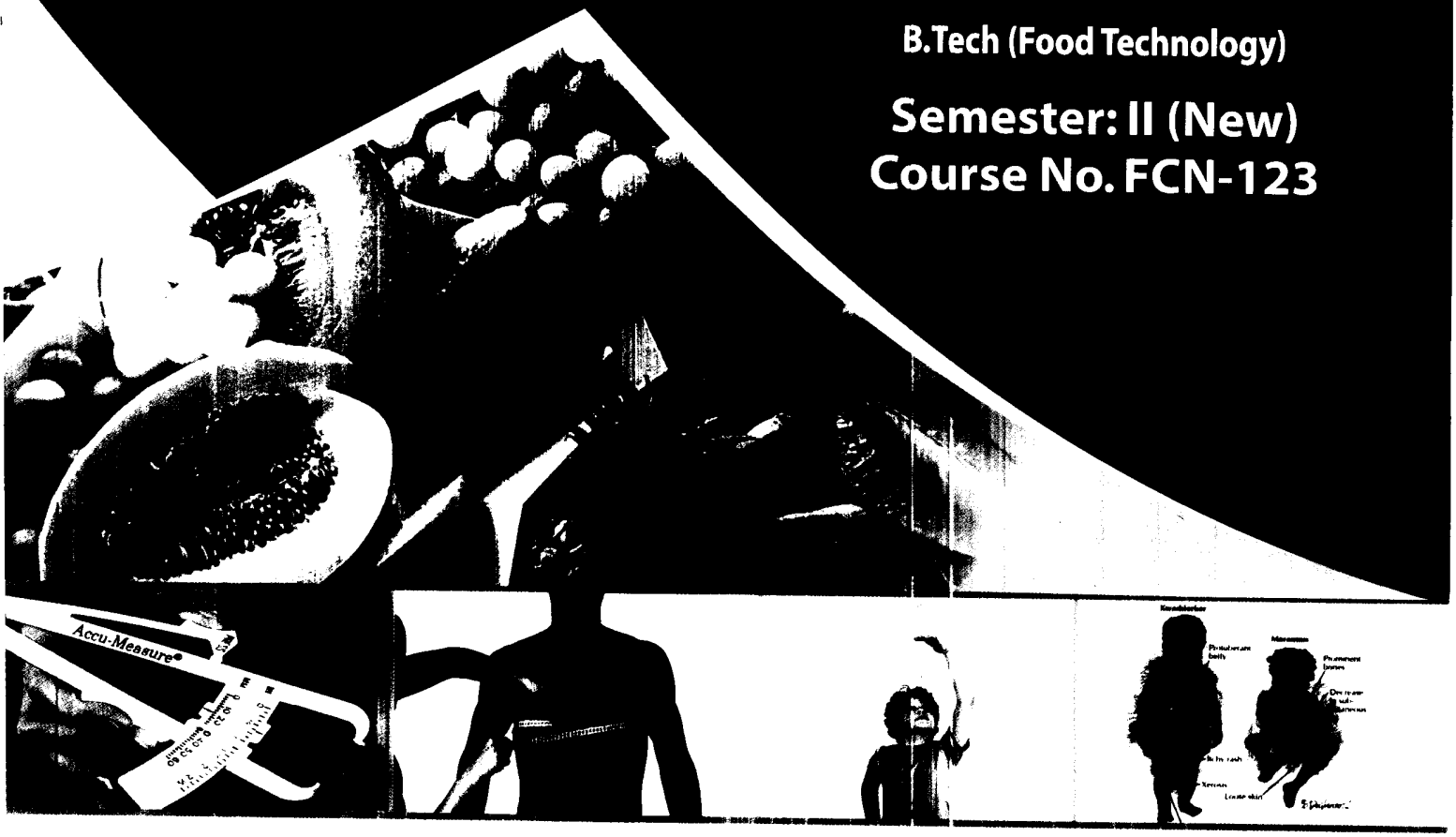
Practical Manual

Human Nutrition

B.Tech (Food Technology)

Semester: II (New)

Course No. FCN-123



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Certificate

This is to certify that Shri/Ku. _____
_____Reg.No._____ has completed the Practical's of Course No. FCN-123 (Human Nutrition) as per the syllabus for B.Tech (Food Technology) First Year II[nd] semester as prescribed by MCAER, Pune.

Date: / / **Course Teacher**

INDEX

Role of various national and international agencies in field of human nutrition

1. National Institute of Nutrition (NIN)

The National Institute of Nutrition (NIN) is one of the premier permanent research Institutes of the Indian Council of Medical Research (ICMR), an autonomous body under the aegis of the Ministry of Health and Family Welfare, Government of India.

- **Headquarters:** Hydrabad
- **Establishment Year**: 1918
- **Role/Objective:**

1. To provide training and orientation in nutrition to key health problems
2. To identify various dietary and nutrition problems prevalent among different segments of the population.
3. To continuously monitor diet and nutrition situation of the country.
4. To conduct operational research connected with planning and implementation of national nutrition programmes.
5. To dovetail nutrition research with other health programmes of the government.
6. To disseminate nutrition information for institutional and community benefit.
7. To advise governments and other organisations on issues relating to nutrition.

2. ICMR: Indian Council of Medical Research

ICMR is the apex body in India for the formulation, coordination and promotion of biomedical research, is one of the oldest and largest medical research bodies in the world.

- **Headquarter:** New Delhi
- **Establishment Year:** 1911
- **Function/ Role:**

1. To reduce the total burden of disease and to maintain health
2. Control and management of communicable diseases, fertility control, maternal and child health
3. Control of nutritional disorders, developing alternative strategies for health care delivery,
4. Containment within safety limits of environmental and occupational health problems;
5. Research on major non-communicable diseases like cancer, cardiovascular diseases, blindness, diabetes and other metabolic and haematological disorders; mental health research and drug research (including traditional remedies).

3. Food Safety and Standards Authority of India (FSSAI)

Food Safety and Standards Authority of India (FSSAI) is an autonomous body established under the Ministry of Health & Family Welfare, Government of India. The FSSAI has been established

under the Food Safety and Standards Act, 2006 which is a consolidating statute related to food safety and regulation in India.

- **Headquarter:** New Delhi
- **Establishment:** 2006
- **Functions/ Role:**

1. Framing of regulations to lay down food safety standards
2. Laying down guidelines for accreditation of laboratories for food testing
3. Providing scientific advice and technical support to the Central Government
4. Contributing to the development of international technical standards in food
5. Collecting and collating data regarding food consumption, contamination, emerging risks etc.
6. Disseminating information and promoting awareness about food safety and nutrition in India

4. CFTRI: Central Food Technological Research Institute

- **Location:** Mysore
- **Establishment Year:** 1950
- **Role/ Function:**

1. The institute develops technologies to increase efficiency and reduce postharvest losses, to add convenience, increase export,
2. Find new sources of food products, integrate human resources in food industries, reduce costs, and modernize.
3. Advise on the formulation of Research and Development programmes and future directions of activities of the laboratory keeping in view the Five Year Plans, national priorities and opportunity areas.
4. Advise on fostering linkages between the laboratory, industry and potential clients.

