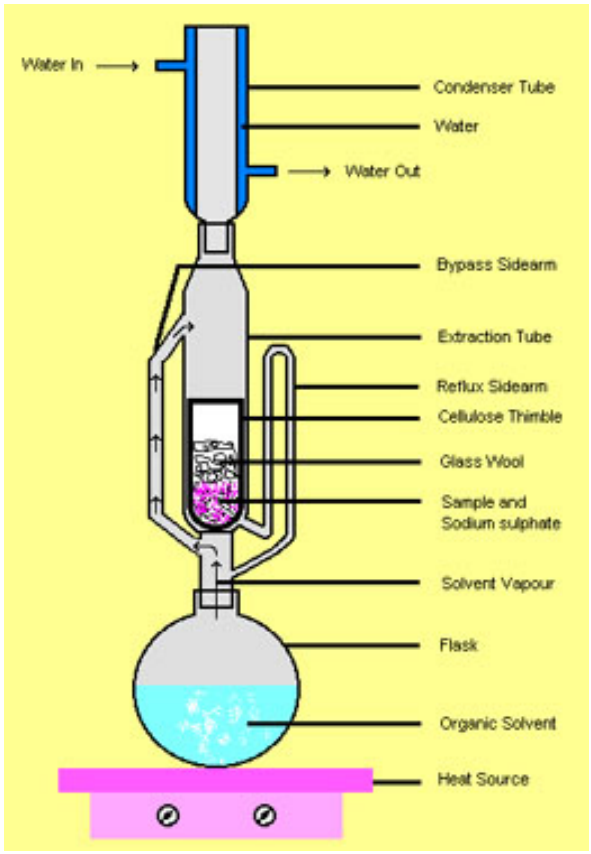
RESULT: The percentage of crude fat (EE) in the supplied sample was =----------%



Thimble

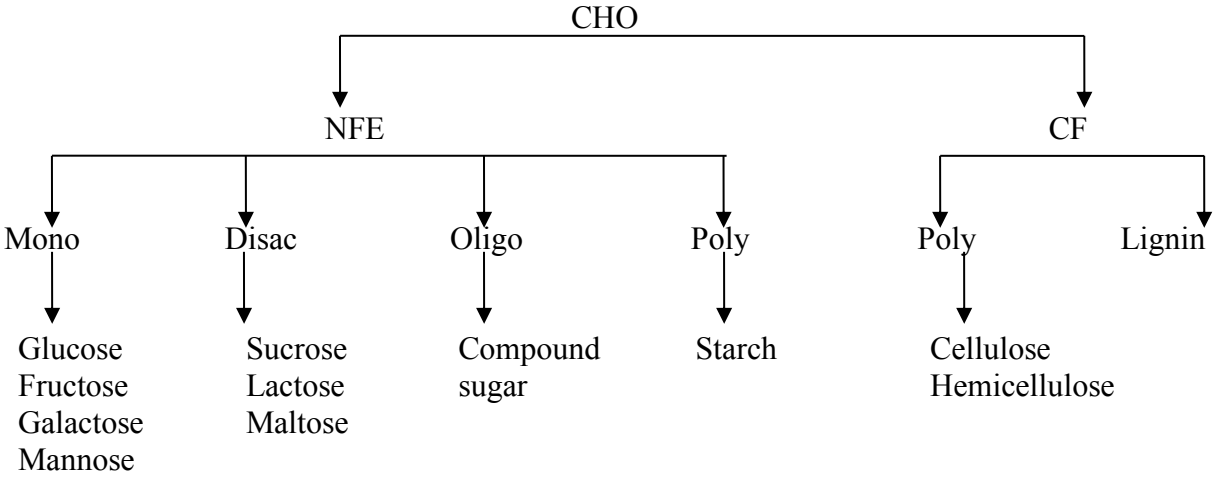


1: Stirrer bar/anti-bumping granules
2: Round bottle or flat bottle flask should not be overfilled and the volume of solvent in the flask should be 3 to 4 times the volume of the soxhlet chamber.
3: Distillation path
4: Soxhlet Thimble
5: Extraction solid (residue solid)
6: Syphon arm inlet
7: Syphon arm outlet
8: Reduction adapter
9: Condenser
10: Cooling water in
11: Cooling water out


Water In
Condenser Tube
Water
Water Out
Bypass Sidearm
Extraction Tube
Reflux Sidearm
Cellulose Thimble
Glass Wool
Sample and
Sodium sulphate
Solvent Vapour
Flask
Organic Solvent
Heat Source

Experiment: 10
Calculation of Nitrogen Fee Extract (NFE) in feedstuffs

NFE is that portion of CHO which is dissolved in 1.25% H_2SO4 and 1.25% NaOH solution. It is composed of water soluble vitamin, mono-saccharides (pentose, hexose), oligo-saccharides (compound sugar & poly-saccharides, starch).



Procedure

It is not chemically determined. It requires only a single mathematical calculation. It is determined by subtracting value of all fraction i.e. moisture, CP, EE, CF & Ash from 100.

There are two methods used for calculating nitrogen free extract i.e. for fresh sample and dry sample.

