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NUTRITION CHEMISTRY AWARENESS

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ABSTRACT

Proteins are essential nutrients that play an important role in growth, tissue repair, muscle development, and maintaining overall health. The present Community Engagement Project focuses on nutritional chemistry awareness, with special emphasis on protein awareness among gym members and the general public. The project aims to study the importance of proteins, identify common dietary sources, and understand public knowledge regarding protein requirements and supplements.

It includes a review of existing scientific literature, a questionnaire-based survey, and laboratory-based study of selected nutritional samples using biochemical testing methods. The project seeks to connect theoretical knowledge with practical applications and promote awareness about the importance of balanced nutrition and informed dietary choices in everyday life.

KEYWORDS: Nutritional chemistry, protein awareness, dietary protein, protein sources, Biuret test, nutritional education, protein supplements.

INTRODUCTION

Proteins are essential nutrients that play a major role in the growth, development and maintenance of the human body. They are organic macromolecules composed of amino acids[1] linked together by peptide bonds. These amino acids contain carbon, hydrogen, oxygen and nitrogen, while some also contain sulfur.

Proteins perform several important biological functions[2]. They contribute to the growth and repair of tissues, form enzymes and many hormones, support immune function[3] through antibodies, and help transport substances within the body. Proteins can also provide energy when required, supplying approximately 4 kcal per gram.

Dietary proteins are obtained from a variety of animal and plant sources. Animal sources include milk, eggs, meat and fish. Plant sources include soybean, pulses, legumes, sattu and other cereal or legume products. Different food sources vary in protein content, digestibility and amino-acid composition. A balanced diet can provide protein through a combination of suitable foods.

Protein awareness is important because individuals may have misconceptions about protein requirements, the nutritional value of ordinary foods and the necessity of supplements. Gym members may be particularly interested in protein supplements for muscle recovery and growth, whereas the general public may obtain protein mainly from regular meals. However, nutritional needs vary according to age, body size, physical activity, health status and other factors.

Nutritional chemistry[4] provides methods for studying the chemical properties of food components. One such method is the Biuret test, which detects peptide bonds through the formation of a coloured complex between copper ions and peptide bonds under alkaline conditions. The intensity of the colour can be measured using a colorimeter[5]. When performed with appropriate standards, blanks and controlled sample preparation, the method can be used for estimating protein concentration.

The present project aims to connect theoretical knowledge of proteins with community awareness and a basic laboratory investigation of selected nutritional samples.

LITERATURE REVIEW

2007 - Protein and Amino Acid Requirements in Human Nutrition

The WHO/FAO/UNU Expert Consultation (2007) reviewed human protein requirements and the importance of amino acids in maintaining growth, tissue repair, and normal body functions. The report highlighted the importance of adequate protein intake for human health**.**

2017 - Protein and Exercise

Jäger et al. (2017) reviewed the role of protein intake in exercise and muscle recovery. The study discussed how adequate protein consumption supports muscle protein synthesis, training adaptations, and recovery in physically active individuals.

2017 – Biuret Reaction for Protein Estimation

Gornall et al. (1949) described the use of the Biuret reaction for protein estimation. Their study explained how proteins react with copper ions under alkaline conditions to produce a coloured complex that can be measured for protein analysis.

2025 – Knowledge and Use of Protein Supplements Among University Students

Qudah et al. (2025) investigated university students' knowledge, attitudes, and practices regarding protein supplements. The study highlighted differences in supplement use and identified the importance of improving nutritional awareness among students and fitness-centre users.

METHODOLOGY

The project used a descriptive educational approach combining a review of scientific literature, a questionnaire survey, and preliminary laboratory testing. The survey was intended to examine protein awareness among gym members and the general public.

Questionnaire survey

A) Survey on Awareness of Chemistry in Fitness, Nutrition and Daily Life

A. Basic information

- Age group

a. Below 18
b. 18 - 25
c. 26 - 35
d. 36 - 45
e. Above 45

- Gender

a. Male
b. Female
c. Prefer not to say

- How long have you been exercising/gym training

a. Less than 3 months
b. 3 - 6 months
c. 6 - 12 months
d. 1 - 3 years
e. More than 3 years

- How frequently do you exercise?

a. 1 - 2 days/week

b. 3 - 6 days/week

c. 5 - 6 days/week

d. Everyday

B. Chemistry and Nutrition

- Do you think chemistry plays an important role in sports and fitness?

a. Yes

b. No

c. Maybe

- Which of the following nutrients do you consider important for muscle growth and recovery?

a. Protein

b. Carbohydrates

c. Vitamins/Minerals

d. All of the above

- Are you aware that proteins are made up of amino acids?

a. Yes

b. No

c. Maybe

- Which information do you usually check on a fitness nutrition/ supplement?

a. Protein content

b. Carbohydrate content

c. Fat content

d. Calories

e. Ingredients

f. Added sugar

g. Other

- Do you understand what "calories" represent in food?

a. Yes

b. No

c. Partially

- Are you aware that carbohydrates, fats and proteins undergo chemical reactions in the body to release energy?

a. Yes

b. No

c. Maybe

C. Supplement and Fitness Product

- Do you consume any fitness supplements?

a. Protein powder

b. Creatine

c. Pre - workout supplement

d. Vitamins/ Minerals

e. Other

- Before consuming a supplement do you check its ingredients and dosage instructions?

