

BIHAR ANIMAL SCIENCES UNIVERSITY

Bihar Veterinary College, Patna

Department of Animal Nutrition

Second Professional Year (UNIT-I)

**Direct and Indirect Calorimetry, Carbon & Nitrogen
Balance Studies
(Lecture-1)**

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Point to be discuss.....

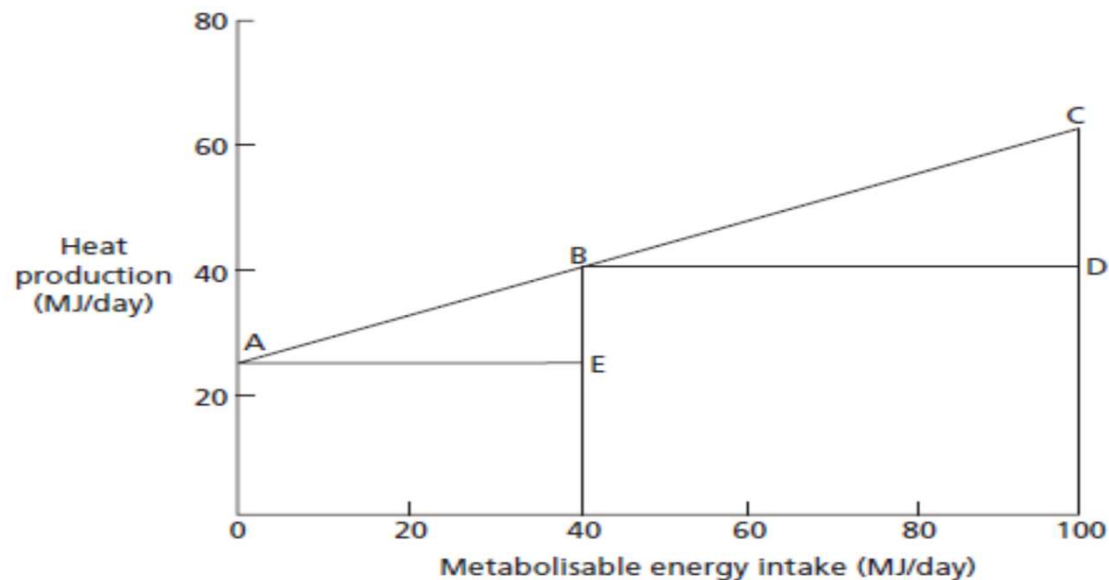
- ✓ **Animal calorimetry**
- ✓ **Methods for measuring heat production and energy retention**
- ✓ **Direct calorimetry**
- ✓ **Indirect calorimetry**

ANIMAL CALORIMETRY: METHODS FOR MEASURING HEAT PRODUCTION AND ENERGY RETENTION

- **Calorimetry means the measurement of heat.**
- **Measurement of heat production & energy retention in animals can be quite complicated, both in principle and in practice.**
- **Heat production of animals can be measured physically, i.e. direct calorimetry.**
- **Alternatively, heat production can be estimated from the respiratory exchange of the animal, i.e. indirect calorimetry.**
- **Respiration chambers can also be used to estimate energy retention rather than heat production, i.e. carbon and nitrogen balance technique**

Animal calorimeter

- **Animals do not store heat**, except for relatively short periods of time.
- **Measurements are made over a periods of 24 hours or longer**, it assume that the quantity of heat lost from the animal is equal to the quantity produced.



(A is the basal metabolism & B & C represent heat production at metabolizable energy intakes of 40 MJ and 100 MJ, respectively)

Direct Calorimetry

- Heat is lost from body principally by **radiation, conduction & convection from body surfaces & by evaporation** of water from the skin & lungs.
- Animal calorimeter is essentially an **airtight, insulated chamber**.
- In early phase calorimeters, **sensible heat losses** measured in water circulated through coils within the chamber & the quantity of heat removed from the chamber, then calculated from the flow rate of water & the difference between its entry & exit temperature.
- **Evaporative heat losses** measured by recording the volume of air drawn through the chamber and its moisture content on entry & exit.