For fresh sample NFE = 100 – (%moisture + % CP + %EE + %CF + %Ash)

For dry sample NFE = 100 – (% CP + %EE + %CF + %Ash)

Calculation of NFE

Components with replication	Fresh basis	DM basis
DM%		
CP%		
EE%		
CF%		
Ash%		
NFE%		

Results: ……

Experiment: 11
Identification of feeds and fodder

Major feeds are roughage, concentrate, mineral supplements & vitamin supplements. Livestock needs all above feeds. Poultry needs all except roughage, although they need some leafy vegetables as roughage.
Classification with Examples of Livestock & Poultry Feeds:

1. Roughage Feeds:
A. Succulent or Green
i) Non-legume Fodders -Maize, Napier, Para, Bajra, Guinea, German, Jowar, Sorghum, Oats, Barley, Sudan grass etc.
Tree Leaves - Jack-fruit, Bamboo, Mander, Banana , Gigha etc.

ii) Legume Fodders- Cowpea, Khesari, Motor, Maticali, Dhancha, Berseem, Alfalfa or Lucern etc.
Tree Leaves- Ipil-Ipil, Bubla etc.

B Dry roughage
Straw (Non-legume): Rice, Wheat, Barley, Jowar, Maize
Straw (Legume): Khesari, Maticali, Motor, Cowpea etc.
Hay (Legume): Khesari, Maticali, Motor, Cowpea, Berseem
Hay (Non - Legume): Sorghum, Jowar, and Oats.

2. Concentrate Feeds:
A. Animal origin -
Fishmeal, Blood meal, Meat Offal, Meat Meal, Feather meal, Hatchery by product meal, Surplus milk etc.

B. Plant origin -
Products: Maize, Wheat, Barley, Oats, Sorghum, Bajra, Khesari, Maticali, Sweet potato etc.
By - products: Rice bran, Wheat Bran, Corn flower, Wheat flower, Bran of Khesari and Maticali, Molasses, oil cake etc.

(# Protein rich concentrate: Fish meal, Blood meal, Meat Offal, Meat Meal, Feather meal, Hatchery by product meal, Surplus milk, Oil cake, Bran of Khesari and Maticali etc)
(# Energy rich concentrate: Rice bran, Wheat Bran, Corn flower, Wheat flower etc.)

3. Mineral supplements: Oyster shell, Bone meal, Egg shell, Lime stone, Chalk powder, Common salt, Vitamin-mineral premix etc.

4. Vitamin supplements: All leafy vegetables, Yellow corn, Fish liver oil, Vitamin-mineral premix etc.

5. Feed Additives: Hormones, Enzyme, Coloring Materials, Flavoring agents etc.

Feed value of some common livestock feeds
(Dry Matter Basis)

Green Fodder (Roughage)	**CP %**	**EE %**	**CF %**	**NEF %**	**Ash %**	**DCP %**	**TDN %**
Napier	11.5	2.2	25.9	44.5	15.9	7.6	60
Para	10,8	2.34	29.25	46.94	10.67	6.9	56
Guinea	7.88	1.19	38.38	37.01	15.54	5.83	65
German	11.0	2.5	30.0	45.0	10.0	605	63
Bazra	16.0	2.0	28.2	38.4	14.0	9.0	61
Cowpea	28.1	3.0	26.7	33.0	9.2	20.3	62
Lucerne	20.2	2.3	30.1	36.7	10.7	16.2	60
Berseem	17.3	1.9	25.9	40.7	14.2	12.8	62
Khesari	30.64	1.26	8.21	56.3	3.52	22.9	76
Ipeal- Ipeal	24.25	5.07	14.07	46.23	9.88	15.1	56
Maize	12.1	1.1	29.6	44.2	13.3	6.0	65
Concentrates							
Wheat	10.5	1.1	1.9	83.8	1.9	6.3	92
Maize	10.6	3.3	2.2	82.1	1.8	7.0	87
Rice bran	14.0	20.4	14.1	35.7	15.8	9.1	76
Wheat bran	11.5	2.9	12.7	62.5	10.4	8.7	70
Mustard oil cake	35.1	14.1	8.2	30.4	9.2	25	72
Til oil cake	34.47	8.72	8.09	34.92	13.80	31	75
Soybean meal	41.7	21.2	6.3	26.0	4.8	--	--
Fish meal	43.1	4.3	3.6	11.5	37.5	35	77
Blood meal	73.4	-	0.7	-	6.0	66	79
Meat offal	53.0	10.0	2.2	8.7	-	48	70
Molasses	3.5	-	-	86.3	10.9	2.4	96
Gram husk	5.7	0.9	48.4	39.0	6.0	3.2	--
Straw(Roughage)							
Rice straw	3.91	7.37	35.92	43.95	14.85	0.3	43
Wheat straw	3.74	1.0	38.9	42.9	14.1	0.1	48
Mineral feeds							
Bone meal	Ca-30.0%, P-15.0%						
Oyster shell	Ca-38.0%						
Limestone	35.0%						
Sodium chloride	Na-38.35%, Cl-60.65%						
Vit-mineral premix	Source of vitamins and minerals						
Others							
Jack fruits leaf	12.24	3.0	19.46	52.86	12.28	-	-
Jack fruit waste	7.9	-	14.1	65.3	-	1.2	19.9
Sugarcane Top	1.5	0.6	9.0	-	-	-	-
Sugarcane bagasse	2.0	1.0	43.0	52	2.5	-	5
Water hyacinth	9.16	2.04	16.03	58.02	14.75	2.2	--
Urea	Non protein N_2 substance, N_2%- 46						