a. Always

b. Sometimes

c. Rarely

d. Never

- Do you know the chemical composition or and active ingredient of the supplement you consume

a. Yes

b. No

c. Maybe

- Where do you usually get information about supplements?

a. Doctor/Dietitian

b. Gym trainer

c. Internet/Social media

d. Product packaging

e. Other

D. Hydration and Body chemistry

- Do you think water and electrolytes are important during exercises?

a. Yes

b. No

c. Maybe

- Do you use electrolyte/energy drinks during or after exercises?

a. Frequently

b. Sometimes

c. Rarely

d. Never

- Which of the following do you associate with electrolytes?

a. Sodium

b. Potassium

c. Chloride

d. Don't know

- Are you aware that excessive consumption of some energy or sport drinks may provide large amounts of sugar or caffeine?

a. Yes

b. No

c. Maybe

B) Survey on awareness of Nutritional Chemistry and Daily Life

A. Basic information

- Age group

a. Below 18

b. 18 - 25

c. 26 - 40

d. 41 - 60

e. Above 60

- Gender

a. Male

b. Female

c. Prefer not to say

- Occupation

a. Student

b. Homemaker

c. Employee

d. Other

B. General Nutrition & Protein Awareness

- Have you heard about proteins as an important part of our diet

a. Yes

b. No

c. Maybe

- Why do you think protein is important for the human body?

a. Muscle development only

b. Provides flavour to food

c. Helps only in diet

d. I don't know

- Do you think protein is needed only by people who exercise or go to gym?

a. Yes

b. No

c. Maybe

- Which of the following foods do you consider to be sources of proteins?

a. Dal/lentils

b. Chana/gram

c. Sattu

d. Soybean/soy products

e. Milk

f. Paneer

g. Egg

h. Meat/Fish

i. Peanuts/nuts

j. Protein powder

k. Creatine

l. I don't know

- Which of the following do you think are plant-based sources of protein?

a. Sattu

b. Dal

c. Chana

d. Soybean

e. Peanuts

f. Milk

g. Egg

h. I don't know

C. Protein Sources & Dietary Choices

- Which of the following do you think is the most affordable source of protein fir an average Indian household?

a. Dal/Pulses
b. Chana/gram
c. Sattu
d. Soybean
e. Not sure
f. Other

- Which statement best describes your understanding of protein supplements?

a. They are a concentrated source of protein
b. They are medicines used to treat diseases
c. They are necessary for everyone
d. They are only for professional athletes
e. Don't know

- Do you think a person can obtain protein from regular foods without using protein powder?

a. Yes
b. No
c. Maybe

- When buying packaged food, do you check its nutritional information or protein content?

a. Yes
b. No
c. Maybe

D. Basic nutritional chemistry

- Do you know that proteins are made up of smaller units called amino acids?

a. Yes
b. No
c. Maybe

- Which of the following do you think is a protein?

a. Protein powder
b. Creatine
c. Glucose

d. Vitamin C

e. Not sure

E. Awareness & Information Sources

- From where do you usually get information about nutrition and protein?

a. Family/Friends

b. Doctor/ dietitian

c. School/College

d. Social media

e. I don't usually seek information

- Would you be interested in learning more about affordable and commonly available protein sources?