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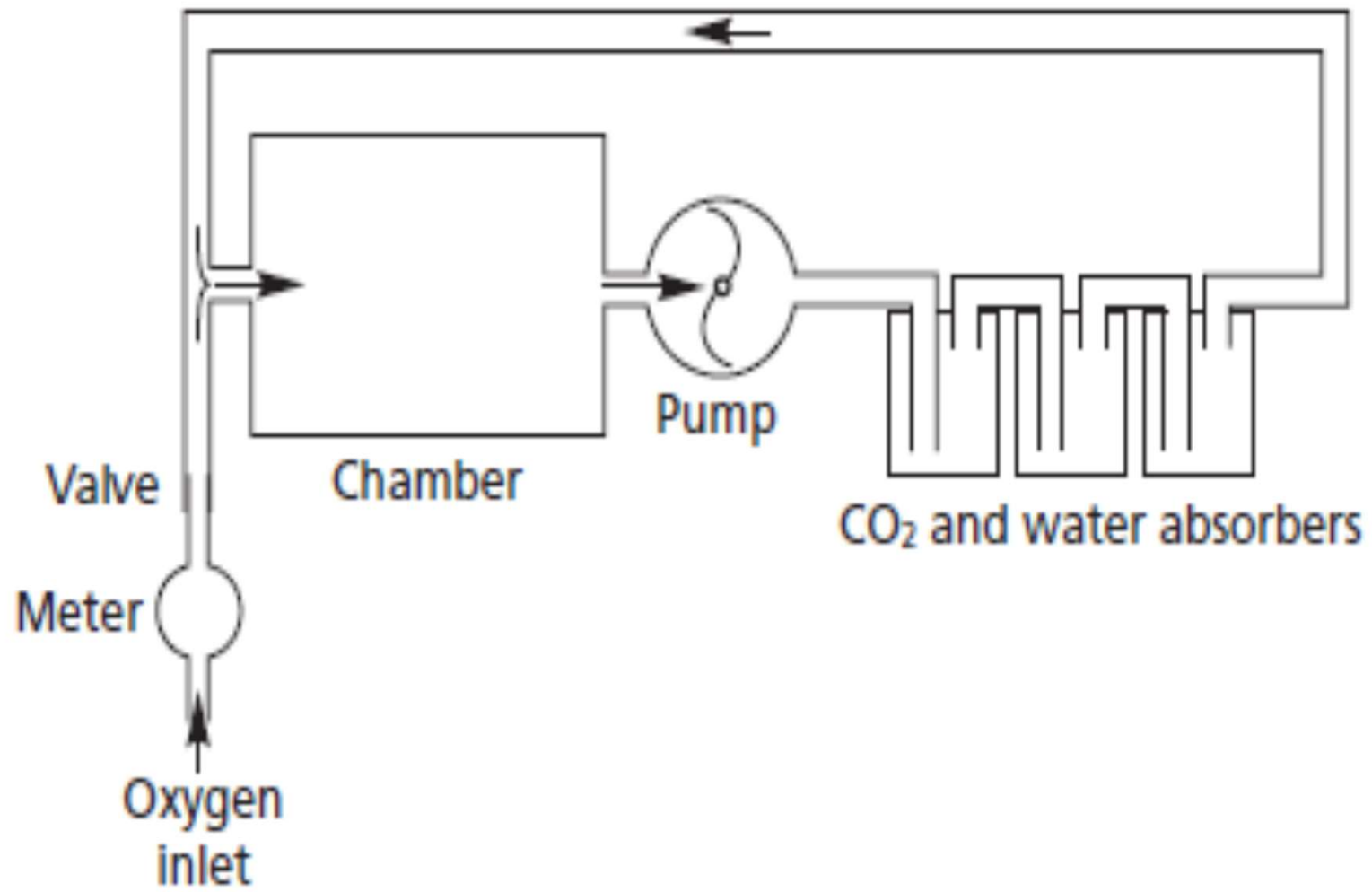
- In a more recent type of calorimeter - **gradient layer calorimeter used.**
 - Quantity of heat is measured **electrically** as it passes through chamber wall.
 - In this calorimeter, **both sensible & evaporative heat losses** can be recorded automatically.
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- **However, Animal calorimeters are expensive to build & earlier types required much labour to operate them, so, presently indirect method is in practice.**

Measurement of respiratory exchange using respiration chambers

- **The simplest type of chamber- closed-circuit type - airtight chamber for the animal together with vessels holding absorbents for CO₂ and water vapour.**
- **The chamber having devices for feeding, watering & milking of animal.**
- **The oxygen used by the animal is replaced from a metered supply.**
- **End of trial period (24 hrs), CO₂ produced measured by weighing absorbent & any CH₄ produced measured by sampling & analysing the air of chamber.**
- **The main disadvantage of closed-circuit chamber- large quantities of absorbents are required i.e. for a cow, 100 kg of soda lime needed/day to absorb carbon dioxide & 250 kg of silica gel to absorb water vapour.**