5. DFRL: Defence Food Research Laboratory

- **Head office: Mysore**
- **Establishment Year: 1961**
- **Role/ Function:**

1. Research and development in food science and technology
2. Studies in the development of convenience foods, preservation of foods, food safety, food packaging, and studies in the spoilage of foods and safety of processed foods
3. Production and supply of processed foods on a limited scale to the Armed Forces and other bodies for national missions
4. Toxicological, nutritional, and biochemical studies
5. Development of pack rations, their quality assurance methods
6. Preservation and packaging methods for long distance transportation of perishable products
7. Evaluation of nutritional requirements of troops deployed under different climatic conditions

6. NDRI: National Dairy Research Institute

The National Dairy Research Institute as the premier Dairy Research Institution undertakes research, teaching and extension activities towards dairy development in the country.

- **Establishment Year: 1923**
- **Head office: Bangalore**
- **Functions / Role**

Institute mainly focus on three fundamental facets of Dairying i.e. production and management of dairy animals for better productivity, innovating suitable milk processing technologies and equipments, and providing the dairy farmers and entrepreneurs with information about existing market demands and practical management inputs for making dairying a self-sustaining, profitable business.

7. FAO: Food and Agriculture Organization

FAO is a specialised agency of the United Nations that leads international efforts to defeat hunger

- **Establishment Year: 1945**
- **Head office: Rome, Italy**
- **Role/ Functions:**

1. Help eliminate hunger, food insecurity and malnutrition
2. Make agriculture, forestry and fisheries more productive and sustainable – promote evidence-based policies and practices to support highly productive agricultural sectors.
3. Reduce rural poverty – help the rural poor gain access to the resources and services they need – including rural employment and social protection.
4. Enable inclusive and efficient agricultural and food systems – help to build safe and efficient food systems and reduce poverty and hunger in rural areas.
5. Increase the resilience of livelihoods to threats and crises – help countries to prepare for natural and human-caused disasters by reducing their risk and enhancing the resilience of their food and agricultural systems

8. WHO: World Health Organization

The World Health Organization (WHO) is a specialized agency of the United Nations that is concerned with international public health.

- **Establishment Year: 1946**
- **Headquarters:** Geneva, Switzerland.
- **Role/Functions:**

1. Prevention and control of specific Diseases
2. Development of comprehensive health services
3. To combat issues like hunger, sanitation and Diseases

9. UNICEF: United Nations Children's Emergency Fund

The United Nations Children's Emergency Fund is a United Nations (UN) Program that provides humanitarian and developmental assistance to children and mothers in developing countries. It is a member of United Nations Development Group.

Establishment: 11 December 1947

Headquarters: New York City, US.

Role:

1. Helping childrens whose lives were at risk in developing countries.
2. Advocates for the protection of children's rights, to help them meet their needs,

EXPERIMENT - 2

Nutritive value of Different Food groups

Introduction :

The type and quality of various foods in diet is based on socio-cultural and economic consideration. It may vary from region to region. Each food in our diet contains a wide range of nutrients serves as a major source of one or more nutrients. Knowing the nutritive value of food groups in your diet may help you maintain good health

Aim:

- To determine food groups on the basis of nutrient content
- **Foods are broadly divided into groups depending on their nutritive value as follows**

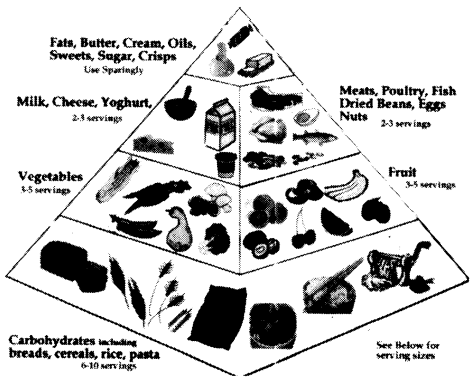
1.	Cereals and millets	2.	Fats and oils
3.	Legumes	4.	Foods of animal origin
5.	Oilseeds and nuts	6.	Milk and milk products
7.	Vegetables	8.	Starchy and sugar products
9.	Fruit	10.	Spices amd condiments

1) Cereals

Eg. Barley, oat, rye and various millets are rich source of protein, certain minerals and vitamin B

a. Wheat

- Nutritive value –The protein content may vary from 9- 16% depending on variety.
- The chief proteins are glutenin and gliadin, Together known as gluten, wheat also contains globulin albumin protease.
- The limiting amino acid are lysine and Threonine The PER of wheat is 1.6 to 1.8
- Thus is markedly increased to about 2.2-2.5 when supplemented.



b. Rice

Rice consists of following parts

1. Outer bran layer, Beaneath of aleurone layer
2. The endospore
3. The germ

- Scutellum contain about 44% and aleurone layer contains 35% of thiamine
- Raw milled rice is poor source of thiamine
- The protein content of rice varies from 0.9%
- The chief protein is glutenin, small quantities of albumins, Globulins and prolamines are also present
- The proteins are limiting in lysine and threonine and to lesser extent in methionine

c. Maize

- The protein calorie malnutrition has found to be high where maize is staple food
- Maize is deficient in tryptophan, lysine and threonine
- The chief protein of maize are glutamine
- Maize is completely lacking in tryptophan and lysine
- Maize protein contain excess of leucine
- More recently new strains of maize (eg. ohaque) Contains more tryptophan and lysine
- The PER of maize is 0.9 to 1.4

e. Barely

- The protein content of barley ranges from 9-12% and is mixture of albumin , globulin, prolamine and gluten in and fair and good source of essential amino acids
- The limiting amino acids in barley is lysine and threonine
- PER of Barley is 1.9-2.2
- Barley is good source of thiamine, pyridoxine and fair source of riboflavin.

f. Millets

- Protein ranges from 9.14% depending on variety. It is good souce of thiamine pyridoxine and fair source of riboflavin niacin. It is fair source of Ca and Fe.
- Pearl miilet is important crop in india.
- Having energy value 1.582kj, Carbohydrate- 72.89, Fat4.29, Protein-11.09 and Water-8.79
- Raw millet provides 378 calories and is rich source. Raw millet is 9% water, 73% carbohydrate 4% fat and 11% protein,
- Energy-1.377 kJ (329 kcal) carbohydrates- 2.19, fat-3.59, protein 10.69, Vitamins-16
- The limiting amino acids are lysine and threonine but excess of which interfere in conversion of tryptophan to niacin and cause pellagra. PER is 11- 1.5 and is increased by supplement of lysine

2) Legumes(Pulses)

- Protein content ranges from 18-25% they are good source of thiamine and riboflavin and fair source of niacin

- Legumes are good source of calcium, iron but poor in phosphourus
- They contain fair amount unavailiable carbohydrates
- Legume proteins are in general good source of lysine and threonine
- They are however poor source of lysine hence legumes protein supplement efficiently with cereal protein