a. Yes

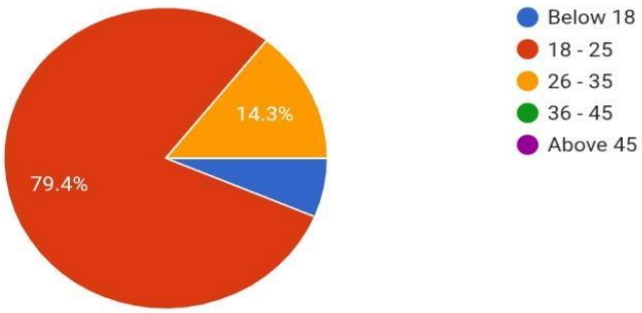
b. No

c. Maybe

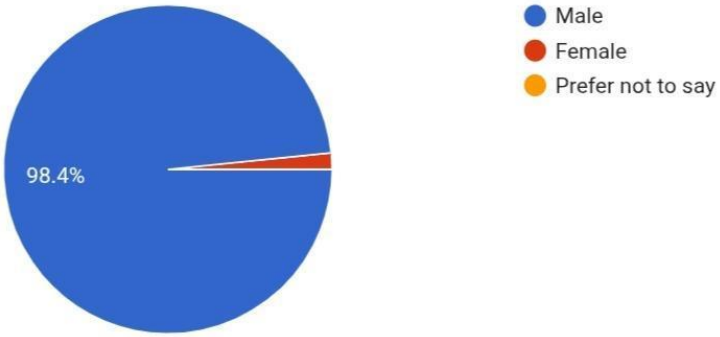
B) Responses

A) Survey on Awareness of Chemistry in Fitness, Nutrition and Daily Life

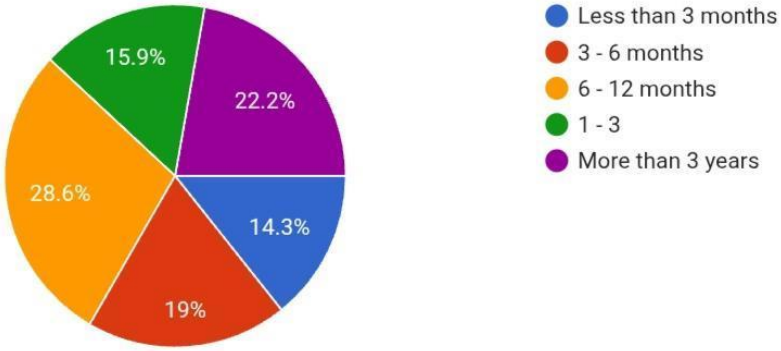
1. Age group



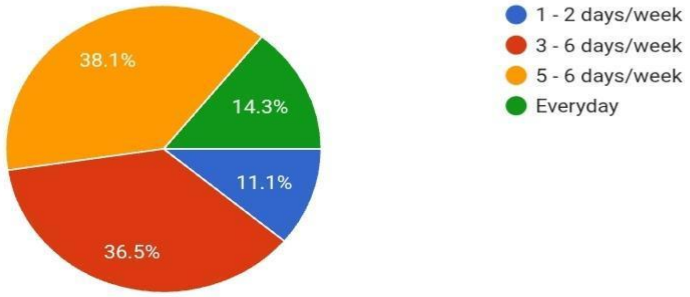
2. Gender



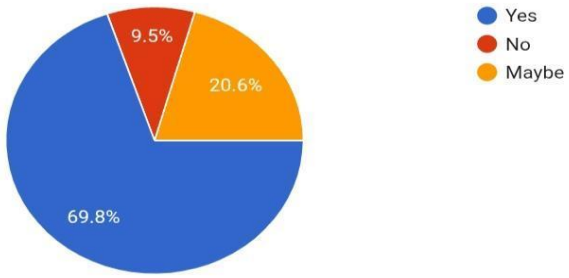
3. How long have you been exercising/gym training?



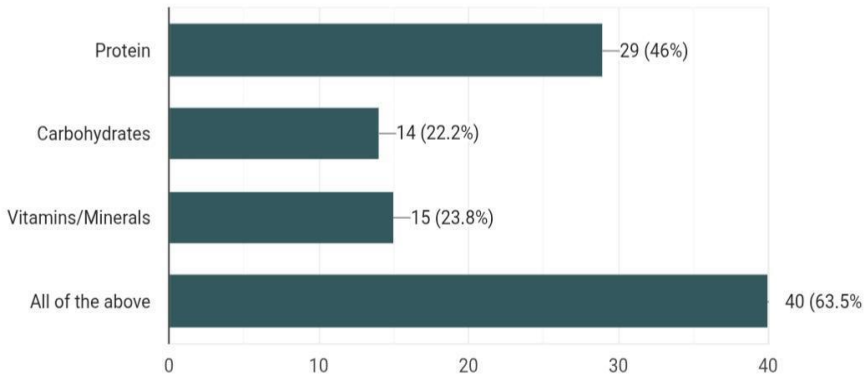
4. How frequently do you exercise?



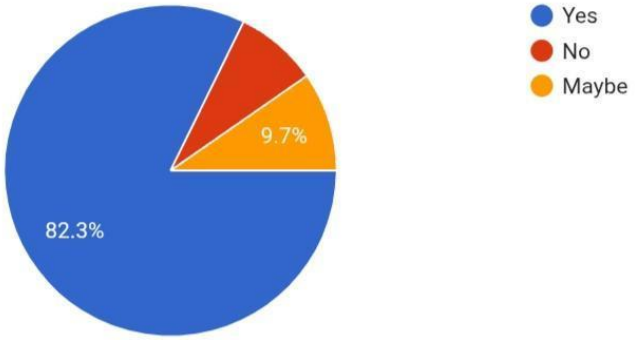
5. Do you think chemistry plays an important role in sports and fitness?



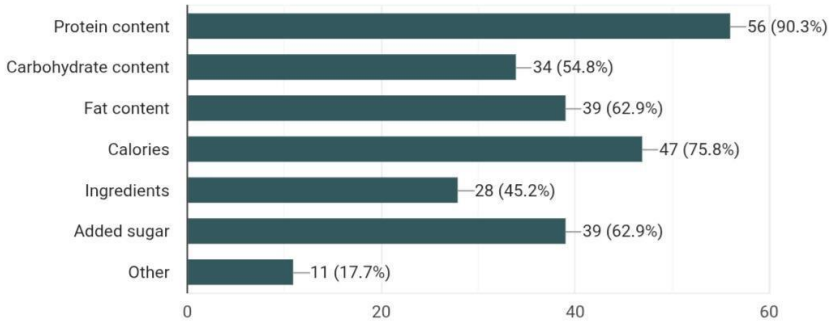
6. Which of the following do you consider important for muscle growth and recovery?



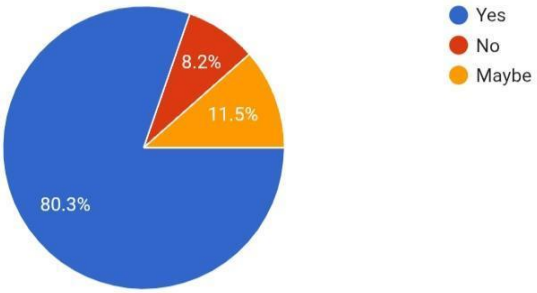
7. Are you aware that proteins are made up of amino acids?



