The Study of Static Magnetic Field Effect on Cholesterol Crystal

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Abstract: In the present work, Cholesterol crystals were grown by single diffusion gel method in the presence of static magnetic field for different strengths such as unexposed and 0.2 Tesla using electromagnet unit (EMU-50) at constant pH, density and concentration of the solution at ambient temperature. Yields and morphology of grown crystals were studied. These crystals were characterized by using XRD and FTIR method.

Keywords: Cholesterol Crystal, Static Magnetic Field, EMU-50, XRD, FTIR

Introduction

Nowadays Crystallization process studies by various researchers, and crystallographers as a curiosity and for application based; which reveals fascinating results. Crystallization techniques available in different fields of science and technology. This paper shows results how static magnetic field effects on Cholesterol Crystal. Existence of Cholesterol found as urinary constituents in human animal and birds. The crystal growth in gel media was studied [1].The biological significance of 37˚C phase transition of Cholesterol was studied [2].The in-vitro Cholesterol crystal has plate like morphology in silica gel in ethanol solvent[3].The growth of Cholesterol in different solvents exhibits different morphology and crystal size [4]. The observations of Cholesterol nucleation in magnetic field [5].Adding extract of phyto-active compound in Cholesterol solution in Ethanol solvent changes morphology of crystal [6].Effect of Fluoride on the Crystallization and Spectral Properties of Cholesterol studied [7].Along with cholesterol crystal, crystallization of struvite, whewellite, brushite,uric acid studied[8,9,10,11].

In the present work, Cholesterol crystals were grown by single diffusion gel method in the presence of static magnetic field for different strengths such as unexposed and 0.2 Tesla using electromagnet unit (EMU-50) at constant pH, density and concentration of the solution at room temperature. Yields and morphology of grown crystals were studied. These crystals were characterized by using XRD and FTIR method.

Materials and Methods

The A.R. grade chemicals used for study of Cholesterol crystal growth are Sodium Meta Silicate (SMS), Acetic Acid (glacial), Acetone, Distilled water. Borosilicate Glass Test tubes of diameter 2.5cm and length 15 cm. Entire procedures carried out in dust free and quiet environment.

Gel Setting and Cholesterol crystals growth in gel media

The gel preparation and gel setting are done by preparing stock solution by dissolving Sodium Meta silicate powder in double distilled water and shaking this solution well. The solution is filtered and kept in clean flask. This solution was mixed with acetic acid to set a suitable pH value of the solution. In the present case pH value is set in (6.5) and with specific gravity of the solution being 1.045g/cc. Then resulting solution was mixed in organic solvent like Acetone in the ratio 2:1 and allowed to set for 96 hours at room temperature. After setting the gel in Acetone solvent, the supernatant solution of 2% concentration of solution in Acetone is poured over set gel. As soon as this solution is added the nucleation process starts at gel formed region of the test tube. Thereafter the test tube should be kept in a quiet and vibration free condition. Fine Cholesterol crystals were observed in test tube after 120 hrs.

Static Magnetic field set up

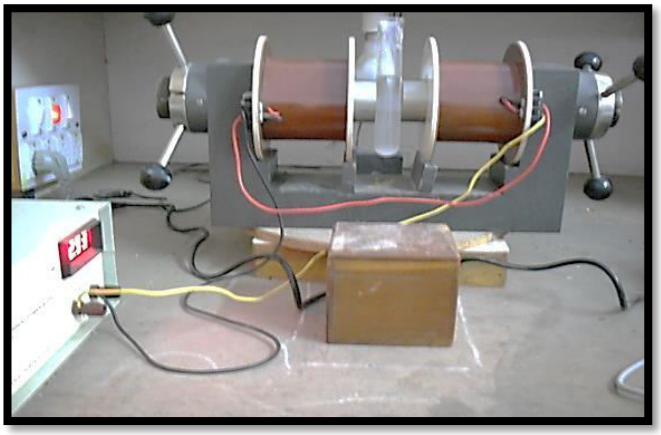

Fig.1. Set up for Cholesterol Crystal growth at 0.2 Tesla magnetic field strengths.