3) Oilseeds and Nuts

Eg. Peanuts, Seasamum seeds Soyabeans and coconut

a. Peanuts-

- It contains about 27-28% protein and 42-50% oil
- It is good source of thiamine, niacin, Pantathonic acid and fair source of riboflavin, Peanut is good source of P, and fair source of Fe,ca
- Protein: Chief protein are globulin
- The limiting amino acids are lysine threonine and methionine, PER-1.6-1.8

b. Soyabean

- Potein content ranges from 35-45% fat content 17-22%
- It is good source of thiamine and niacin and fair source of riboflavin
- Soyabean contains trypsin and growth inhibitor and hemagglutinins
- Proteins- Chief protein of soyabean is globulin know as glycine
- Soyabeans are all good source of lysine and threonine
- They supplement effectively cereal protein
- PER are 1.9 to 2.2 and is increased to 2.8-5by suppliments with methionine

c. Sesame

- Protein content of seed varies from 16-20% and oil content 55-60%
- It is good source of thiamine and fair source of riboflavin, niacin. `The seed coat is rich in Ca present as oxalate in seed coat.
- The dehusked seed has low Ca and oxalic acid content
- Sesame oil is rich in essential fatty acid
- Sesame protein consist of mixture of globulin the protein are good source of essential amino acids
- It is rich source of methionine and tryptophan but is deficient in lysine
- PER is 1.7-1.8 is increased to 2.7-2.9 when supplemented with lysine

d. Coconut:

- Cocunut protein is a good source of all essential amino acids
- PER is 2.1-2.4 at 10% protein level

4) Vegetable

a. Green leafy vegetable

- This source of protein containing about 2.7%
- They are rich in ascorbic acid and good source of folic acid and ca.

- Some of the leafy vegetable may contain oxalic acid and it may interfere in absorption of ca present in diet.
- Roots and Tubers: Good source of starch
- They are fair to poor source of protein , B vit and ascorbic acid
  eg. Carrot

Other vegetable:

- They are broadly divided into
- Green peas and leaves good source of protein and b vitamin
- Gourd and pumpkin-Fair source of ascorbic acid and minerals
- Okra and brinjal-Fair source of ascorbic acid and minerals

5) Fruits

- Fruits contain different sugar, Organic acid and fair to good source of ascorbic acid
- Soluble carbohydrate fruits contain glucose, Fructose and sucrose carbohydrate content varies from 2-20 gm /100g.
- Calorific value of fruit also varies from 2-300mg/ 100g but higher in citrus fruit is 60-80mg/100gm.
- Fruits are poor source of B vitamin but fair source of folic acid 6- 9 mg/100 g.
- Carotene- poor source in general except mango, Papaya
- Pectin is present in small amount
- Good source of potassium 250-370mg/1000

6) Fats and oils(Processed raw materials)

- Fat and fat products serve mainly a source of energy. They are also important source of vit. E and essential fatty acids some are good source of vit a and vit E
- Fats of animal origin- They are poor source of vit E and essential fatty acids. They contain cholesterol.
- Fats of plant origin- Vegetable fat (Except coconut) are good source of essential fatty acids

7) Egg and egg products and poultry

- Whole egg contains13% protein and good source of vit.A, Riboflavin and vit. B12 and Vitamin C.
- Its cholesterol content is about 490mg / 1000g contain heat labile factors called avidin and reacts with biotin and make it unavailable.
- Egg is good source of Fe, P and poor source of Ca.
- Egg white contains about 11% protein

8) Spices and condiments:

- **Eg**. Chilli, Turmeric, Garlic, Onion, Coriander, Asafoetida, Ginger etc. Commonly used to enhance The palatability of food responsible for reducing putrefying bacteria, Excess consumption not desirable

9) Beverages

- Beverages are liquid other than water specifically prepared for human consumption

a. Non Alcoholic Beverages

- Examples are tea, coffee, cocoa, fruit juices etc. tea also contains tanins, Essential oils and high level of oxalic acid
- Fruit beverages are not harmful

b. Alcoholic Beverages

- Different beverages contain varying amount of alcohol. Alcohol is stimulant in moderate use but excess consumption is harmful.

10) Milk and milk products

- Milk is the most complete of all foods
- Relatively deficient in iron
- Contains protein of good quality.
- Human milk has less fe, ca protein content as compare to cow milk. Its lactose content (7%) is 1.5 times than cow milk(4.8%)

11) Sugar and sugar product

Eg. Cane sugar, Glucose, Jaggery, Honey etc sugars provide empty calorie (4 kcal/g) but jiggery besides energy also supplies

Nutritional labelling of Food Products

General information:

Nutrition information on food labels can support consumers in making informed food choices. It can be found in nutrition labelling (to be provided on labels of prepackaged foods, under the title "Nutrition Facts"); nutrition claims, which include both nutrient content claims and health claims; and the ingredient list. Labelling the nutritional content of food has become important not simply because the consumer has right to know what is in the food products, but also to help us make proper dietary choices.

- **Nutritional Labelling:**

Nutrition labelling is the standardized presentation of the nutrient content of a food, based on a specific amount of food. It will appear on most prepackaged foods in a table format with the title "Nutrition Facts."

- **Basis of the Nutrient Information**

The nutrient information in the Nutrition Facts table is based on a specific amount of the food. The energy value is provided in Calories. Most nutrients are provided in grams or milligrams, and as a percentage of a Daily Value based on a reference standard. Vitamins and minerals are expressed only as a percentage of a Daily Value based on a recommended daily intake. Nutrient values are rounded according to specific rules set by government.

- **What information should a food label contain?**

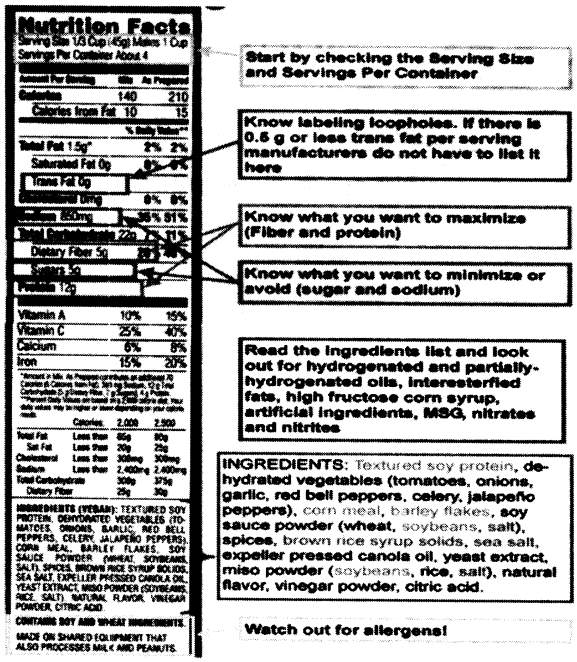
The mandatory information that a food label should carry is the following:

1. **Name of the product** or name under which the product is sold. Brand names are not obligatory.
2. **List of ingredients**: This should be in decreasing order of weight and should be preceded by the word 'Ingredients'. The list of ingredients is not compulsory if the product is made of one ingredient only.
3. **Quantity of certain ingredients:** If a product name includes a particular ingredient, eg. 'Chicken Pie', then the list of ingredients should include as percentage how much chicken is actually used in the product.
4. **Net weight or volume of the product.**
5. **Date of minimum durability**: In case of highly perishable foods, the 'Use by' date should be used. Note that the term 'Expiry date' does not exist in Maltese legislation. Other food stuffs may be

labelled with the term 'Best Before' or 'Best Before End'. The dates printed should be in the following order Day/Month/Year to avoid confusion to consumers.

