

Physical chemistry formal report essay sample

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Biological lipids are a chemically diverse group of compounds, the common and defining feature of which is their insolubility in water. The biological functions of the lipids are as diverse as their chemistry. Fats and oils are the principal stored forms of energy in many organisms. Phospholipids and sterols are major structural elements of biological membranes. Other lipids, although present in relatively small quantities, play crucial roles as enzyme cofactors, electron carriers, light-absorbing pigments, hydrophobic anchors for proteins, “chaperones” to help membrane proteins fold, and emulsifying agents in the digestive tract, hormones, and intracellular messengers. This chapter introduces representative lipids of each type, with emphasis on their chemical structure and physical properties. (Nelson & Cox, 2008)

According To Campbell, 2009, Biochemistry 6th Edition, lipids are compounds that occur frequently in nature. They are found in places as diverse as egg yolks and the human nervous system and are an important component of plant, animal, and microbial membranes. The definition of a lipid is based on solubility. Lipids are marginally soluble (at best) in water but readily soluble in organic solvents, such as chloroform or acetone. Fats and oils are typical lipids in terms of their solubility, but that fact does not really define their chemical nature. In terms of chemistry, lipids are a mixed bag of compounds that share some properties based on structural similarities, mainly a preponderance of nonpolar groups. Classified according to their chemical nature, lipids fall into two main groups. One group, which consists of open-chain compounds with polar head groups and long nonpolar tails, includes fatty acids, triacylglycerols, sphingolipids, phosphoacylglycerols,

and glycolipids. The second major group consists of fused ring compounds, the steroids; an important representative of this group is cholesterol.

The following statements are the objectives of this experiment: to investigate the lipid composition of common foods such as corn oil and egg yolk, and glycerol. The significance of this experiment to verify lipids if they are present or absent in such known foods that contained lipids through different tests. And also for the students to understand deeply through personal experience and could conclude whether it is positively or negatively present according to the corresponding results. The scope of this experiment involves qualitative analysis helps to reveal the ability of the student to verify and understand those reactions could be obtained in the experiment. This is limited in the availability of the reagents to be used in each test, the samples to be tested and the substitution of chemicals restricted to use in the experiment that student could be able to verify experimentally. Since, there are some of them which are not available in the laboratory and failed to substitute chemicals.

THEORETICAL BACKGROUND

Lipids are chemically heterogeneous mixtures. The only common property they have is their insolubility in water. We can test for the presence of various lipids by analyzing their chemical constituents. Foods contain a variety of lipids; most important among them are fats, complex lipids, and steroids. Fats are triglycerides, esters of fatty acids and glycerol. Complex lipids also contain fatty acids, but their alcohol may be either glycerol or sphingosine. They also contain other constituents such as phosphate,

choline, ethanolamine, or mono- to oligosaccharides. An important representative of this group is lecithin, a glycerophospholipid, containing fatty acids, glycerol, phosphate, and choline. The most important steroid in food is cholesterol. Different foods contain different proportions of these three groups of lipids. Structurally, cholesterol contains the steroid nucleus that is the common core of all steroids:

A test that differentiates between cholesterol and lecithin is the acrolein reaction. When lipids containing glycerol are heated in the presence of potassium hydrogen sulfate, the glycerol is dehydrated, forming acrolein, which has an unpleasant odor. Further heating results in polymerization of acrolein, which is indicated by the slight blackening of the reaction mixture. Both the pungent smell and the black color indicate the presence of glycerol and therefore fat and/or lecithin. Cholesterol gives a negative acrolein test. (Bettelheim & Landesberg)

And to determine the presence of phosphate, molybdate test is used test to detect the presence of phosphate at your solution and the appearance at the lab is purple pink as the phosphate is containing lipids and lipids will react with molybdate test to give pink color.

Glycerol is a simple compound that contains three hydroxyl groups. When all three of the alcohol groups form ester linkages with fatty acids, the resulting compound is a triacylglycerol; an older name for this type of compound is triglyceride. Note that the three ester groups are the polar part of the molecule, whereas the tails of the fatty acids are nonpolar. It is usual for three different fatty acids to be esterified to the alcohol groups of the same

glycerol molecule. Triacylglycerols do not occur as components of membranes (as do other types of lipids), but they accumulate in adipose tissue (primarily fat cells) and provide a means of storing fatty acids, particularly in animals. They serve as concentrated stores of metabolic energy. Complete oxidation of fats yields about 9 kcal g⁻¹ in contrast with 4 kcal g⁻¹, for carbohydrates and proteins. Plant oils are liquid at room temperature because they have higher proportions of unsaturated fatty acids than do animal fats, which tend to be solids. Conversion of oils to fats is a commercially important process. It involves hydrogenation, the process of adding hydrogen across the double bond of unsaturated fatty acids to produce the saturated counterpart. Oleomargarine, in particular, uses partially hydrogenated vegetable oils, which tend to include trans fatty acids (Cambell, 2009)

METHODOLOGY

The materials and chemicals used in the analysis of lipids were the following:

Materials/equipmentsChemicals

Test tubes

Alcohol lamp

Medicine droppers

Iron ring

Iron stand

Wire gauze

Wash bottle

Beaker

Filter paper

6 M HNO₃

NaOH

Molybdate reagent

KHSO₄

Sulfuric acid, H₂SO₄

Glycerol

Corn oil

Egg yolk

There were two tests conducted in this experiment such that phosphate and acrolein test. The following are the methods done in the laboratory. First, Phosphate Test, about 0.2 grams of sample to each test tube three clean and dry test tubes and labeled them. Three milliliters of 6 M nitric acid was added to hydrolyzed the compound to each test tube. These test tubes were placed in the prepared boiling water bath (100 mL of tap water in a 250-mL beaker) for five minutes. The test tubes were cooled to room temperature then the acid was neutralized by three milliliters of 6 M NaOH and mixed. The samples in which a precipitate appeared were filtered on top of a 25-mL Erlenmeyer flask. The turbid hydrolysate was poured in the test tube through filter paper. Two milliliters of each neutralized (and filtered) sample was transferred into clean and labeled test tubes. Then three milliliters of a molybdate solution was added to each test tube and mixed the contents. Next, the test tubes were heated in a boiling water bath for 5 min and cooled them to room temperature. Lastly, it was added 0.5 mL of an ascorbic acid solution and mixed the contents thoroughly. Then we had waited 20 minutes

for the development of the purple color. Three observations were recorded on the data notebook.

And in the Acrolein Test for Glycerol, one gram of potassium hydrogen sulfate, KHSO_4 , was placed in each of seven clean and dry test tubes and labeled them. A few grains of purely prepared, lecithin and cholesterol, was added to two of the test tubes. And about 0.1 g, from each, glycerol, corn oil, and egg yolk was added to the other three test tubes. To the six test tubes a few crystals of sucrose added. Each test tube was gently heated, one at a time, over the alcohol lamp flame, shaken it continually from side to side. When the mixture melts it slightly blackens, and noticed the evolution of fume it stopped heated. And the observation was recorded specially the smell.

RESULTS AND DISCUSSION

A lipid is an organic compound found in living organisms that is insoluble in water but soluble in nonpolar organic solvents. When a biochemical material (human, animal, or plant tissue) is homogenized in a blender and mixed with nonpolar organic solvent, the substances that dissolve in the solvent are lipids.

To detect the presence of lipids in a specified sample (oil, glycerol and egg yolk) in this experiment, we conducted different tests such that: phosphate and accrolein test. The presence of free phosphate in acidic solution can be detected by adding a molybdate to the solution. A phosphate containing lipids will react with molybdate test to give pink color. When lipids containing

phosphate groups in their structures are added to a strong acid solution such as the solution used here, the lipid hydrolyses, producing free phosphate.

The free phosphate then reacts as in Equation 1, forming a yellow precipitate. Based on the results (table 1. a) among the following solutions glycerol gave positive result since it turned pink color. Table 1. a

PHOSPHATE TESTEGG YOLKOILGLYCEROL

a) colorDark orange solution(lower layer) Yellowish solution (upper layer)

dark orange solutionPale pink solution

b) conclusionsnegativenegativepositive

The presence of free phosphate in acidic solution can be detected by adding a molybdate to the solution. Equation illustrates the pertinent reaction between phosphate and ammonium molybdate solution in the presence of nitric acid (HNO₃). $\text{HPO}_4^{2-}(\text{aq}) + 12\text{MoO}_4^{2-}(\text{aq}) + 3\text{NH}_4^+(\text{aq}) + 23\text{H}_3\text{O}^+(\text{aq}) \rightarrow (\text{NH}_4)_3[\text{P}(\text{Mo}_3\text{O}_{10})_4] (\text{yellow, s}) + 35\text{H}_2\text{O}(\text{l})$ After a few minutes, the yellow ammonium molybdo-phosphate precipitates from the reaction mixture. The second is acrolein test; it is used to differentiate cholesterol and lecithin. When lipids containing glycerol are heated in the presence of potassium hydrogen sulfate, the glycerol is dehydrated, forming acrolein, which has an unpleasant odor. Further heating results in polymerization of acrolein, which is indicated by the slight blackening of the reaction mixture. Both the pungent smell and the black color indicate the presence of glycerol and therefore fat and/or lecithin. Cholesterol gives a negative acrolein test. Based on the result below (Table 1. b), glycerol and sucrose gave positive

result for acrolein while negative in egg yolk. This test responds to glycerol free or linked as an ester. Table 1. b

ACROLEIN TEST Egg yolk sucrose glycerol

a) observation Fried egg like odor Black ppt Pungent odor

c) conclusions negative positive positive

The figure 1 shows the chemical reaction for the positive result specifically in glycerol.

CONCLUSION AND SUMMARY

Lipids are a diverse range of compounds for which no agreed definition exists. A general summary of the chemistry, occurrence, composition and biology of these essential and fascinating natural compounds is presented here. They are chemically heterogeneous mixtures that have only common property which is insolubility in water. They also contain other constituents such as phosphate, choline, ethanolamine, or mono- to oligosaccharides. We had been verified lipids in some test such that phosphate and acrolein test and investigated the lipids composition to the common foods such as corn oil and egg yolk, and glycerol. This resulted to some experimental results that conclude positively and negatively result corresponding to the information gathered.

REFERENCE

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