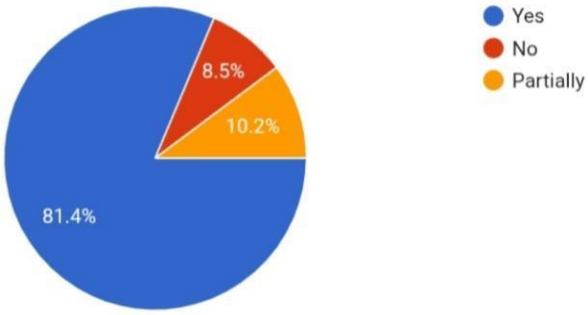
8. Which information do you usually check on a fitness nutrition/supplement?



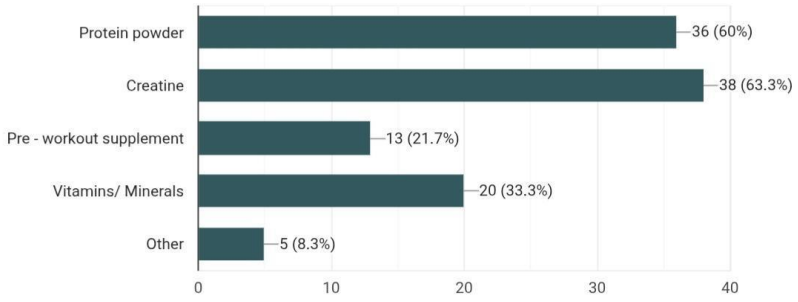
9. Do you understand what "calories" represent in food?



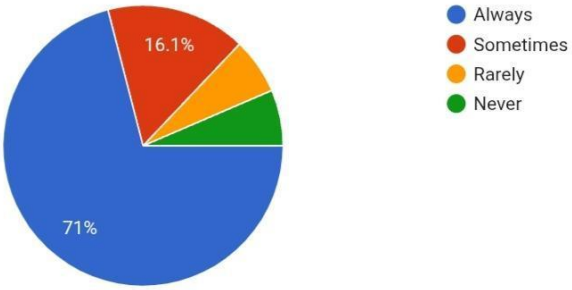
10. Are you aware that carbohydrates, fats and proteins undergo the chemical reactions in the body to release energy?



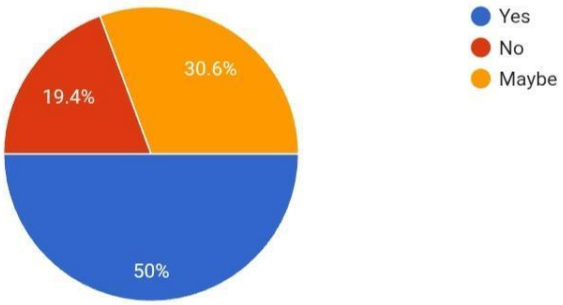
11. Do you consume any fitness supplements?



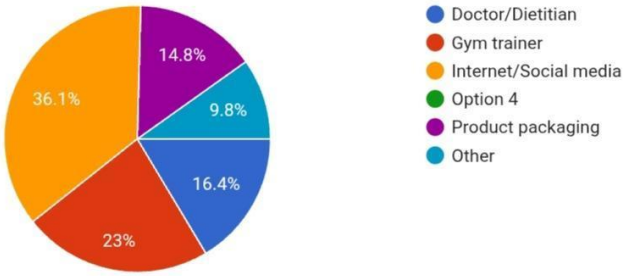
12. Before consuming a supplement do you check its ingredients and dosage instruction?



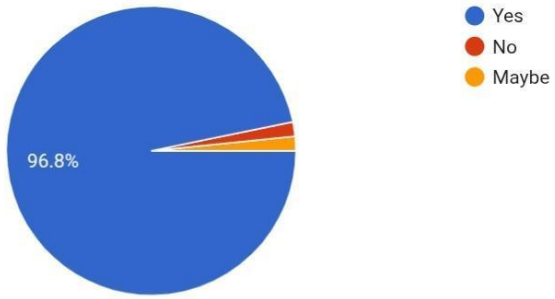
13. Do you know the chemical composition or an active ingredient of a supplement you consume?



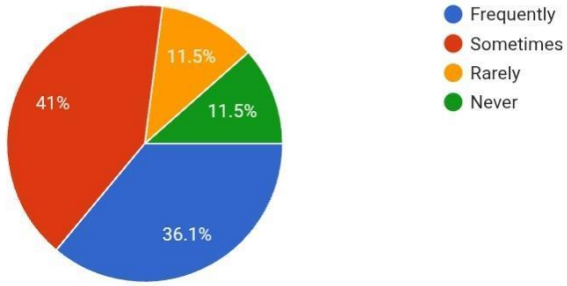
14. Where do you usually get information about supplements?



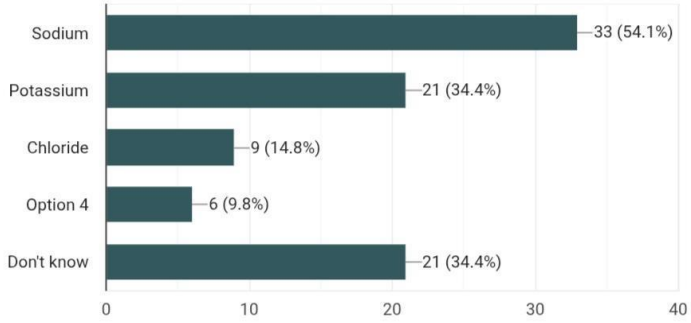
15. Do you think water and electrolytes are important during exercise ?



