

chemistry project soya bean milk

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Introduction

In the realm of food chemistry, the humble soybean has long been celebrated for its versatility and nutritional value. Among the many products derived from this leguminous marvel, soya bean milk stands out as a cornerstone of plant based nutrition. **A chemistry project soya bean milk** offers students and researchers a hands on opportunity to explore the intersection of biology, chemistry, and food science. By dissecting the composition, processing steps, and analytical techniques involved in producing and evaluating soybean milk, one gains a deeper appreciation for the science that underpins everyday foods.

Whether you're a high school student eager to showcase your laboratory skills, a college chemistry major looking for a robust capstone project, or a hobbyist fascinated by the science of dairy alternatives, this guide will walk you through every step of a comprehensive chemistry project focused on soya bean milk. From conceptualizing objectives to interpreting results, you'll discover how to transform raw data into meaningful insights about this popular beverage.

1. Understanding Soya Bean Milk: An Overview

1.1 What Is Soya Bean Milk?

Soya bean milk is a plant based liquid extracted from soybeans. Unlike dairy milk, it contains no lactose, making it suitable for lactose intolerant individuals. Chemically, it is a complex emulsion composed of proteins, fats, carbohydrates, vitamins, minerals, and various bioactive compounds.

1.2 Nutritional Profile

Key nutritional components include:

- Proteins: Approximately 6–8 /g per 100 /mL, primarily composed of glycinin and ;" 6öævÇ–6–æ–âà
- Fats: Around 3–4 /g per 100 /mL, rich in unsaturated fatty acids.
- Carbohydrates: Roughly 3–5 /g per 100 /mL, mostly in the form of oligosaccharides.
- Vitamins & Minerals: Good source of vitamin /B ,, B †, folate, iron, and calcium (if fortified).

1.3 Common Uses

Beyond consumption as a beverage, soybean milk serves as a base for tofu, tempeh, soy yogurt, and as a dairy substitute in baking, cooking, and beverage formulations.

2. Why Study Soya Bean Milk?

Examining soya bean milk in a laboratory setting provides multifaceted educational benefits:

- Demonstrates extraction and emulsification techniques.
- Illustrates analytical chemistry methods such as titration, spectrophotometry, and chromatography.
- Highlights the importance of pH, protein solubility, and fat content in food quality.
- Encourages critical thinking about sustainability and nutritional adequacy.

3. Project Objectives

For a robust chemistry project, set clear, measurable goals. Typical objectives may include:

1. Quantify the protein, fat, and carbohydrate content of homemade soya bean milk.
2. Determine the optimal soaking and blending conditions to maximize yield.
3. Analyze the pH profile during storage and its effect on shelf life.
4. Compare the results with commercially available soy milk products.
5. Assess the impact of fortification (e.g., calcium or vitamin /D) on nutritional value.

4. Materials & Methods

4.1 Materials

- Raw soybeans (unsalted, non hulled)
- Distilled water
- Blender or food processor
- Cheesecloth or fine muslin
- Large saucepan
- Thermometer
- pH meter or pH strips
- Refractometer (optional for sugar measurement)
- Laboratory reagents: Folin Ciocalteu reagent, NaOH, Na₂CO₃, Bradford reagent, BCA reagent, etc.
- Standard solutions for calibration (e.g., BSA for protein, cholesterol for fat)
- Glassware: volumetric flasks, pipettes, cuvettes
- Safety equipment: gloves, goggles, lab coat

4.2 Experimental Design

Structure your project into distinct phases:

1. Soaking Phase: Determine optimal soaking time (e.g., 8 /h, 12 /h, 16 /h) to soften beans and reduce anti nutritional factors.
2. Blending & Filtration: Blend soaked beans with water, then filter to obtain the liquid fraction.
3. Heating & Pasteurization: Heat the filtrate to 90 /°C for 5 /min to denature proteins and inactivate enzymes.
4. Cooling & Storage: Cool to room temperature, then refrigerate samples for shelf life studies.
5. Analytical Tests: Perform protein, fat, carbohydrate, pH, and caloric analyses.

5. Experimental Procedure

5.1 Soaking and Preparation

1. Measure 100 /g of raw soybeans and rinse thoroughly.
2. Place beans in a large bowl and add enough distilled water to cover them by 5 /cm.
3. Allow soaking for 12 /hours at room temperature (or experiment with 8 /h and 16 /h as control).

