Laboratory Analysis of Proteins Lipids and Carbohydrates in Milk

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The food industry is highly regulated by government authorities, and all food chains and supplies are evaluated according to international standards to control and assure quality. Milk is an essential food all over the world. So in order to meet the milk requirements, composition and characteristics analysis of milk is necessary. In lab experiments, the proximate analysis technique is used. In proximate analysis, the percentage of fats, protein, and carbohydrates is determined. During laboratory activity, the percentage of proteins, carbohydrates, and water can be analyzed (Imperiale et al., 2023).

Determination of the composition is necessary to calculate food value. Laboratory results can be compared with the expected values. The purpose of the lab activity is to allow us to use their knowledge of macromolecules and design a whole line of experiments to evaluate the composition of milk. Understanding the macromolecule assay is very useful in the analysis of milk composition. In this course, we are challenged to advance and test our skills in scientific reasoning, formulating a hypothesis, and schematically running experiments. Any kind of unknown substance is evaluated to identify its chemical nature and macromolecular assay. It is anticipated that milk includes carbohydrates, fats, and proteins. According to previous literature, major part of milk composition is proteins. There are numerous kinds of proteins in milk.it is predicted that fats are the most important portion of milk. Milk composition and percentages of different macromolecules in milk can give us knowledge about the physical and chemical properties of milk. (Siddiqui et al., 2024).

Material and methods:

The food we eat is made of cells. We digest our food and obtain energy and the raw materials from which to build our own cells. We can use chemical indicator tests to determine which kinds of macromolecules particular foods contain. Each food sample is considered an unknown because its exact molecular composition is not known. In order to investigate our unknowns using chemical indicator tests, we must first find out how the indicator chemicals react with each type of macromolecule. As an example, in order to test for the presence of starch, we need to know what color the indicator chemical produces when it is combined with starch versus the color it produces when there is no starch.

Experimental work:

There are four basic components of organic food. The composition of these four macromolecules in milk was evaluated in the laboratory using standard protocol. Availability of the material and utensils was also kept under consideration. The following are the procedures used in the analysis of milk macromolecules (Imperiale et al., 2023).

Test for carbohydrates: carbohydrates are divided into two basic types, starch and simple sugar.

Test for starch: lugol's reagent or iodine solution is used to test starch. The iodine solution is yellowish brown to dark purplish in color.

Procedure:

Material: two test tubes, Iodine solution, Milk sample.

Methodology:

- Take two separate test tubes, one with a milk sample other containing control (distilled water).
- Add 3 drops of iodine solution in both tubes separately.
- Record the result in both test and control.
- Change in the color is an indication of starch presence.

Benedict's solution: This is used to test simple carbohydrates in the sample. Benedict's solution is a blue-colored liquid with copper ions. When benedicts solution and simple sugar solutions are heated for a while, the color changes from blue to brick red.

Materials: Two test tubes, milk, distilled water, water bath, Benedict's solution.

Method

- Add 3 drops of Benedict's solution to 5 ml of milk in a test tube.
- Add 3 drops of Benedict's solution to 5 ml of distilled water in another test tube as a control.
- Now place both test tubes in a beaker half-full of water. Heat this water bath on a hot plate until the water in the beaker has boiled for 2-3 minutes.
- Record the change in color as an indicator of simple sugar presence or absence.

2. Testing for lipids:

Grease spot test: Put a small drop of milk on a piece of paper. Next to it, put a small drop of water. Allow both to dry. Record what happened to both the spots.

Water will evaporate, but milk will leave an oil spot due to fats (Linehan et al., 2024).

3. Testing for Proteins using the CuSO4 test

Biuret Test

Materials: Cuso4, milk, 40% NaOH, dropper, test tube holder.

Method:

- Take a small amount of 40% NaOH in a dropper.
- Add a few drops of 40% NaOH in a test tube containing 5ml milk.
- With the help of a dropper, take 1% CuSO4 solution.
- Add a few drops in the same test tube containing milk.
- Shake well and note the change in color.

4. Testing pH using pH indicator paper: pH can easily be checked with an electronic device called a pH meter. Sometimes for more convenience, pH paper is also used to check pH. pH paper is quite easy to use. Just dip a side of paper in milk solution, and after drying for a second, match the color with the chart. The neutral pH is 7. Above this, pH is basic, and below is acidic (Aydogdu et al., 2023).

Results:

Chemical indicator test	A positive result (macromolecule present)	Negative results (control)
Iodine test	Starch +ve	-ve
Benedict's test for Simple Sugars	Simple sugar +ve	-ve

Grease-spot test for Lipids	Fats +ve	-ve
Biuret Test	Proteins +ve	-ve
pH	6.5 slightly acidic	7

Table 1.1 Composition of milk macromolecules

Conclusion: To evaluate the food value of any product, an analysis of its components is the first step. Although these efforts were driven to check the precise balance of macromolecules in milk. Through all these tests we summarized the results. On the basis of the results, we concluded that fats are a very important component of milk. The fact that diet has a major effect on milk fat percentage has made this milk component of particular interest. A grease spot test confirms the presence of fats. It's a topic of further research that milk fats are heat resistant or labile and other fat characteristics. Proteins and sugar also guarantee the food value of milk. As we concluded, proteins are present in milk on the basis of the biuret test. The color change was evident after adding reagents to the milk sample. Our experiments will emphasize more use of milk in the future as a healthy diet. But still, there is a need to analyze the exact amount of all these molecules and the effect of these molecules on human growth (Imperiale et al., 2023; Linehan et al., 2024).

References

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