6. **Conditions for storage**: In case the product requires special storage.
7. **Name or business name and addess of manufacturer** or packer or seller established in Malta or the European Union.
8. **Origin**: Origin is only obligatory where failure to give such details might be misleading to the consumers to the origin of the foodstuffs. Certain foods however dictate specific rules and for example in case of honey and beef, the origin is obligatory.
9. **Instructions for use:** This is required when if such instructions are not laid down, it would be difficult for consumers to make correct use.
10. **Alcohol content**: In case of alcoholic beverages with more than 1.2% by volume of alcohol, the actual alcoholic strength in %.
11. **Allergy advice:** Ingredients which may cause allergies, e.g nuts, must be declared on the label with a clear reference.
12. **GMOs:** Products containing genetically modified organisms must carry the notice 'This produts contains GMOs'.
13. **Nutritional Information:** Pre-packed products which carry a nutritional claim such as: 'low fat', 'rich in fibre', etc., must carry nutritional information expressed per 100g or 100ml. There are some exceptions to the above information. Taking for example salt - this does not need to have a list of ingredients, if nothing is added to it. Neither does it need to acarry a durability date, since salt in itself is a preservative. On the other hand, there are products which need specific information,such as eggs, honey, chocolate and poultry.

Reading a Nutritional Label



- **Nutrition claim**:

Any claim which states, suggests or implies that a food has particular beneficial nutritional properties due to:

(a) the calorific value it (i) provides; (ii) provides at a reduced or increased rate; or (iii) does not provide and/or

(b) the nutrients or other substances it (i) contains; (ii) contains in reduced or increased proportions; or (iii) does not contain.

- **A 'Health claim'** is any statement about a relationship between food and health. The European Commission authorises different health claims provided they are based on scientific evidence and can be easily understood by consumers.

- On the other hand, a **'Medicinal Claim'** is a health claim which states or implies that a product has the property of treating, preventing or curing disease. Medicinal claims on food labels are prohibited under European labelling regulations.

EXPERIMENT - 4

Calculation of Basal Metabolic Rate (BMR)

Introduction:

Basal Metabolic Rate is the energy used for performing the body functions of living body in awake state. BMR is a feature of Metabolic function.

Objective :

1. To calculate energy required by individual during physical, emotional and digestive rest.
2. To assess minimum energy required to sustain vital functions like working of Heart, Brain, Respiration

- **Basal Metabolism:**

The minimum amount of energy required for maintain vital function in an organism at complete rest, measured by basal metabolism rate in fasting individual who is awake and resting in a comfortably warm environment.

- **Basal Metabolic Rate (BMR):**

The Basal Metabolic Rate is the minimum rate at which the body use energy at complete rest. It is minimum amount of energy needed to keep the body alive and is a largest component of an average person daily energy experiment.

- **Factors affecting the BMR:**

1. **Age:** BMR tends to decrease as we get older because of increased percentage of body fat, children have higher BMR because of energy cost of growth.
2. **Size:** BMR tends to be greater in tall thin people.
3. **Body composition**: Those with a high percentage lean body (low % fat) tend to have higher BMR because of muscle is metabolically more active than fat.
4. **Breast feeding:** BMR is higher in nursing mother than other women because of energy cost of synthesizing milk.
5. **Dieting:** BMR decreases during weight loss diet fasting.
6. Exercise: BMR increases with regular exercise, but it probably little affected by moderate level of exercise.
7. **Malnutrition:** BMR decreases during Malnutrition.
8. **Pregnancy:** BMR increases during Pregnancy.
9. **Sex:** BMR is higher in males than females even same weight because of their relatively larger bulk of muscle.

10. **Stress**: BMR increases during periods of the emotional stress.
11. **Thyroid Activity:** BMR is regulated by a harmonethyroxine secreted by thyroid gland. It increases if the thyroid is overactive and decreases if thyroid is underactive.
12. **Weather**: BMR increases during both very cold and hot weather.

Body Surface Area (BSA):

- BSA is measured or calculated surface of human body for many clinical purpose.
- BSA is better indicator of metabolic mass than body weight because of it is less affected of
- BSA is simple than many measures of volume.
- BMR is directly proportional to BSA. It depends upon body weight & height.

Formula for BSA:

$$BSA\,(m^2) = 0.007184 \times wt\,(kg)^{0.425} \times ht\,(cm)^{0.725}$$

Example :

Observations:

1. Weight = 45kg.
2. Height = 155cm

Calculations for BSA:

$$BSA\,(m^2) = 0.007184 \times wt\,(kg)^{0.425} \times ht\,(cm)^{0.725}$$

By applying log to both sides

$$\begin{aligned} Log\,(BSA) &= \log(0.007184) + 0.425\,[\log(45) + 0.725(\log 155)] \\ &= -2.14 + 0.425 \times 1.653 + 0.725 \times 2.190 \\ &= -2.14 + 0.703 + 1.589 \\ &= -2.14 + 2.29 \\ &= 1.53\ m^2 \end{aligned}$$

Observations:

1. Weight (kg.)
2. Height (cm)

EXPERIMENT - 5

Calculation of Body Mass Index

Introduction:

Body Mass index is a measurement of person height, weight it is intended to quantify tissue mass. It can be used as general indicator of a healthy body weight based on height.

Objective :

1. To calculate energy required by individual during physical, emotional and digestive rest.
2. To assess minimum energy required to sustain vital functions like working of Heart, Brain, Respiration

Nutritional Indices in Adult:

The international standard for assessing body size in adult is Body Mass Index (BMI).

BMI is calculated using the following:

1. Weight (kg)
2. Height (m^2)

1. Waist /Hip Ratio:

- Waist circumference is measured at level of the umbilicus to the nearest 0.5cm.
- The subject should stand erect with relaxed abdominal muscles, arm at side and feet together.

2. Hip Circumference:

- It measured at the point of greatest circumference around hips & buttocks to nearest 0.5cm.
- The subject should be staining & measure should squat beside him.

Example :

Observations:

a. Height- 155m^2
b. Weight-45 kg
1. Head Circumference- 21.5 (cm)
2. Chest Circumference-25 (cm)
3. Waist Circumference- 28 (cm)
4. Hip Circumference- 32 (cm)
5. Mid arm Circumference- 9.2 (cm)

$$BMI = \frac{\text{Weight (kg)}}{\text{Height (m}^2\text{)}}$$

$$= \frac{45}{1.55*1.55}$$

$$= 18.75$$

Below 18.5	Underweight
18.5 – 24.9	Normal
25.0 – 29.9	Overweight
30.0 and above	Obese

Category	BMI (kg/m²)	
	from	to
Very severely underweight		15.0
Severely underweight	15	16
Underweight	16	18.5
Normal (healthy weight)	18.5	25
Overweight	25	30
Obese Class I (Moderately obese)	30	35
Obese Class II (Severely obese)	35	40
Obese Class III (Very severely obese)	40	

Observations:

Height (cm)	
Weight (kg)	
Head circumference (cm)	
Waist circumference (cm)	
Hip circumference (cm)	
Mid arm circumference (cm)	

EXPERIMENT - 6

Anthropometric Measurements

Introduction:

Anthropometric measurement are used to assess the size, shape and composition of the human body. Anthropometric measurement means the measurement of body height and proportions.

Factors Affecting Anthropometric measurement :

1) Genetic factor
2) Plan of Nutrition
3) Environment factor
4) Physical activity

Anthropometric methods:

- It is an essential component of clinical examination of infant, children and pregnant women.
- It is used to evaluate both under and over nutrition.
- The measured values reflect the current nutritional status and don't differentiate between acute and chronic changes.

