Chemistry food acids flashcard

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The purpose of this investigation is to find out how stable unsaturated fats are compared to saturated fat when these are exposed to great heat-energy and more specifically water. By this information, this can be used as a tool by understanding how certain fats or oils behave at certain conditions and the chemistry behind it, and improve our awareness when it comes to selecting the " right" type of oil in our cooking. Fats and oils (lipids) are hydrophobic organic compounds, which are termed as a result to trimesters to glycerol and three tatty acid chains (carboxylic-acids).

These undergo a condensation reaction to form a triglyceride-molecule and the by-product, three molecules of water [1].

The general structure of triglyceride can be presented below: Where R, R' and R" represent particular carbon fatty acid chains. The fatty acid composition is the most important characteristic of the triglyceride. The physical and chemical properties of particular triglycerides depend on the nature and arrangement of these fatty acid residues, and how these react with each other and external substances.

In the saturated fatty acid-molecule there are no double- ended carbons.

Hence, all the carbons in the structure are saturated with hydrogen-atoms. All of these hydrogen atoms attached to the backbone keep saturated fats intact, but also help protect it against oxidation and the binding of free radicals (molecules which have unshared pair of electron on their outer valence- shell, making these very reactive) [2]. In contrast, the unsaturated fatty acid-molecule has at least one double-bonded carbon in the structure.

In the unsaturated fatty acid's case, two types exist: mono-unsaturated fatty acid and poly-unsaturated fatty acid. The difference between these is that the mono-unsaturated fatty acid chain only contain one CICS double-bond between two carbons, hence the term mono. These types have less than the maximum possible number of hydrogen atoms in their molecule.

As a result, these become more reactive to free radicals and the process oxidation (lipid perpetration, See Figure 1. 0 and 1. 05), and increase the probability of a particular oil of becoming rancid.

This changes the chemical properties of the molecules, particularly its dour, taste and its safety for consumption. As the poly- unsaturated fatty acids contain more than one CICS double-bond, these are even more reactive to the external environment (the more double-bonds a fatty acid chain contains, the more reactive it is to light, oxygen and heat [3]) and more importantly; lipid perpetration (See Figure 1.

0 and 1. 05) [5. 6] As a result, the properties between these differ slightly in terms of boiling-point and melting-point; one is more stable than the other.

Above: Figure 1. 0: Mechanism involved in the formation of exocrine ring (epoxies): direct attack by a hydrotherapy radical on the vinyl carbons, leading to the orientation of an exocrine group and an alkyl radical [5] Figure 1. 05: As a result of the exocrine-ring, the particular section of the fatty acid chain becomes further oxidized to an alloyed.

This breaks the chain, resulting in shorter fatty acid chains [6] Examples of the mentioned kinds of fatty acid chains can be illustrated below: Figure 1. :

The structure of a typical saturated triglyceride As saturated fats do not contain any double-bonds, they tend to be very stable in comparison to the other mentioned types – contributing to a greater melting point. Hence, solid fats are mainly composed of saturated fatty acids. The straight, crisscross molecular structure of saturated fatty acids (Figure 1.

0) makes it easy for these to align on top of each other, Witt the presence to dispersion torte within and between corresponding TA acid chain, causing these to have an adhesive, compact structure in general.

With the non-polar “ carbon-wall” (glycerol portion of the structure) and the forces, these further resist water-molecules of reaching their main target: the ester-bond (C-O bond) connecting the alcohol and carbonyl-group (Figure 1. 2 below). Consequently, this contributes to the strong stability of saturated fats. Figure 1. 2: The red highlighted areas are the ester-bonds the water-molecules target to hydrolysis.

These hydrolysis a particular triglyceride into glycerol and carboxylic acids (free fatty acids).

However, in mono-unsaturated fatty acids the presence of the CICS double-bond causes the molecule to bend, having a slightly different arrangement. The CICS double results in hydrogen-atoms being on the same side of the bond, and the carbon-groups on the opposite, as following (Figure 1. 3): Figure 1. 3: CICS double-bond.

This result the fatty acid chains having an irregular structured (Figure 1. 4) in imprison to the saturated fats: Figure 1. 4: The structure of a typical mono-unsaturated triglyceride Observing Figure 1. , it can be seen that the distance between the top fatty acid chain and the second is much greater in comparison to the distance between the two bottoms.

Thus, the dispersion-force is weaker as a result of this; structure is less stable. Furthermore, the alignment of mono-unsaturated fats becomes more complicated as a result of this arrangement; they do not superimpose well. As a result of these factors, this simplifies for H2O-molecules of approaching and breaking the ester-bond; hence, ore fatty-acids are separated.

In poly-unsaturated fatty acids, the presence of at least two CICS-double bonds causes the structure of the fatty acid chain to be even more complicated (Figure 1. 4): Figure 1.

5: The structure of a typical poly-unsaturated triglyceride Observing Figure 1. 5, it can be seen that the distance between the bottom two fatty acid chains is even more greater than what it has been seen in Figure 1. 1 and Figure 1. 4. Also, these will ineffectively superimpose, and stack together.

Thus, this simplifies it even further for H2O-molecules to approach and break the ester-bonds.

Consequently, more fatty acid chains will separate, thus increasing the acidity-concentration of the oil. By using this information, it has been hypothesized that unsaturated fats will hydrolysis more, to produce greater acidity, in comparison to saturated fats. It is important to understand that poly-unsaturated fats will hydrolysis the most of these different types, due to the greater number of double-bonds and its complicated structure.

Topic: Usage of different types of oils in cooking. Aim: To measure the free fatty acid-concentration of different types of oils after exposed to heat and water.

Hypothesis: Unsaturated fats are more likely to hydrolysis during cooking than saturated fats of similar chain-length. Materials Refer to Appendix 1 .

Method In this experiment, deterrent types to oils were tried at the temperature range 170-190 degrees Celsius, at the same time being exposed to a particular amount of water. Periodic samples were taken in each frying to later be used to determine the change in acidity, via titration. The methods are described in details in Appendix 2. These were the controlled variables in the experiment: * Temperature * Amount of oil fried * Amount of wet cloths exposed to the oils

The different types of oils (saturated, mono-unsaturated, poly-unsaturated; coconut oil, olive oil and sunflower oil) were the independent variables of the experiment. Results At the end of frying the oils, the amount of water diffused into the cloths was calculated by subtracting the initial amount of water in the beaker with the final amount of water; as mentioned in Method. In each case, this was then divided by the number of wet cloths exposed to the oil.