# SNS COLLEGE OF TECHNOLOGY

**An Autonomous Institution**
**Coimbatore – 35**

Accredited by NBA – AICTE and Accredited by NACC – UGC with 'A+ Grade
Approved by AICTE , New Delhi and Affiliated to Anna University , Chennai.

## DEPARTMENT OF AGRICULTURE ENGINEERING

### 19AGE307 – ERGONOMICS OF FARM MACHINERY AND IMPLEMENTS

### III – YEAR VI SEMESTER

### UNIT 1 – INTRODUCTION

### TOPIC – ASSESSMENT OF ENERGY EXPENDITURE BY OXYGEN CONSUMPTION

# Assessment by Oxygen Consumption

- By monitoring oxygen consumption, researchers and ergonomists can assess the metabolic demands of specific activities, evaluate the efficiency of workstations, and design interventions to optimize energy expenditure.

- The relationship between oxygen consumption (VO2) and energy expenditure is based on the assumption that, under normal physiological conditions, the body primarily relies on aerobic metabolism, where oxygen is used to oxidize substrates for energy production.

- The overall process is represented by the respiratory exchange ratio (RER) or respiratory quotient (RQ), which is the ratio of carbon dioxide produced (VCO2) to oxygen consumed (VO2).

# Respiratory Quotient

- The ratio of carbon dioxide produced to oxygen consumed
- The RQ provides information about the nutrient mixture catabolized for energy.
- The RQ equals 1.00 for carbohydrate, 0.70 for fat, and 0.82 for protein.

# Respiratory Quotient

- The ratio of the volume of carbon dioxide released to the volume of oxygen consumed by a body tissue or an organism in a given period.

- The respiratory quotient (RQ) obtained from indirect calorimetry, defined by the ratio carbon dioxide production (VCO2)/oxygen consumption (VO2), is affected by extremes of substrate use by the body

# Assessment by Oxygen Consumption

*Energy Expenditure (EE) = (3.941×VO2 + 1.11×VCO2)×caloric equivalent for oxygen*

In this equation:

- *EE* is the estimated energy expenditure in kilocalories per minute.
- *VO2* is the volume of oxygen consumed in liters per minute.
- *VCO2* is the volume of carbon dioxide produced in liters per minute.
- The caloric equivalent for oxygen depends on the assumed respiratory quotient (RQ).
- Caloric Equivalent for Oxygen = 5.0 kcal/LO2

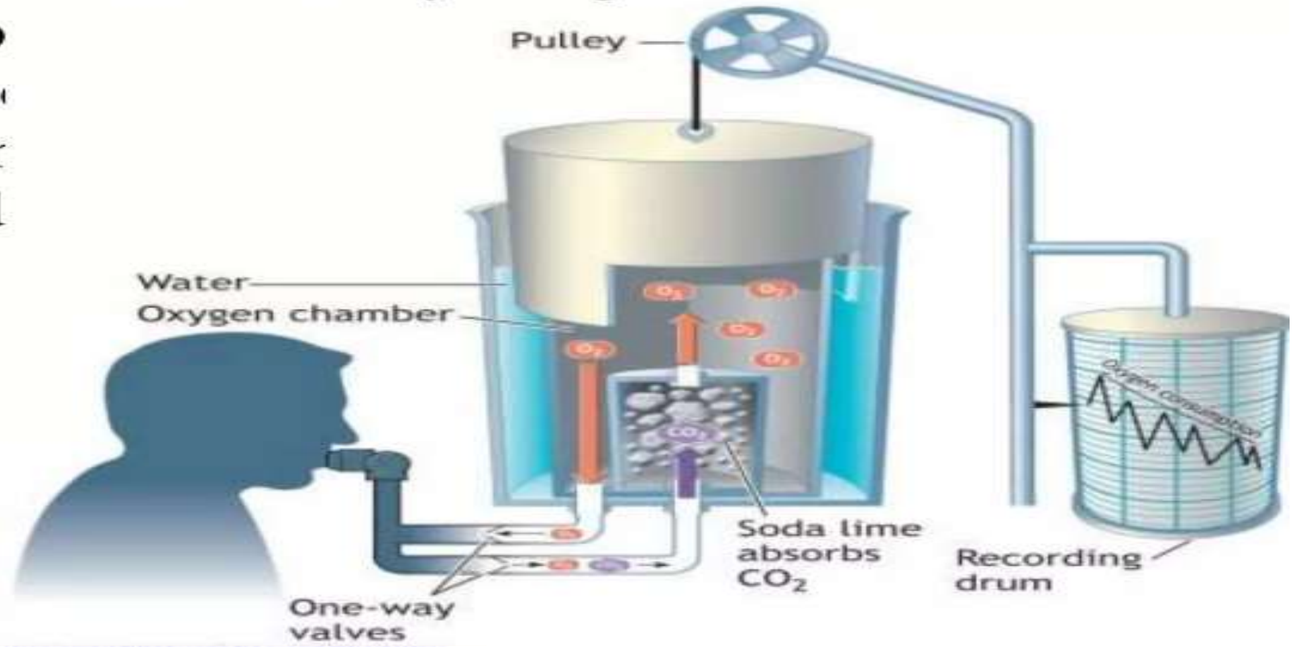
# Respiratory Exchange Ratio

- To estimate the amount of energy used by the body, it is necessary to know the type of food substrate being oxidized.
- The carbon and oxygen contents in these substrates vary greatly, hence the amount of oxygen used during metabolism depends on the type of fuel being oxidized.
- The ratio between the amount of $O_2$ consumed and $CO_2$ released is termed respiratory exchange ratio (RER).
- $RER = VCO_2 / VO_2$

# Techniques of Measuring Oxygen Consumption

1) the closed circuit method.

The simplicity of this method and its ability to directly measure oxygen consumption has considerable theoretical importance but limited practical application .the subject breathes 100% oxygen from prefilled container (spirometer) .the equipment is a closed system because the subject rebreathes only the gas in the spirometer. A canister of po breathing circuit absorbs th drum attached to the spiron record the oxygen removed the systems total volume.



# Techniques of Measuring Oxygen Consumption

## 2) The open circuit method.

This method provides a relatively simple way to measure oxygen consumption . A subject inhales ambient air with a constant composition of 20.93% oxygen ,0.03% carbon dioxide and 79.04% nitrogen (includes a small quantity of inert gases). The changes in oxygen and carbon dioxide percentage in expired air compared with percentages in inspired ambient air indirectly reflect the ongoing process of energy metabolism. Thus analysis of two factors the volume of air breath during a specific time and the composition of expired air provides a practical way to measure oxygen consumption and infer energy expenditure.

**There are three open circuit method to measure oxygen consumption during**

1. **Portable spirometry**
2. **Bag technique**
3. **Computerize instrumentation**

# Oxygen Consumption Rate

| S. No. | Work category | Physiological response | |
|---|---|---|---|
| | | Oxygen consumption (l/min) | Heart rate (beats/min) |
| 1 | Light work | < 0.5 | Up to 90 |
| 2 | Moderate work | 0.5 - 1.0 | 90-110 |
| 3 | Heavy work | 1.0-1.5 | 110-130 |
| 4 | Very Heavy work | 1.5-2.0 | 130-150 |
| 5 | Extremely heavy work | > 2.0 | 150-170 |


Thank You !