Anthropometry for Children:

Accurate measurement of height and weight is essential. The result can be used to evaluate physical growth of the child.

Other Anthropometric measurement:

- Mid arm circumference
- Skin fold thickness
- Head circumference
- Head/ Chest ratio
- Hip/ Waist ratio

Measurement for Adults:

1. **Height:**

- The subject stand erect and bare footed on a stadiometer with a movable head piece.
- The head piece is leveled with skull vault and height is recorded to nearest 0.5 cm.

2. Weight:

- Use a regularly calibrated electronic or balanced beam scale, Spring scales are less reliable.
- Weight in light clothes, no shoes.
- Read to nearest 100 g.

Advantages of Anthropometry:

- Objectives with high specificity & sensitivity.
- Measure many variable of nutritional significance (Height, weight, Hc, skin fold, thickness, waist).
- Reading arm numerical &gradable on the standard growth chart.
- Reading are reproducible.

Limitations of Anthropometry:

- Inter observers errors in measurement.
- Limited nutritional diagnosis.
- Problems with reference standard i.e., local versus international standards.

Observations:

Sr. No.	Particular	Observations
1.	Height (Cm)	
2.	Weight (Kg)	
3.	Mid arm circumference	
4.	Skin fold thickness	
5.	Head circumference	
6.	Head/ Chest ratio	
7.	Hip/ Waist ratio	
8.	Mid arm circumference	
9.	Skin fold thickness	
10.	Head circumference	

Calculations and Results :

EXPERIMENT - 7

Preparation of Balanced diet and RDA of Nutrients

Introduction:

A balanced diet may be defined as one which contains the various groups of foodstuffs such as energy yielding foods, body building foods and protective foods in the correct proportion so that an individual is assured of obtaining the minimum requirement of all the nutrients. The components of a balanced diet will differ according to age, sex, physical activity, economic status and the physiological state viz., pregnancy, lactation etc.

Balanced diet for different groups are given:

1. **Balanced diet at high cost:**
   Such diets which include liberal amounts of costly foods such as milk, eggs, meat, fish and fruits and moderate quantities of cereals, pulses, nuts and fats.
2. **Balnced Diets at Moderate Cost:**
   These diets will include moderate amounts of milk, eggs, meat, fish, fruits and fats and liberal amounts of cereals, pulses, nuts and green leafy vegetables.
3. **Balanced Diet at Low Cost**
   These diets will include small amounts of milk, eggs, meat, fish and fats and liberal amounts of cereals, pulses, nuts and green leafy vegetables. The I.C.M.R. Nutrition Expert Group (1968) recommended balanced diets at low costs.
4. **Diets for Pregnant and Nursing Mothers:**
   Balanced diet at low cost suggested by the ICMR Nutrition Expert Group for pregnant and lactating women are given. It will be observed that diet containing minerals amount of milk and other animal food which are costly.
   The diets at moderate and high costs are also given.

Recommended Dietary Allowance (RDA):

The average daily dietary nutrient intake level sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a particular life stage and gender group. RDA represents the level of the nutrient to be consumed daily to meet all the requirements of most of the individuals in a given population. RDA value of a nutrient is valid only when all other dietary nutrient intakes are satisfactory.

RDA of Nutrients:

1. **Calories:**
   In estimating the calori requirements, the following factors will ahave to be taken into account:

a. Physical activity
b. Body size and composition
c. Age and sex
d. Physiological state and
e. Climate and environment

The daily calorie requirement (Kcal) recommended by the Nutrition Expert Group ICMR are as follows:

Group	RDA
Infants (0 -6 months)	120/kg
Infants (7 -12 months)	100/kg
Childrens (1 -3 years)	1200
4 to 6 years	1600
7 to 9 years	1800
10 to 12 years	2100
Adolescents:	
Boys (13 -15 years)	2560
16 to 18 years	3000
Girls (16 to 18 years)	2200
Adult males	2400 to 3900
Adult females	1900 to 3000
Pregnant women	2200
Lactating women	2600

2. Protein:

Proteins are required for maintainance, growth and in condition of pregnancy and lactation. Periodical infection and infestation commonly prevalent among people living in the developing countries decrease protein absorption and hence increase protein requirements.

The daily protein requirements of Indians of various age groups as recommended by ICMR are as follows:

Group	RDA
Infants (0-6 months)	2.3-1.8 g/kg
Infants (7-12 months)	1.8-1.5 g/kg
Childrens (1-12 years)	17-41 g/kg
Adolescents:	
Boys (13-18 years)	55-60 g/
Girls	50 g
Adult man	55g
Adult women	45 g
Pregnant women	55 g
Lactating women	65 g

3. Fats:

Fats provides the essential fatty acids such as linoleic, lenolenic acid and arachidonic acids. Further fats are essential for the absorption of fat-soluble vitamins like vitamin- A, pro-vitamin A (Carotene). Excess of saturated fat and cholestrol consumption has been found to be associate with hypercholestrolemia and atherosclerosis.

The recommendation of the ICMR Nutrition Expert Group are as follows:

Group	RDA
Adults	10% of total calories in the diet from the fat.
Adolescents	15% of total calories in the diet from the fat.
Childrens (1-11 years)	15% of total calories in the diet from the fat.
Birth (0-1 Year)	30% of total calories in the diet from the fat

The dietary fat should be rich in essential fatty acids

4. Calcium:

The utilization of dietary calcium in human subjects varies from 15-20 percent depending on the age and physical state. The daily Calcium recommended by ICMR Nutrition Expert Group are as follows:

Group	RDA
Infants (0-1Year)	0.5-0.6 g
Children (1-12 Years)	0.4-0.5 g
Adolscents: Boys and Girls (13-15 Years)	0.6-0.7 g
Boys and Girls (16-18 Years)	0.5-0.6 g
Adults (Men and Womens)	0.4-0.5 g
Pregnants and Lactating womens	1.0 g

5. Iron:

The daily iron requirement recommended by ICMR Nutrition Expert Groups are as follows:

Group	RDA (mg/kg body weight)
Infants (0-12 months)	1 mg/kg
Children (1-12 Years)	15-2 mg/kg
Adolscents: Boys (13-18 Years)	25 mg/kg
Girls (13-18 Years)	35 mg/kg
Adults (Man)	20 mg/kg
Adult Women	30 mg/kg
Pregnancy	40 mg/kg
Lactation	30 mg/kg

Techniques in Animal feeding experiments

Introduction:

Animal feeding experiments are carried out for studying biological ability of nutrients and safety of food

Why anials are used?

- Animals are small and easy to handle
- Life span of animal is less
- Easy to breed and multiply
- Their nutritional requirement is also known

What types of animals are used:

- Albino rats
- Mice
- Rabbit
- Monkey
- Dogs

Purpose of Experiment:

To Know:

- Toxicity
- Cancer
- Research institute
- Teaching

Basic requirements:

1. Building- should be separate and temperature regulated (21-24^{0}C, RH-50%)

Types:

Self content- Animals (Male &female brought fro outside and multiplied)
Partially content- some of the animals are brought from outside
Mixed content: from own and from outside both types of rats

2. **Cages** :

i. Individual cages: (57"x10"x12")
ii. Breeding cages: (60"x10"x12")
iii. Metabolic cages:

Size of the cages depending upon size of animal=WxN sq/cm
Where, **W** = weight of animal
N = No. of animals

3. Balance: for weighing animals
4. Drinking devices: rubber bottle, open china katori
5. Feeding devices: perforated plate ad small rubber ring
6. Bedding: small animals requires special bedding wheat bran and rice husk
7. Test animals: Rat is the most commonly used life span is about 3 years feds on mothers milk upto 21 days.