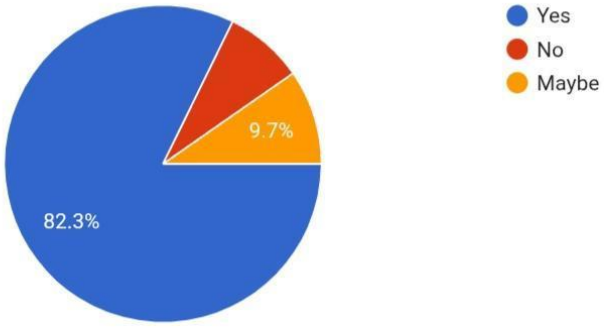
16. Do you use electrolyte energy drinks during or after exercises ?



17. Which of the following do you associate with electrolytes?

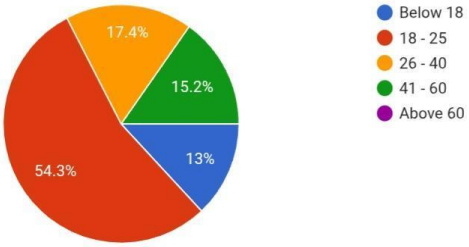


18. Are you aware that excessive consumption of some energy or sport drinks may provide large amounts of sugar or caffeine?

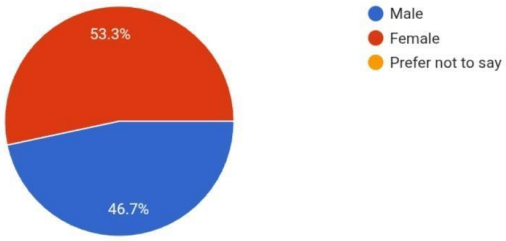


B) Survey on awareness of Nutritional Chemistry and Daily Life

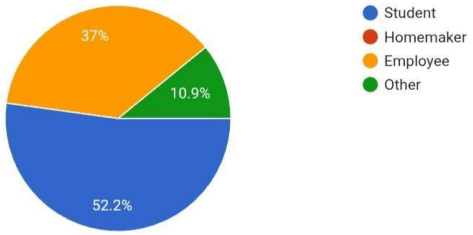
1. Age group



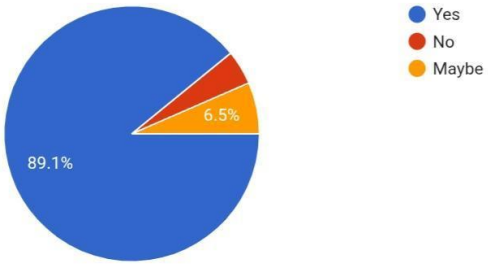
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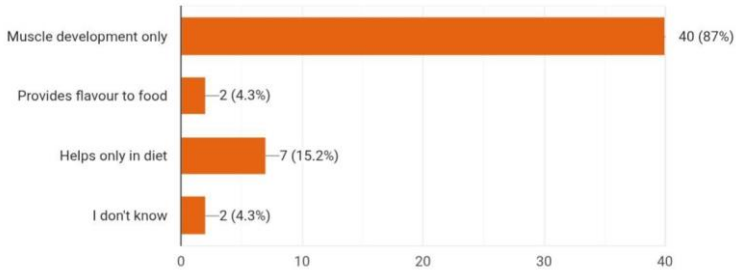
3. Occupation



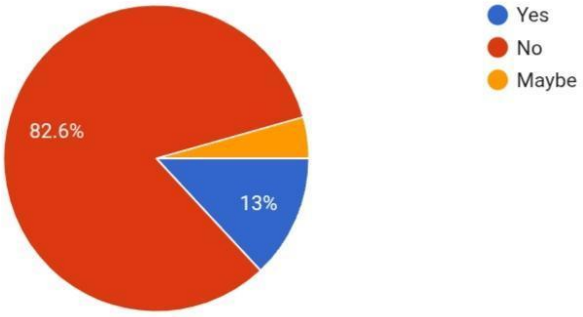
4. Have you heard about proteins as an important part of our diet



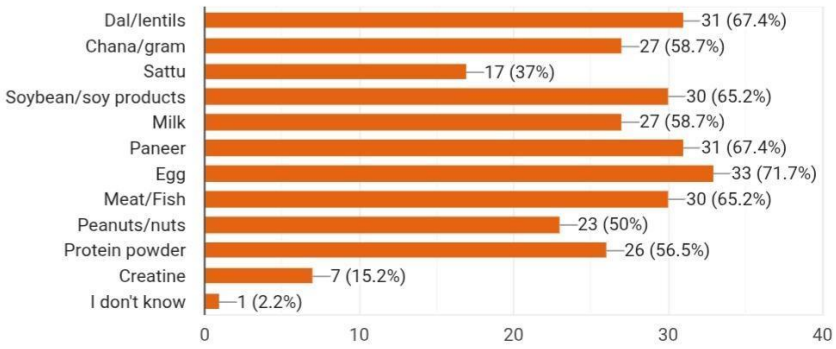
5. Why do you think that protein is important for human body