(a) Closed circuit

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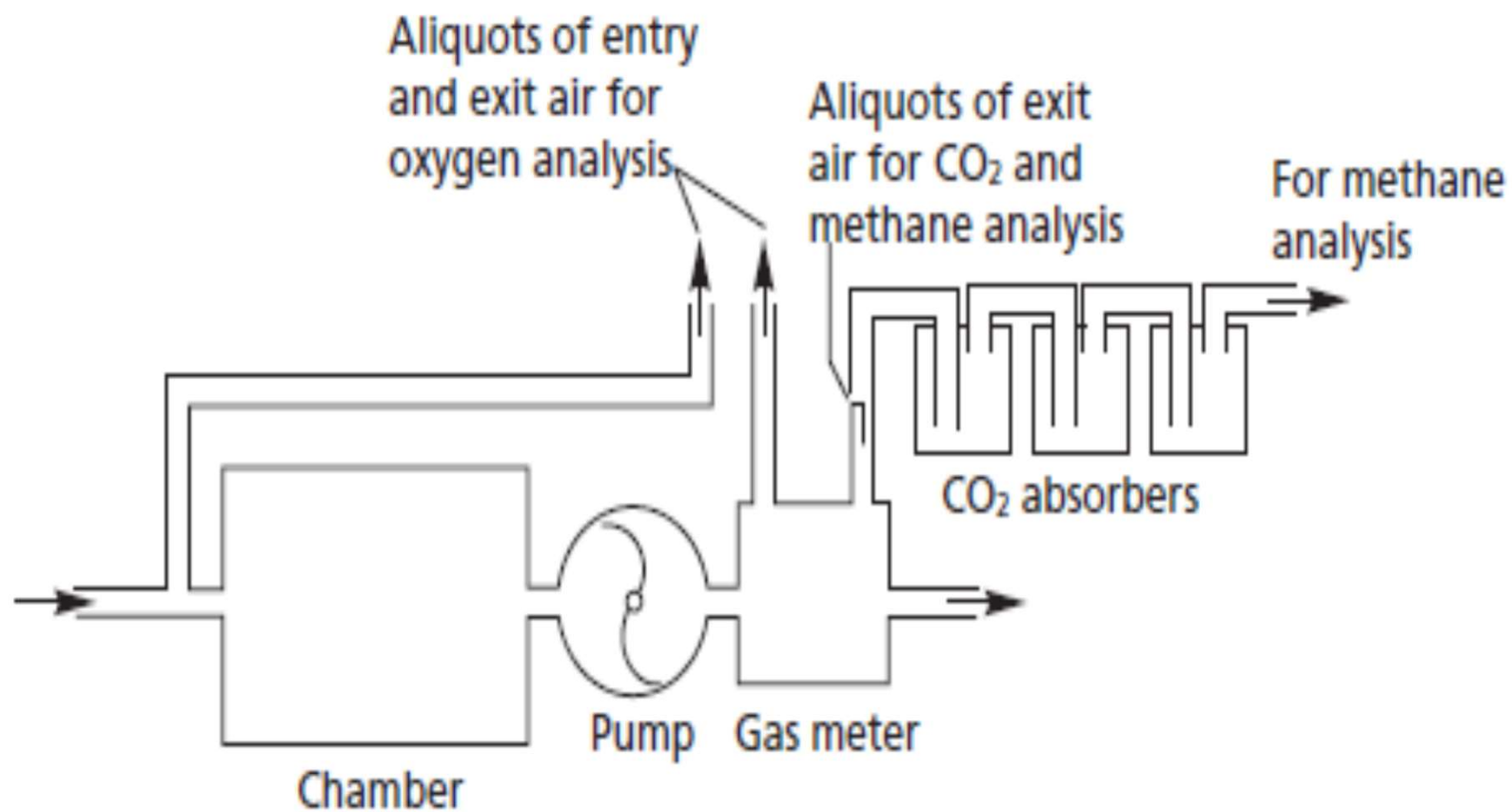


Open-circuit type of chamber

- **Air drawn through the chamber at a metered rate & sampled for analysis on entry & exit.**
- **Thus, CO₂ production, CH₄ production & O₂ consumption can be estimated.**
- **If conditions for the animal are to be kept normal, very accurate measures of gas flow and composition are required.**
- **Modern equipment, based on infrared analysers, open-circuit chambers have now largely replaced closed-circuit chambers.**

Cont.....

(b) Open circuit



Discussions.....

Questions, if any.....??

THANKS