After gestation period it weighs about 4-5gm from 21-50 days they are called weeming rats. After 50 days they attained maturity

21 days old rats used for PER, NPR, PNV

Adult rats used for DC, TD, BV, NPU and amino acid score.

Computation of energy requirements based on various activity

Computation of energy requirement on the basis of physical activity can be determined by following method, It has an unit of Kcal /hr/kg Physical activities can be include

Activity	Energy requirement Kcal/kg/hr
Sleeping	1.0 Kcal/kg/hr
Standing	1.7 Kcal/kg/hr
Walkingwith medium speed	4 Kcal/kg/hr
Personal necessity	3 Kcal/kg/hr
Sports and exercise	4 Kcal/kg/hr
Light work	1.7 Kcal/kg/hr
Heavy work	3.5 Kcal/kg/hr
Medium work	2.5Kcal/kg/hr

1. Calculate energy value required for a lady has personal information as age 35 yrs. Wt. 50 kg, ht. 5.5 ft , colour is fair and she spend her time as follows sleeping 7 hr typing work 8 hr, sitting 1.5 hrs , walking 1 hr, standing 2.5 hr, personal necessity 3 hrs and sport activity 1 hr.

Activity	Energy required	Net requirment
Sleeping	7 x 1.0	7 Kcal/kg/hr
Typing	1.7 x 8	13.6 Kcal/kg/hr
Sitting	1.5 x 1.7	2.55 Kcal/kg/hr
Walking	1 x 4	4 Kcal/kg/hr
Standing	2.5 x 1.7	4.25 Kcal/kg/hr
Personal necessity	3 x 3	9 Kcal/kg/hr
Sports activity	1 x 4	4 Kcal/kg/hr

:. Total energy requirement for all given activities per kg of body wt. = 44.4 Kcal/hr

:. Total net energy required = 44.4 x 50

= 2220 Kcal/hr

:. Total net energy required for 50 kg of body weight = 2220 Kcal/hr

:. Hence person require 2220 Kcal/hr of energy to perform stated activities.

1) Calculate the total energy / calory requirment for your own activites

Sleeping	8 hr
Sitting	3 hr
Light work	3 hr
Walking	2 hr
Standing	3hr
Personal necessity	2 hr
Exercise	3 hr
Weight	44 kg

Activity	Energy required	Net requirment
Sleeping	8 x 1.0	8 Kcal/kg/hr
Light work	3 x 1.7	5.1 Kcal/kg/hr
Sitting	3 x 1.7	5.1 Kcal/kg/hr
Walking	2 x 4	8 Kcal/kg/hr
Standing	3 x 1.7	5.1 Kcal/kg/hr
Personal necessity	4 x 3	12 Kcal/kg/hr
Exercise	1 x 4	4 Kcal/kg/hr
	Total	**47.3 Kcal/kg/hr**

Total energy requirement for all given activities per kg of body wt. = 47.3 Kcal/hr

Total net energy requirement = 47.3 x 44

= 2081.2 Kcal/hr

Total net energy required for 44 kg of body weight = 2081.2 Kcal/hr

Hence person requirement of energy to perform stated activities is 2081.2 Kcal/hr.

Determination of Energy value or calories by using Bomb Caloriemeter

Relevant information:

A bomb caloriemeter wii measure amount of heat generated when sample or fuel is burned in a sealed chamber called bomb caloriemeter. Reaction is carried out in pure oxygen gas bomb caloriemeter provide simple, inexpensive accurate method to determine the calorific value or sulphur contain solid, liquid.

Principle:

A know sample is burned in a seal chamber i.e bomb caloriemeter the air replace by pure oxygen & sample is ignited electricity. As sampleis produced and rise in temperature is determined or measured the amount of heat is produced and rise in tem determined or measured , sample ignited may be equal to the amount of heat absorbed by bomb caloriemeter

Temperature	^{0}C or K
Time	Min
Mass	Kg
Heat energy	Calories
Temperature	^{0}C or K

Different parts of bomb calorimeter

1. **Bomb-** Bomb consist of different parts i.e bomb body & lid bomb is made from steel containg chromium nickel.

   Bomb body having capacity of 300ml & wall of bomb is strong enough to pressure up to 300 atm
2. **Buckemen thermometer:** used to measure tem change
3. **Water jacket:** it is composed of copper to avoid losses during process in temperature
4. **Crucible**: The stainless of steel crucible is effered as sytandard also platinum

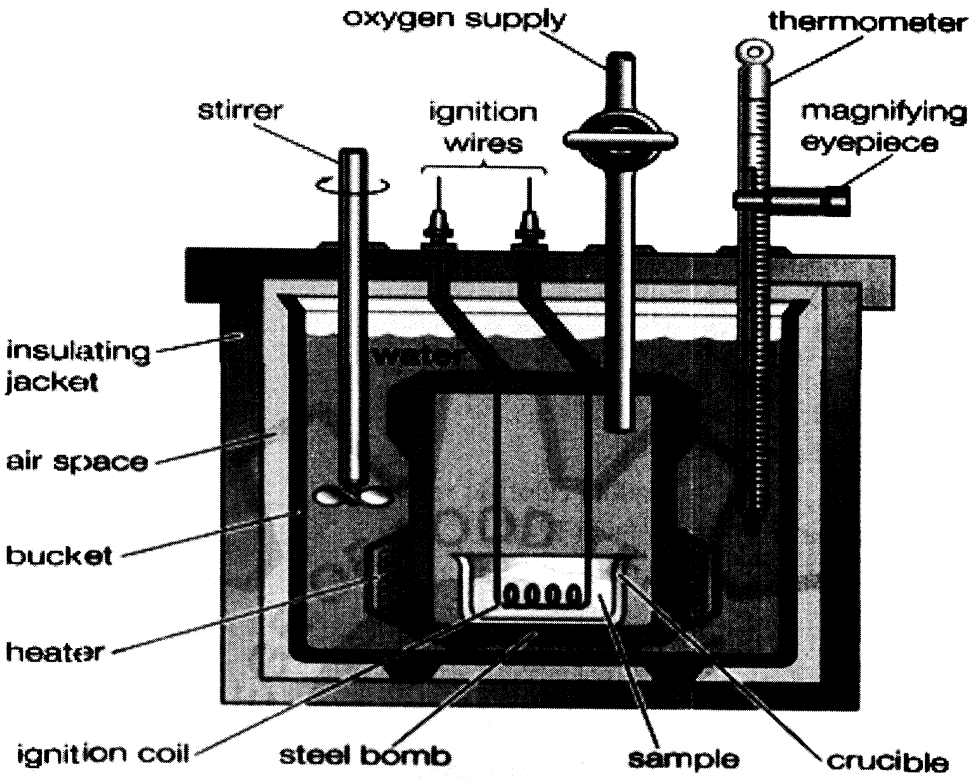


Fig. Bomb Calorimeter

1. **Stirrer:** the role of stirrer is to uniform distribution of heat absorbed by water
2. **Ignition wire**: platinum wire is used to ignite sample and also major wire
3. **Standard sample**- benzoic acid , nepthaline

- **Sample size**: sample use to determined energy value should not more than 1.1 gm sample should be uniformed and air dried

- **Protocol:**

1. Weight accurate 1gm of ground food sample in crucible .
2. Put crucible in bomb then arrange the firing wire across the electrode within the place crucible in a position such a way that cotton threads make sample
3. Introduce water in bomb by using pipette charge the bomb with pure oxygen class the wall and lid effectively using little pressure.
4. Detact bomb from oxygen supply weight pure the pre weighted water quantity in a caloriemeter sufficient to submerge the bomb.
5. Transfer bomb into caloriemeter.
6. Take initial reading or temperature start electrioc supply and allow 7% completely then note down temperature change or rise in temperature.