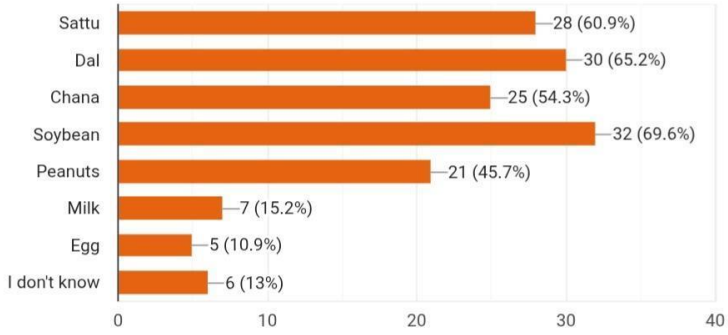
6. Do you think protein is needed only by people who exercise or go to gym



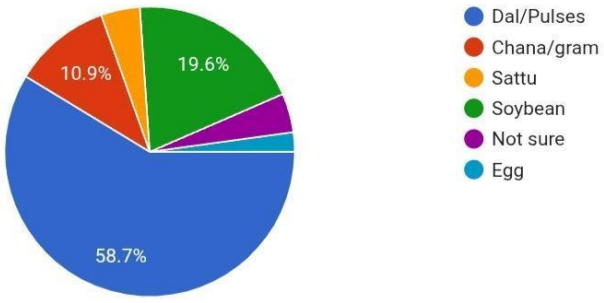
7. Which of the following force do you consider to be sources of proteins



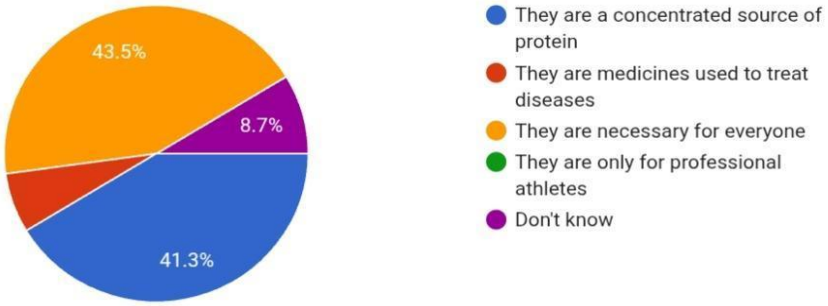
8. Which of the following do you think are plant based sources of proteins



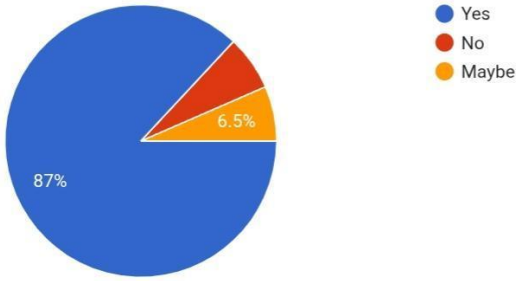
9. Which of the following do you think is the most affordable source of protein for an average Indian household



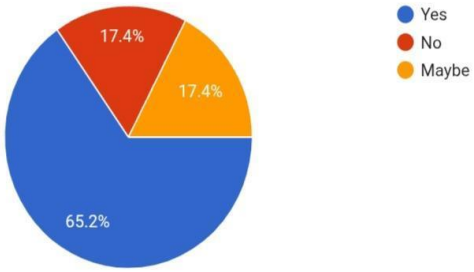
10. Which statement based describes are understanding of protein supplements



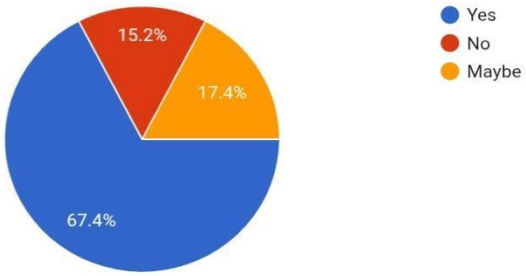
11. Do you think a person can obtain protein from regular foods without using protein powder



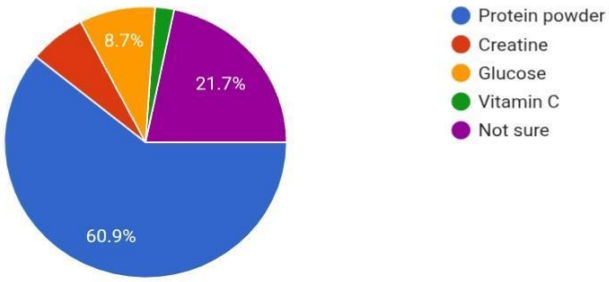
12. When buying packaged food do you check its nutritional information of protein content



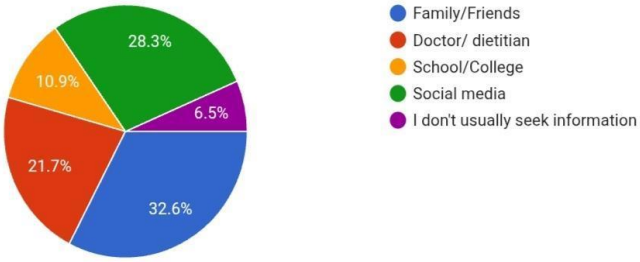
13. Do you know that proteins are made up of smaller units called amino acids



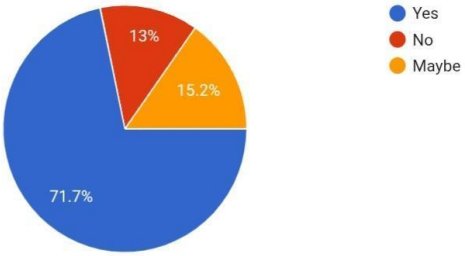
14. Which of the following do you think is a protein



15. From where do you usually get information about nutrition and protein



16. Would you be interested in learning more about affordable and commonly available protein sources



C) TEST PERFORMED FOR PROTEIN TESTS



SAMPLES USED FOR PROTEIN DETECTION

1. Biuret test

Aim: To detect the presence of proteins in selected nutritional samples using the Biuret test and to record their absorbance using a colorimeter at 530 nm.