5.2 Blending and Filtration

1. Drain soaked beans and transfer to a blender.
2. Add 300 /mL of distilled water (ratio 1:3, bean:water).
3. Blend on high speed for 2 /minutes until a smooth slurry forms.
4. Pour the mixture through cheesecloth over a bowl, squeezing gently to extract maximum liquid.

5.3 Heating

1. Transfer the filtrate to a saucepan.

2. Heat to 90 °C while stirring continuously to prevent scorching.
3. Maintain 90 °C for 5 /minutes, then remove from heat.

5.4 Cooling and Storage

1. Allow the liquid to cool to 25 °C.
2. Transfer to sterilized 250 /mL glass bottles, seal tightly.
3. Store at 4 °C and sample at 0, 3, 7, and 14 days for shelf life analysis.

5.5 Analytical Tests

Below are concise protocols for key analyses.

1. Prepare a standard BSA curve (0–2 /mg /mL {¹).
 2. Mix 50 /μL of sample with 1 /mL Bradford reagent.
 3. Incubate at room temperature for 5 /min.
 4. Measure absorbance at 595 /nm using a spectrophotometer.
 5. Calculate protein concentration from the standard curve.
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1. Weigh 5 /g of sample into a thimble.
 2. Extract with petroleum ether for 8 /h in a Soxhlet apparatus.
 3. Evaporate solvent under reduced pressure.
 4. Weigh the residue to determine fat percentage.
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1. Prepare a glucose standard curve (0–200 /mg /mL {¹).
 2. Add 1 /mL of sample to 5 /mL of 5 /% phenol, then slowly add 15 /mL concentrated sulfuric acid.
 3. Stir and incubate at 30 °C for 30 /min.
 4. Measure absorbance at 490 /nm.
 5. Calculate carbohydrate content from the standard curve.
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1. Calibrate the pH meter with standard buffers (pH /4.0, 7.0, 10.0).
 2. Measure the pH of freshly prepared soy milk and at each storage time point.
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1. Dry a known mass of sample to constant weight.
 2. Place in a bomb calorimeter, combust in oxygen, and record heat of combustion.
 3. Calculate caloric value (kcal /g {¹) using the standard conversion factor (4.184 /kJ /kcal {¹).

6. Analytical Techniques and Their Significance

6.1 Spectrophotometry

Allows rapid, quantitative measurement of analytes like proteins and carbohydrates. It relies on the Beer–Lambert law, where absorbance is directly proportional to concentration.

6.2 Chromatography

High performance liquid chromatography (HPLC) can separate individual amino acids or fatty acid profiles, offering deeper insight into the nutritional quality of soy milk.

6.3 Thermogravimetric Analysis (TGA)

Used to assess moisture loss and thermal stability, which are critical for shelf life and packaging decisions.

6.4 Microscopy

Optical or electron microscopy can reveal the size distribution of protein–fat globules, impacting mouthfeel and stability.

7. Results & Discussion

7.1 Yield and Composition

Typical yields range from 250 mL to 300 mL per 100 g of soybeans, depending on soaking time and blending efficiency. Protein content often falls between 6 % and 7 %, while fat content averages 4 %. Carbohydrates contribute roughly 3 % of the total mass.

7.2 Effect of Soaking Time

Extending soaking from 8 h to 16 h generally improves protein solubility, increasing yield by ~5 %. However, overly long soaking can lead to nutrient leaching and a slight increase in anti nutritional factors like trypsin inhibitors.

7.3 pH Dynamics

Freshly prepared soy milk typically has a pH of 6.5–6.8. Over refrigerated storage, the pH may drift slightly downward (to ~6.3) due to microbial metabolism. A stable pH is essential for preventing spoilage and maintaining flavor.

7.4 Comparative Analysis with Commercial Products

Commercial soy milks often contain added sugars, stabilizers, and fortification agents. When comparing homemade and commercial samples, the homemade version usually exhibits lower caloric density but higher protein purity. Fortified commercial milks can match or exceed the protein content of homemade versions.

7.5 Shelf Life

Under refrigeration, homemade soy milk remains palatable for up to 7

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