Calculation

x- amount of sample of fuel
W- wt or mass of water
W- water equivalent of instrument
T1- initial temp
T2- final temp
L- high calorific value
L= (W+w) (T2-T1) / x
Cw – wire energy
Ct- cotton thread
Ca- acid value
Cc- environment

Heat libarated by fuel of sample = x × L
= product calorific value
Heat absorbed by apparatus = (W+w) (T2-T1)
Heat libarated by sample = heat absorbed by apparatus

Formula

$$x.\ L = (W + w)\ (T2-T1)$$

$$L = \frac{(W + w)\ (T2-T1)}{x}$$

Correction factors :

1) Colling correction (Cc) should added
2) Ignition wire correction (Cw) should be added
3) Cotton thread correction (Ct) should be substracted
4) Acid correction (Ca) should be minus

$$L = \frac{[(W + w)\ (T2-T1)\ Cc] - [Cw+Ct+Ca]}{x}$$

Observations and Results :

Diet for specific Health Cindition (Diabetic patient)

Introduction:

- Diabetes mellitus is caused by a deficiency in the secretion of insulin.
- **Clinical types of Diabetes:**

1. Juvenile Diabetes:

This includes all the diabetes below the age of 20 years. The disease is priirily due to the deficiency of insulin. The subjects are generelly undernourished and ematiated. They require high calorie-high protein diet and insulin for maintaining the blood sugar level within normal limit.

2. Adult diabetes (Maturity onset diabetes):

A majority of them are obese subject. A treatment will consists of a reducing diet rich in protein and carbohydrates along with a oral anti-diabetec drug to maintain the blood glucose within normal limit. These subjects require less insulin than juvenile diabetes.

Treatment for a Diabetes Mellitus: The principles of treatments are as follows:

1. Diet
2. Moderate excercise
3. Insulin in juvenile diabetes

Diet for Diabetes Mellitus:

Only weighed quantity of food should be consumed according to the diet schedule prescribed by the physician. The most important consideration should be given to

1) Calorie needs and
2) The proportion of calories from carbohydrates, proteins and fats.

The calorie requirement should be about 5% less than the actual requirements for the patients height and ideal body weight.

The proportion of proteins, fat and carbohydrates in the Diet:

The proportion of calories derived from carbohydrates, fats and proteins in the diets will depend on the type of diabetes as indicates below table:

Type of diabetes	Carbohydrates	Fats Calories (%)	Proteins
Juvenile diabetes	40	40	20
Adult obese diabetes	60	20	20
Adult diabetes with normal body weight	40	40	20

Diet for specific Health Cindition (Obesity)

Introduction:

Obesity is the most common nutritional disorder it is defined as the condition in which excessive accumulation of fat in the adipose tissues has taken place. It arises when the intake of food is in excess of physiological needs.

Occurrences:

Several factors may contribute to the development of obesity are given:

1. Age and sex
2. Pregnancy
3. Economic status
4. Eating habits
5. Physical activity

Treatment of Obesity:

The proncipal treatment in obesity is reduced calorie intake. The patient should be made to understand that

1. Obesity is caused by the excess consumption of calorie than the reuired to meeth the calorie needs
2. The lack of excercise or physical work is a contributory cause the development of obesity and
3. There is no slimming food or slimming diet which does not depend on low calorie intake

Reducing diet:

The aim of reduced calorie intake is to produce a calorie dificit in the body which will results in the fat stored in the adipose tissue being used to meet calorie need. It has been observed in obese adults a diet providing 1000 Kcal will help to reduce the body weight by 1 to 1.5 kg a week.

Theorotical calculation of Energy value

Energy: The capacity to do work is called as Energy.

The units of energy are calories, joule, kilocalories, erg etc.

The relation between units:

1Kcal or 1 Kilocalories = 1000 Calories

1 joule=10^7erg.

Measurement of Energy:

1. In-vivo:

In-vivo determination of energy is the measurement of energy in laboratory by using Bomb caloriemeter. The energy is called Calorific fuel value (CFV).

2. In-vitro:

The energy measurement by using Human body system and that energy is called Physiological fuel value (PFV). The physiological fuel value is always less than calorific fuel value.Mathematically it is proved that physiological fuel value is less than calorific fuel value.

$$\text{Percent digestability coefficient} = \frac{N_I - N_L}{N_I}$$

Where, N_I= Nutrient Intake

N_L= Nutrient loss

Percent digestability coefficient for different nutrients:

Carbohydrate	98%
Fat	95%
Protein	92%

Note: When percent digestability coefficient is 95 or above then the loss of energy is Zero (0).

Physiological fuel value and Calorific value

1. Physiological Fuel Value (PFV)

Carbohydrate	4.0 kcal/g
Fat	9.0 kcal/g
Protein	4.0 kcal/g

2. Calorific Fuel Value (CFV)

Carbohydrate	4.1 kcal/g
Fat	9.45 kcal/g
Protein	5.65 kcal/g

Prove that physiological fuel value is less than calorific value

By using the following formula you can calculate:

$$\frac{\text{CFV} - \text{loss of energy x \% digestability coefficient}}{100}$$

NOTE :

1) Digestibility coefficient is 95 & above then loss of energy is equal to zero
2) Loss of energy for carbohydrates & fat is zero
3) But in case of protein loss energy is 1.2 Kcal

Calculate PFV

1) Carbohydrates :

$$\text{PFV} = \frac{(4.1-0)\,X\,98}{100}$$

$$= 4.01 \approx 4\ \text{Kcal/g}$$

2) Fat :

$$\text{PFV} = \frac{(9.45-0)\,x\,95}{100}$$

$$= 8.93 \approx 9\ \text{Kcal/g}$$

Hence, proved that PFV<CFV

3) **Protein** :

$$\text{PFV} = \frac{(5.65-1.2)\,X\,92}{100}$$

$$= \frac{4.45\,x\,92}{100}$$

$$= 4.094 \approx 4\ \text{Kcal/g}$$

Calculation of energy value based on adult consumption unit (ACU)

1 ACU= 2400 Kcal

Various groups	Consumption unit in Kcal
Adult male	
Light work	1.0
Moderate work	1.2
Heavy work	1.6
Adult female	
Ligh	0.8
Moderate work	0.9
Heavy work	1.2
12-21 years child	1
Childrens	
9-12	0.8
7-9	0.7
5-7	0.6
3-5	0.5
1-3	0.4

1) Calculate adult consumption unit & total energy required for a joint family consist of grand father ; grand mother, two married brother & six childrens of age 16byears , 10 years, 8 years, 4 years, & 2 years

Family members:

Grand father, grand mother, first brother, second brother, first brother wife, second brother wife and six children

Grand father, grand mother performs the light work

Energy requirement	ACU (K cal)
Grand father	1.0
Grand mother	0.8
First brother	1.0
Second brother	1.0
First brother wife	0.8
Second brother wife	0.8
16 years child	1.0
8 years child	0.7
6 years child	0.6
4 years child	0.5
2 years child	0.4
10 years child	0.8

Total= 9.4

Now, 1 ACU = 2400 Kcal

9.4 AUC = 9.482400 Kcal

= 22560 k cal energy requirement of given family.

