

# SCIENTIFIC FEEDING AND DIGESTIBILITY

DEPT OF ANIMAL NUTRITION

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# Scientific feeding & its Importance

- Knowledge of the quantitative needs of the body for these nutrients and of the relative value of feeds as source of them is known as scientific feeding.

# Feeding Experiments

1. Comparative Feeding Trials: When there is comparison in between two different feed stuffs
  - But we are unable to prove the superiority of one feed over other
2. Feeding trials with laboratory animals: results of experiment over lab animals are not implemented over farm animals it can be used as pilot study.
  - Cost of experiment is less
  - Individual and environmental variability is very less
  - Slaughter for chemical composition can be performed

# Feeding Experiments

3. Purified Diet method: it consist of purified sources of various nutrients such as
  - Protein: casein
  - Carbohydrate: Starch
  - Fat: lard or oil
  - Mineral and vitamin: pure salts or compounds
  
4. Germfree Technique: Intestinal organisms in the host sometime create complication in interpretation of data
  - Thus scientist develop “Specific Pathogen Free SPF” animals for experiments
  - Animals were totally free of contamination i.e. bacteria, yeasts, moulds etc.

# Feeding Experiments

5. Group feeding versus individual feeding:

6. Controlled versus Ad-Libitum feeding:

- Ad-lib feeding is most common
- It doesn't give result for certain purpose e.g. digestibility.
- In trials controlled feeding is followed

7. Equalized paired feeding:

8. Slaughter experiment:

# Digestibility

- Portion of feed or of any single nutrient of feed which is not recovered in faeces.
- When expressed in % known as digestibility coefficient.

$$\text{Dig. Coe. Of a nutrient} = \frac{\text{Amount of the nutrient in feed eaten} - \text{Amount of nutrient in the faeces}}{\text{Amount of nutrient in feed eaten}} \times 100$$

- Ex. 1 bullock consumed 10 kg grass hay and excreted 4 kg dung dry matter. Moisture content of hay 4%. Calculate Dig Coe.
- Dig coe. 58.3% this is Apparent Dig. Coe.
- Faeces contain many metabolic products like mucosal debris, unspent enzymes, microorganisms, undigested feed
- In the same e.g. dung DM excreted 3.7 kg + 0.3 kg from body
- True Dig Coe of DM= 
$$\frac{9.6-(4-0.3)}{9.6} \times 100 = 61.4\%$$
- Thus the value of true digestibility Coe. is always greater than Apparent Dig.

- Dig coe. are estimated for all organic nutrient
- But for ash dig. is never be estimated
  - It doesn't contribute to the energy content of the feed
  - Most of the absorbed minerals are excreted through gut
- Actually mineral availability can be determined by using isotopes (labelled minerals)



# Methods of determining digestibility

<b>1. <i>In vivo</i> method</b>	<b>Direct method</b>	
	<b>Indirect method</b>	<b>By difference</b>
		<b>By indicator/marker</b>
<b>2. <i>In sacco</i> method/semi <i>in vivo</i> method</b>		
<b>3. <i>In vitro</i> method</b>		

# *In vivo* methods (Direct Methods)

- Trials :
  - Digestion trials
  - Metabolic trials
- A digestion trials involves a record of the nutrient consumed and of the nutrient voided in faeces
- Metabolic trials is conducted to calculate the balance of nutrients retained in the body which requires quantitative collection of urine and milk besides the faeces.

# Norms adopted in conducting trials

- Selection of animals:
- Preliminary period:
  - In non ruminant 2-3 days
  - Ruminants 6-8 days
- Collection period:
  - 2-3 day adaptation period after transferring to cages
  - 3-5 day collection period in case of poultry and 7-10 day in ruminants
- Test feed:
  - Test feed shd not be deficient in any nutrient

- Limitation:
  - Some feeds are not fed alone as they either doesn't supply bulk or they doesn't fullfill the requirement
  - There digestibility shd calculated via indirect method

# *In vivo* methods (Indirect Methods)

- Digestibility by Difference:
  - Here two digestion trials are conducted
  - In first: animals are fed basal diet
  - In second: basal diet + test feed
  - Digestibility is calculated by difference
- The basal diet in such experiments should be of maintenance type
- There is an associative effect on digestibility of one feed over another.
- Digestibility determination in poultry

- Indicator Method: use of inert reference substance as an indicator/marker.