Sr. No.	Cholesterol Crystal Growth Parameters	
1	Specific Gravity of stock solution	1.045 g/cc
2	Acid used for pH setting	Acetic acid
3	Stock solution at pH	6.5
4	Temperature	Room Temp.
5	Supernatant solution in Acetone Solvent	2%
6	Gel Aging	96 hrs
7	Time of Static Magnetic Field Exposure	30-120mins.
8	Duration Growth Period	120hrs

Table.1.Cholesterol Crystal Growth Parameters

An Electromagnets (EMU-50) of 7.5 kg placed at 10mm air gap with flat polepieces (50 mm diameter) is used to apply magnetic field strength as shown in figure 1.The magnetic field strengths were varied by using appropriate currentto the coils and it is measured by Gauss meter. Similar procedure of gel setting done above adopted for static magnetic field exposure. After setting the gel, in Acetone solvent, the supernatant solution of 2% concentration of solution in Acetone is poured over set gel. As soon as this solution is added the nucleation process starts at gel formed region of the test tube. Thereafter the test tube should be kept in a Electromagnets (EMU-50) one by one for exposure of steady magnetic field strength at magnetic field exposure of 0.2 Tesla (Core coil current 2.93 Amperes) at room temperature. The test tubes were tighten using cork and kept in a quiet and vibration free condition for 120 hours. Fine Cholesterol crystals were observed in test tube at the center of upper gel region and some at the bottom as shown in figure 2.Then crystals were collected from test tubes on filter paper for weighing.

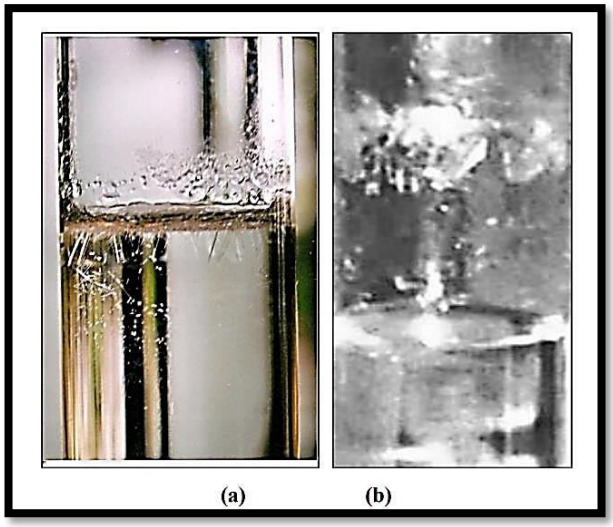

Fig.2. Cholesterol Crystallization (a) At Nucleation State (b) After 120 Hrs

Crystal Yield Analysis

Yields of Cholesterol crystals grown are given in table.2. and plotted in figure 3.

Sr. No.	Magnetic field in Tesla	Time in Minutes	Yield of Cholesterol Crystal after 120 hours in gm at pH 6.5
1	0	0	1.61
2	0.2	30	0.66
3	0.2	60	0.74
4	0.2	90	1.37
5	0.2	120	1.53

Table.2. Yields of Cholesterol Crystal

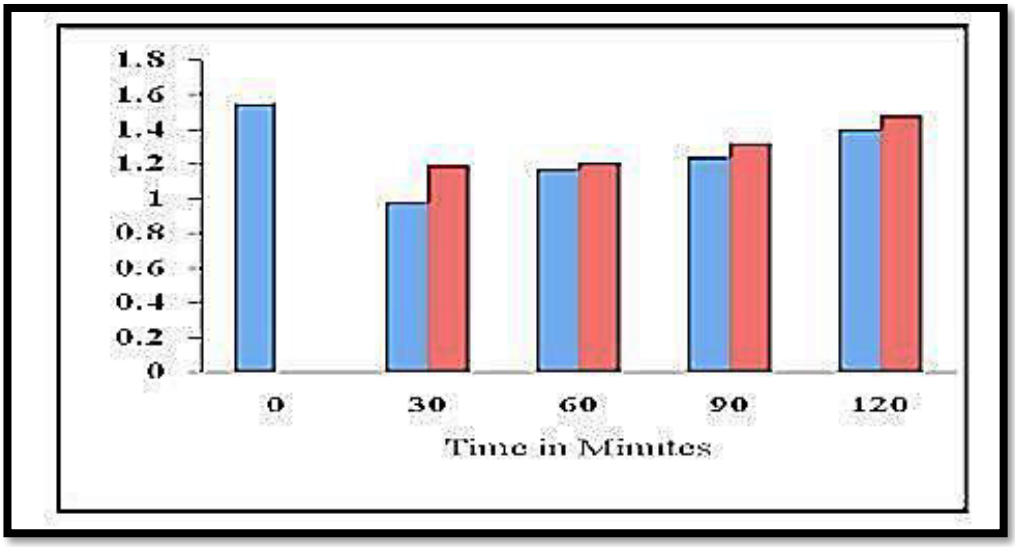

Fig. 3.Plot of time v/s yield of cholesterol crystal in mg in acetone solvent

Crystal Characterization Analysis

XRD and FTIR Studies were conducted to characterize the crystals grown.