Principle: The Biuret test is based on the reaction between copper(II) ions in an alkaline medium and the peptide bonds present in proteins. This reaction produces a violet or purple-colored complex. The intensity of the color generally increases with the amount of protein present under controlled experimental conditions.

Requirements

Apparatus: Test tubes, test-tube stand, measuring pipettes or micropipettes, beakers, glass rod, filter paper, and colorimeter.

Chemicals: Biuret reagent, distilled water, and the selected nutritional samples, such as whey protein, milk, soybean extract, sattu extract, egg white, and creatine supplement as a comparison sample. BSA (bovine serum albumin) is used for preparing protein standards when performing colorimetric calibration.

Preparation of BSA standards

A BSA stock solution of 1 mg/mL was used to prepare standards of different concentrations. The required volume of BSA stock was mixed with distilled water to make a final volume of 1 mL.

BSA stock (ml)	Distilled water (ml)	Total concentration (ml)
1. 0.0	1.0	1 ml
2. 0.2	0.8	1 ml
3. 0.4	0.6	1 ml
4. 0.6	0.4	1 ml
5. 0.8	0.2	1 ml
6. 1.0	0.0	1 ml

Preparation of protein sample

Different protein stock solutions of 1g/ml in 100 mL were used to prepare standards of different concentrations. The required volume of protein stock was mixed with distilled water to make a final volume of 100 mL.

Protein sample(ml)	Distilled water (ml)	Total concentration (ml)
1. Sattu powder - 1 g	100 ml	100 ml
2. Soyabean powder - 1g	100 ml	100 ml
3. Milk - 1 ml		
4. Whey protein - 1 g	100 ml	100 ml
5. Egg white - 1 ml	100 ml	100 ml
6. Creatine - 1 g	100 ml	100 ml
	100 ml	100 ml

Procedure

1. Prepare the nutritional samples using the extraction and dilution methods already used in your experiment.

2. Label separate test tubes for each sample and prepare a reagent blank containing 1 mL distilled water and 1 mL Biuret reagent.

3. Add 1 mL of each prepared sample to its respective test tube.

4. Add 1 mL of Biuret reagent to each sample tube and mix gently.

5. Allow the tubes to stand for approximately 10–20 minutes at room temperature, using the same reaction time for all samples.

6. Observe and record the color developed in each tube.

7. For colorimetric measurement, set the colorimeter to 530 nm. Use the reagent blank to zero the instrument, then measure and record the absorbance of each sample.

8. Record the readings without changing or estimating any values.

***Safety*:** Wear a lab coat, gloves, and safety goggles. Biuret reagent is alkaline and may cause skin or eye irritation.

Observation

A) BSA samples

Tube no	BSA stock	Water	Absorbance
1. Blank	0 ml	1 ml	0.05
2. BSA 1	0.2 ml	0.8 ml	0.07
3. BSA 3	0.4 ml	0.6 ml	0.08
4. BSA 4	0.6 ml	0.4 ml	0.10
5. BSA 5	0.8 ml	0.2 ml	0.11
6. BSA 6	1.0 ml	0.0 ml	0.12

B) Protein samples

Sample name	Dilution factor	Water in ml added	Sample in ml	Absorbance
7. Sattu	1g in 100 ml	1 ml	1 ml	0.09
8. Soyabean powder	1g in 100 ml	1 ml	1 ml	0.15
9. Milk	1ml in 100 ml	1 ml	1 ml	0.26
10. Creatine	1g in 100 ml	1 ml	1 ml	0.06
11. Whey protein	1g in 100 ml	1 ml	1 ml	0.58
12. Egg white	1g in 100 ml	1 ml	1 ml	0.12

The samples showed different absorbance values. Whey protein showed the highest observed absorbance, followed by milk, soybean extract, egg white, sattu extract, and creatine supplement.

Result: The Biuret test produced different colorimetric responses among the selected samples. Whey protein showed the highest recorded absorbance at 530 nm, whereas creatine showed the lowest. Since the samples had different preparations and some absorbance readings exceeded the BSA calibration range, the results are reported as observed absorbance values rather than calculated protein concentrations.

Precautions

1. Use clean test tubes and pipettes to avoid contamination.
2. Maintain the same sample and reagent volumes for all tubes.
3. Mix the samples and reagent thoroughly.
4. Keep the reaction time consistent for all samples.
5. Use a reagent blank for colorimetric measurements.



BEFORE



AFTER

2. Xanthoproteic Test for Proteins

Aim: To detect aromatic amino acid residues in selected nutritional samples using the Xanthoproteic test.