Ideal specification of indicator:

1. Totally indigestible and unabsorbable
2. No pharmacological action on digestive tract it shd be inert to digestive tract
3. It must mix intimately with and remain uniformly distributed in the digesta
4. It shd be pass through the tract at a uniform rate and shd be voided entirely
5. It can be readily be determined chemically
6. Preferably be a natural constituent of the feed under test

	<b>1. Internal or natural indicator</b>
	i.e. component of a feed e.g. lignin, silica, AIA
Indicators	
	<b>2. External Marker</b>
	e.g. Chromic oxide, carmine red

- Digestibility of a nutrient is calculated by estimating the concentration of the indicator in feed and faeces and that of the nutrient in the feed and faeces without the quantitative collection of total faeces and measuring the feed consumption

$$\text{Dig. Coe. Of a nutrient} = 100 - \left( 100 \times \frac{\% \text{ indicator in feed}}{\% \text{ indicator in faeces}} \times \frac{\% \text{ nutrient in faeces}}{\% \text{ nutrient in feed}} \right)$$



# Semi-*in vivo* technique

- Digestibility / Degradability of feeds in the rumen can be determined by keeping the feed sample in bags which are immersed in rumen contents of rumen fistulated animals.
- Bag is made up of nylon, dacron or silk cloth which is indigestible
- Bag shd be of very fine mesh so that the test feed particle shd not pass out of the bag undegraded also allow the rumen microbes to enter in the bag
- Bags are removed at different time interval and observe the % disappearance of different nutrient.

# Factors affecting degradability by semi in vivo method

- Particle size of the test feed
- Bag porosity
- Sample size to bag surface ratio
- Diet of the animal
- Bags per animal per incubation time
- Positioning of bags in the rumen
- Incubation length

# *In-Vitro* digestibility technique

- Digestibility of feed is estimated outside rumen using *in-vitro* rumen fermentation technique
- This is useful in evaluation of newer feedstuffs such as unconventional feeds.
  - a. One stage technique:**
    - Performed in the laboratory
    - Feedstuff is incubated with rumen liquor at 39<sup>0</sup> C under anaerobic condition
    - Test feed + artificial saliva + rumen inoculum
    - Determination of IVDMD and IVOMD

- b. Two stage technique:** one stage technique only simulates process in rumen
- Residue left after first stage is further treated with acid pepsin solution

# Factors affecting digestibility of feedstuff

- Broadly classified into 3 major categories

A. Animal Factor B. Plant Factor C. Feed Preparation

## A. Animal Factor

a. **Species of the animal:** ruminant can digest feedstuff in a better way than non ruminants

b. **Age of the animal:** young and old animals are less efficient in digestion of feed.

c. **Work:** light work improve digestibility than that of heavy work

d. **Individuality:** individual variation of upto 25% has been observed in animals with same feedstuff

e. **Level of feeding:** higher level of feeding lead to faster movement of feed from GI tract.

## **B. Plant Factor:**

**a. Chemical composition of feed:** grains are well utilized than that of forages

Digestibility of forage depends on soil composition, stage of maturity, frequency of cutting, variety and strain of plant.

## **C. Preparation of feed:**

- a. Particle size of feed
- b. Soaking of grains
- c. Processing of grains
- d. Nutrient content of ration

# Balanced Ration

- **Ration:** feed offered for a given animal during a day of 24 hrs may be at a time or in a proportion
- **Balanced ration:** that furnish nutrients in such proportion and amount that it will nourish animal for 24 hrs. and required nutrients must be contained in the amount of DM the animal is able to consume in the 24 hrs period



# Desirable Characteristics of a Ration

- Highly digestible
- Palatable
- Variety of feeds
- Enough mineral matter
- Fairly laxative
- Fairly bulky to satisfy hunger
- Ration should include green fodder
- Avoid sudden change in diet
- Maintain regularities in feeding
- Feed should be properly prepared and processed

# Energy Requirement for Maintenance

- Maintenance requirements are estimates of the amount of nutrients needed to achieve such equilibrium states.