Powder X Ray Diffraction Analysis

Powder XRD pattern of Cholesterol crystal recorded by X Ray Diffract meter Philips PW1840 Cholesterol crystallizes in triclinic structure[13,14] with cell parameters as follows; a=14.10A˚,b=33.74A˚,c=10.46A˚,α=94.60˚,β=90.0˚γ=95.72˚

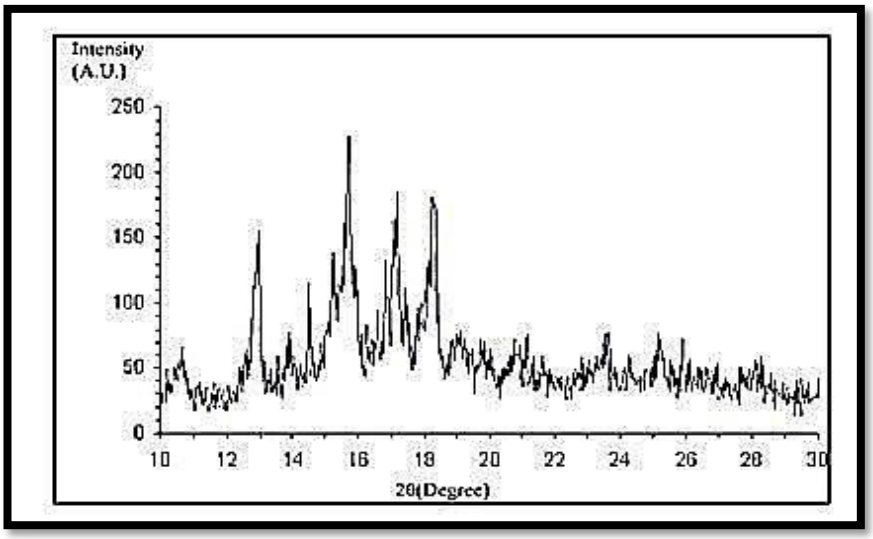

Fig.4 Powder XRD of Cholesterol crystal

FTIR Analysis

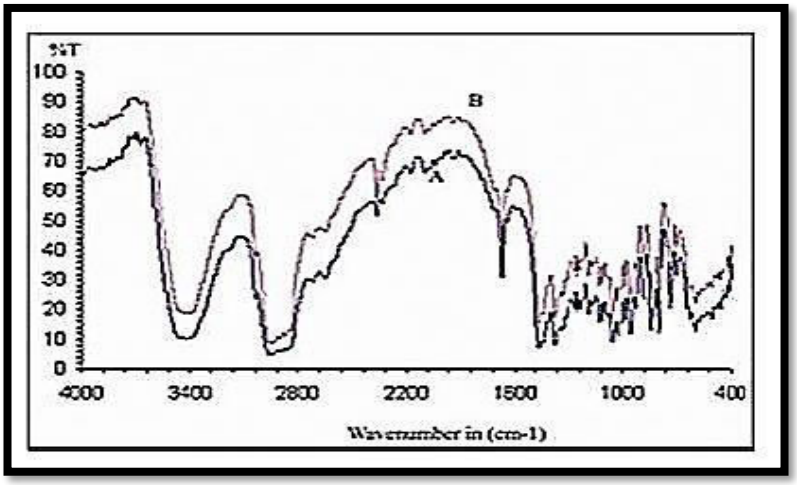

Fig.5. FTIR of Cholesterol crystal

The FTIR spectrum of Cholesterol crystal is confirmed by recording with FTIR-BUSY-6100 JASCO spectrometer in a scan range ($4000cm^{-1}$- $400cm^{-1}$).The FTIR analysis of Cholesterol crystal grown as shown in figure 5..FTIR analysis of crystal grown with and without Static Magnetic Field Exposure in acetone solvent is as shown in figure 5. It is found that for O-H functional group FTIR spectra recorded for exposed Cholesterol crystals shows shifting of relative frequencies to lower sides in comparison with the FTIR spectra obtained for unexposed crystals in Acetone solvent.

Conclusion

The photographs of Cholesterol crystals grown are shown in figure 2.

The morphology of Cholesterol Crystals observed as rectangular platy and is in good agreement with result published. The powder XRD pattern shown in figure no. 4 of Cholesterol crystal confirmed and results are in good agreement with results reported in literatures.

Also FTIR analysis pattern shown in figure.5 of Cholesterol crystal confirmed and results are in good agreement with results reported in literatures.

FTIR pattern obtained for Cholesterol crystal grown under exposure of magnetic field at the nucleation time exhibits more % transmittance than for magnetic field strength in 0.2T.Thedifference of % transmittance found increased and depth of %transmittance dip at frequency 2355.64 cm^{-1} is found increased as exposure time is increased.

Size of crystals and mass of crystals slightly increased with increasing strength of magnetic field but mass of crystals and number of crystals found increased in unexposed state.

Yields of Cholesterol crystals grown are given in table no.2 and plotted in figure 3 is found slightly increased as influence of increasing magnetic field.

Overall yield found less duringexposure of magnetic field as compared to without exposure of magnetic field.

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