1) Calculate total AUC calories requirement of your own family

Father , mother, brother, I

Family member- father, mother, brother, I

Father perform moderate work & mother perform light work

Energy requirement	ACU (K cal)
Father	1.2
Mother	0.8
I 18 years	0.8
Brother (21 years)	1.0
(25 years)	1.0

Total AUC = 4.8

Now 1 ACU = 2400 Kcal

4.8 AUC = 4.8 x 2400

= 11520 Kcal

Computation of energy value on the basis of percent chemical composition.

Energy value = Calorific Value × Mass

Q.1. Calculate the energy value of 200 ml of milk shake consisting of 100 ml milk, 50 gm banana and 50 gm fig.

Chemical composition

Sr.No.	Name of fruit	Protein	Fat	Carbohydrates
1	Banana	1.2 %	0.3 %	27.2 %
2	Fig	1.3 %	0.2 %	7.6 %
3	Milk	4.3 %	6.5 %	5%

1. Banana :-

Step I:-

- Name of the product – Banana Fruit
- Volume of the product – 200 ml
- Chemical composition of banana 1.2% protein,0.3% fat, 27.2% carbohydrate

Standard energy value of nutrient per gram

- Carbohydrates :- 4 K cal/g
- Protein :- 4 K cal/ g
- Fat :- 9 K cal/g

Conversion of given data per gram

Carbohydrate = 27.2 / 100 = 0.272g

Protein = 1.2 / 100 = 0.012g

Fat = 0.3 / 100 = 0.003g

1 gm of banana gives 4 K cal protein

$= 0.012\ 8 \times 4 = 0.\ 048$ Kcal/g

1 gm of banana gives 4 K cal Carbohydrate

$= 0.0272 \times 4 = 1.088$ Kcal/g

1 gm of banana gives 9 K cal Fat

$= 0.003 \times 9 = 0.027$ K cal / g

Total energy provided by 1 gm of banana

$= 0.048 + 1.088 + 0.027$

$= 1.163$ K cal / g

Energy obtained by 50 gm of banana

$= 1.163 \times 50 = 58.15$

$=$ **58.15 K cal/ 50 g**

2) Fig

Convert chemical composition in gm

Protein = $1 \times 1.3/100$ = 0.013 g

Fat = $0.2 \times 1/100$ = 0.002 g

Carbohydrates = $1 \times 7.6/100$ = 0.076 g

1 gm of fig give 4 Kcal Carbohydrates

$= 0.076 \times 4$

= 0.052Kcal

1 gm of fig give 4 K cal fat

$= 0.076 \times 4$

= 0.304Kcal

1 gm of fig provide 9 K cal fat

$= 0.002 \times 9$

= 0.018Kcal

Total energy provided by 1 g of fig

= 0.052 + 0.304 + 0.018

= 0.374 kcal

Energy obtained from 50 g of fig

$=50 \times 0.374$

= 18.70 kcal

3) Milk :-

Calculate energy value of 100 ml of milk

Convert chemical composition in gram

Protein = $4.3 \times 1/100$ = 0.043 ml

Fat = $6.5 \times 1/100$ = 0.05 ml

Carbohydrates = $5 \times 1/100$ = 0.05 ml

1 ml of milk gives 4 K cal protein

$= 0.043 \times 4 = 0.172$ K cal/ g

1 ml of milk gives 4 K cal carbohydrates

$= 0.05 \times 4 = 0.20$ K cal/g

1 ml of milk provide 9 K cal fat

$= 0.065 \times 9 = 0.585$ K cal/g

Total energy provided by 1 ml of milk

$$=0.172+0.585+0.020$$
$$= 0.957 \text{ K cal/g}$$

Energy obtained in 100 ml of milk is

$$=0.957 \times 100 / 1$$
$$= 95.7 \text{ Kcal/ ml}$$

So, total energy provided by 200 ml of milk shake consisting of 100 ml milk, 50 g banana and 50 g fig is calculated as

$$=58.15+18.70+95.7$$
$$=172.55 \text{ Kcal/ml}$$

Q. 2) Calculate energy value of 200 gm of carrot halva consisting carrot, sugar, pure ghee and milk.

Milk – 100 ml
Sugar – 25 g
Ghee - 10 g
Carrot – 65 g

Carrot

Protein - 0.9 %
Fat – 0.2 %
Carbohydrates – 10.6 %

Protein $= 1 \times 0.9 \div 100$
$= 0.009$ g
Fat $= 0.2 \times 1 \div 100$
$= 0.002$ g
Carbohydrates $= 1 \times 10.6 \div 100$
$= 0.106$ g

1 gm of carrot gives 4 K cal protein

$$0.009 \times 4 = 0.036 \text{ K cal/g}$$

1 gm of carrots gives 9 K cal fat

$$0.002 \times 9 = 0.018 \text{ K cal/g}$$

1 gm of carrot provide 4 K cal carbohydrates

$$0.106 \times 4 = 0.424 \text{ K cal/g}$$

Total energy

$$= 0.036 + 0.018 + 0.424$$
$$\mathbf{= 0.478 \text{ Kcal/g}}$$

Milk
Volume of milk = 100 ml
Chemical composition of milk
Protein- 4.3 %
Carbohydrates – 5 %
Fat – 6.5 %

Conversion of given data into gram
Carbohydrates = 5 / 100 = 0.05 g
Protein = 4.3 / 100 = 0.043 g
Fat = 6.5 /100 = 0.065 g

Energy value per gram
Carbohydrates

$0.05 \times 4 = 0.20$ K cal/g

Protein

$0.043 \times 4 = 0.172$ K cal/g

Fat

$0.065 \times 9 = 0.585$ K cal/g

Total energy for 1 gm = **0.957 Kcal**/g
Total energy for 100 ml = **95.7 Kcal**

Energy value for sugar
Total volume of sugar – 25 g
Sugar contains only carbohydrates
1 g of sugar provide 4 K cal
25 g of sugar provide
$25 \times 4 = 100$ Kcal

Energy Value for ghee
Total volume of ghee – 10 g

As ghee contain only fat
9 K cal/g of ghee is for 1 g
10 gm of ghee provide
$10 \times 9 = 90$ Kcal
Total energy value of 200 gm of carrot halva is

Hence, Total energy value of carrot + milk + sugar + ghee
$= 95.7 + 100 + 90 + 31.07$
= 316.77 Kcal.