Structuring of oils using amide based gelators

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Abstract:-

Structuring liquid oils has become an active areaof research in the past decade, mainly due to pressures toreduce saturated fat intake and eliminate trans fats from ourdiets. However, replacing hard fats with liquid oil can lead tomajor changes in the quality of food products. Recent strategiesto impart solid-fat functionality to liquid oils includethe addition of unusual compounds to oil, leading to itsgelation. Several long chain compounds are found to have gelation abilities. This study highlights the use of amide based organogelators for gelation of oils.

Keywords:-organogel, structuring, gelator.

Introduction:-

Unsaturated fats can be altered by reaction with hydrogen effected by a catalyst. This action, called hydrogenation, tends to break all the double bonds and makes a fully saturated fat. To make vegetable shortening, then, liquid *cis*-unsaturated fats such as vegetable oils are hydrogenated to produce saturated fats, which have more desirable physical properties e.g., they melt at a desirable temperature (30–40 °C), and store well, whereas polyunsaturated oils go rancid when they react with oxygen in the air. However, trans fats are generated during hydrogenation as contaminants created by an unwanted side reaction on the catalyst during partial hydrogenation. A guideline for the appropriate amount of fat—a component of daily food consumption—is established by regulatory agencies like the Food and Drug Administration. The recommendation is that 20-35% of total daily calories should come from fat, with 10% or fewer from saturated fat and the majority from polyunsaturated and monounsaturated fats.[2] While consumption of small amounts of saturated fats is common in diets,[3] meta-analysesfound a significant correlation between *high consumption* of saturated fats and blood LDLconcentration,[4] a risk factor for cardiovascular diseases.[5] Other meta-analyses based on cohort studies and on controlled, randomized trials found a positive,[6] or neutral,[7] effect from consuming polyunsaturated fats instead of saturated fats (a 10% lower risk for 5% replacement).[7]The present study highlights the use of amide based organogelatorN-(2-aminoethyl)octadec-9-enamide **(1)** for the solidification of oils without altering their chemical structure and properties.

1

Material & method:-

N-(2-aminoethyl)octadec-9-enamide **(1)** was synthesized by the reaction of oleic acid and thionyl chloride. Thionyl chloride was taken in a three naked flask provided with a stirrer, separatory funnel and a water condenser fitted with gas trap at the top. The flask was kept in an electrically heated water bath for 15 min. The temperature of the bath was kept at 60^0C. Oleic acid, taken in the separatory funnel, was then slowly added over a period of 30 min. The reaction mixture was stirred simultaneously. After the complete addition of oleic acid, the reaction mixture was kept stirring for another 15 min. Meanwhile, ethylene diamine was taken in a beaker, kept in an ice bath. The reaction mixture was then slowly added to it with continuous stirring. A brownish solid separates out. It was then recrystallized and dried [10].

Results & discussion:-

The formation of desired product was ensured from its IR & NMR spectrum.