Principle: The Xanthoproteic test detects aromatic amino acid residues, particularly those of tyrosine and tryptophan, through nitration by concentrated nitric acid. The reaction produces a yellow color, which may become orange or deepen to yellow-orange after the addition of an alkali. Phenylalanine generally gives a weaker response.

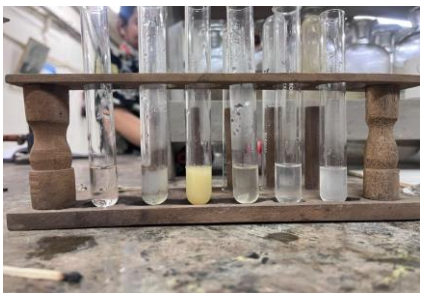
Requirements

Apparatus: Test tubes, test-tube stand, pipettes, beakers, and a water bath if required by the laboratory's approved procedure.

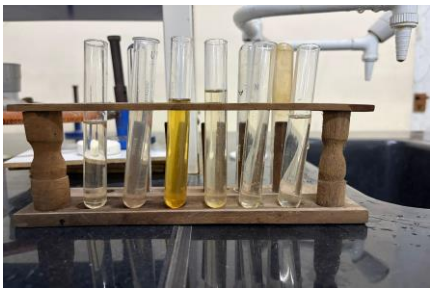
Chemicals: Prepared nutritional sample solutions, concentrated nitric acid, sodium hydroxide solution, and distilled water.

Samples: Whey protein, milk, soybean extract, sattu extract, and egg-white sample.

Safety: *Concentrated nitric acid is highly corrosive and an oxidizer. This test must be performed under the supervision of your laboratory teacher, using appropriate PPE and the institution's approved method. Do not heat concentrated nitric acid directly over a flame.*



BEFORE



AFTER

Result: The appearance of yellow coloration, deepening toward orange after alkalization, indicates a positive Xanthoproteic reaction and supports the presence of nitration-reactive aromatic amino acid residues in the sample. Whey protein showed a yellowish-orange response in the experiment. The test is qualitative and does not determine the total protein concentration.

Precautions

1. Perform the test only under the supervision of a laboratory teacher.

2. Wear gloves, a lab coat, and chemical splash goggles.
3. Handle concentrated nitric acid in a fume hood or other approved ventilated setup.
4. Never pipette acids by mouth.
5. Allow the reaction mixture to cool before adding alkali if required by the laboratory protocol.
6. Add sodium hydroxide carefully, as neutralization may release heat.
7. Dispose of the reaction mixtures according to college laboratory rules.

OBSERVATION AND ANALYSIS

1.1. Analysis

Among the tested samples, whey protein showed the highest recorded absorbance of 0.58, followed by milk at 0.26 and soybean at 0.15. Egg white showed an absorbance of 0.12, sattu showed 0.09, and the creatine supplement showed the lowest reading of 0.06.

These observations describe the measured absorbance values only. They do not establish the actual protein content of the samples or prove that the samples can be ranked by protein concentration. The highest BSA standard had an absorbance of 0.12, whereas the whey and milk readings exceeded this value. Therefore, their concentrations cannot be reliably estimated by extrapolating from the recorded calibration standards.

Furthermore, the instrument was initially zeroed using distilled water, while the water-plus-Biuret reagent mixture showed an absorbance of 0.05. Differences in sample preparation, extraction efficiency, dilution, and possible interference may also have influenced the readings.

Creatine should not be classified as a protein source. Its reading is included for comparison as a tested supplement, not as evidence of its protein content.

1.2. Questionnaire analysis

Survey measure	Gym members	General public
1. Number of participants	63	47
2. Participants aware of major protein sources	~ 50 (77 -80%)	~42 (89.4%)
3. Participants aware of protein functions	~51(80.3%)	~41(87.2%)
4. Participants familiar with protein supplements	~36(60%)	~19(40.4%)
5. Participants who reported using protein supplements	~36(60%)	~26(55.3%)

The gym member group showed higher actual usage of supplements (60%protein powder, 63.3% creatine) and better technical knowledge (77.4% know about amino acids). In contrast, the general public group (48 responses, 51.1% students, 54.3% female) had good basic awareness (89.4% heard about protein) but their understanding of functions was limited to muscle building only (87.2%). Confusion about supplements was higher in the general public - 44.7% thought supplements are necessary for everyone, compared togym members where 71% reported always checking dosage. Both groups correctly identified affordable plant-based sources like Dal/Pulses - 59.6% of general public chose Dal/Pulses as most affordable source.

CONCLUSION

The Community Engagement Project explored nutritional chemistry awareness with particular emphasis on proteins, their biological importance, dietary sources, and the use of protein supplements. The literature review highlighted the importance of adequate dietary protein and the role of nutritional knowledge in making informed food choices.

The preliminary Biuret colorimetric investigation produced measurable absorbance readings for sattu, soybean, milk, whey protein, creatine supplement, and egg white. Whey protein showed the highest recorded absorbance, while creatine showed the lowest. However, because the sample readings were not all within the BSA calibration range and the reagent blank was not confirmed to have been used to re-zero the instrument, reliable protein concentrations could not be determined from the available data.

The questionnaire survey provides an opportunity to understand protein awareness among gym members and the general public. Its final conclusions should be based on the actual responses collected. Overall, the project demonstrates the connection between nutritional chemistry, laboratory analysis, and public education, while highlighting the importance of appropriate experimental controls and cautious interpretation of scientific results

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