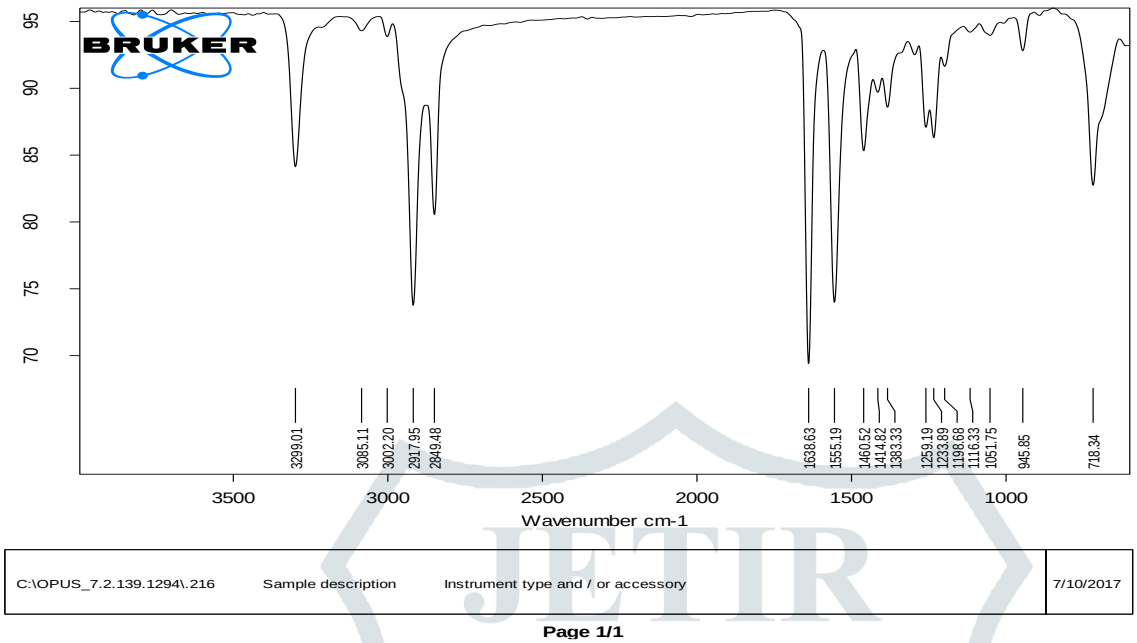

fig 1 : Infra-red spectrum of 1

The infra-red spectrum of the compound is recorded on Bruker. The signals around 1500cm^{-1} indicates the presence of unsaturation i.e. double bond. The signals at 2917.95cm^{-1} and 3299cm^{-1}indicates the presence of amide moiety in the compound.

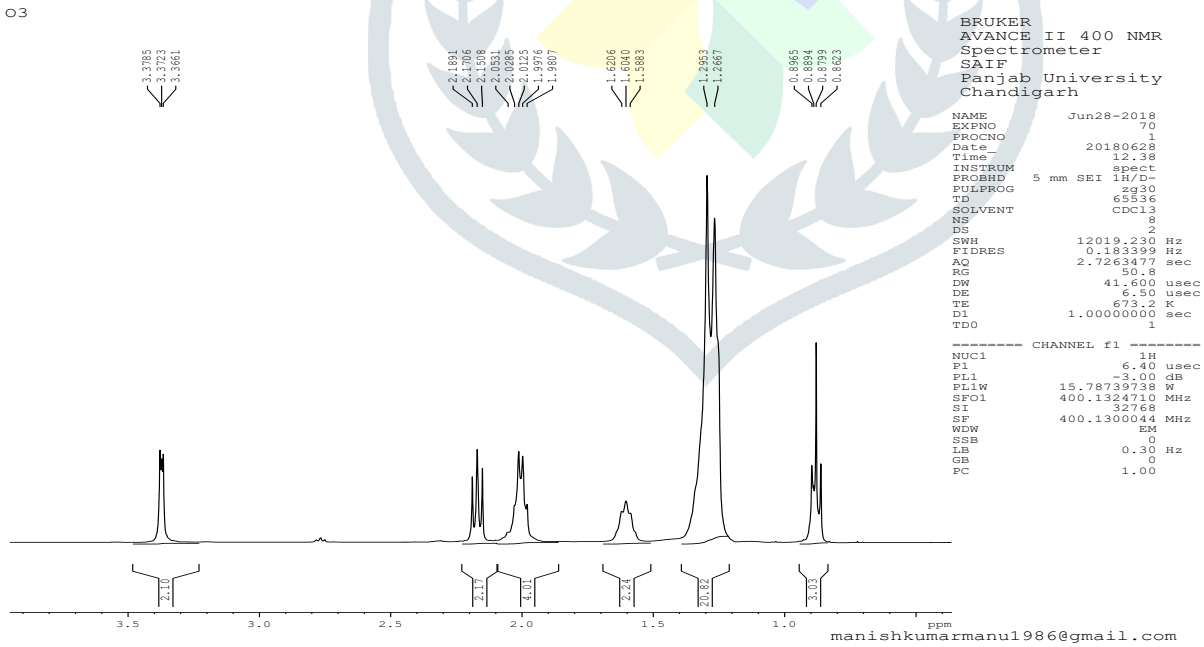

fig 1 : H^{1}NMR spectrum of 1

The H^{1}NMR spectrum of the compound **1** is recorded on BrukerAvance 400 NMR Spectrometer at SAIF, Punjab University, Chandigarh. The signal around 5.0 indicates the presence of alkene protons. The signal at 6.4 indicates the presence of amide protons. The signals around 1.30 indicates the presence of saturated protons.

Gels are prepared by warming the gelator in solvent, until a clear solution is obtained, and then cooling the solution to the room temperature. First photograph is taken on heating where clear and transparent solution is formed which can flow. On cooling an opaque gel is formed which do not flow. The gel formation is ensured by inverting the tube when the solution does not undergo flow. The stability of the gels formed is appreciable.

Gelation behaviour of **1** was tested with mustard oil and sesame oil, which shown gelation successfully at a concentration of 8.5%w/v and 8.0%w/v respectively.

Figure 1a. Gelation of mustard oil

Figure 1b. Gelation of sesame oil

Conclusion:-

Gelation is a better option for the solidification of oils. It does not change the chemical properties of the oil and hence prohibits the formation of trans fats. Since gelation is reversible, we can easily return to liquid oil state by heating up to the melting point of the gel.

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