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TECHNICAL CHALLENGES IN CHOLESTEROL REMOVAL FROM DAIRY PRODUCTS

Malik, P; Danthine, S; Paul, A; Blecker, C*
Food Science and Formulation Unit, Gembloux Agro-BioTech, University of Liege, Belgium

INTRODUCTION

NEED TO REMOVE CHOLESTEROL

Reduce risk of diseases related to high cholesterol products	• Cardio Vascular Diseases • Cardio Vascular Diseases in Type 2 Diabetes • Type 2 Diabetes
Valorization of Dairy By-Products	• Buttermilk Powder (Rich source of MFGM)

- Milk Fat Globule Membrane (MFGM) constitutes 2-6% of Fat globule
- Milk Fat Globule Membrane has around 2% cholesterol

Dietary Cholesterol Intake Level Recommendation by WHO: **< 300 mg/ day**

BENEFITS OF REMOVING CHOLESTEROL

Dairy Products	Cholesterol content/ 100 g	Benefits of removing cholesterol
Fat Rich Dairy Products		
Butter	219 mg	**Low Cholesterol Products** **Increase in market for health conscious consumers**
Butter oil	230-286 mg	
Cream cheese	110 mg	
Industrial By-Products		
Buttermilk powder	80 mg	**Exploring potential use in health food industry** **Extend application in pharmaceutical industry** **Liposome preparation**

COMPARISON OF DIFFERENT METHODS TO REMOVE CHOLESTEROL

PROCESS	% REMOVAL	APPLICABILITY/ CHALLENGES
Physical		
Vacuum Steam Distillation	75-93%	Formation of toxic oxidation products
Short Path Molecular Distillation	70-90%	Low Molecular weight Triglycerides & flavor compounds distill out
Supercritical Fluid Extraction	90-95%	Remove lipid-soluble components, flavor & nutritional components
Biological		
Cholesterol Reductase	Upto 50%	Coprostanol is formed (poorly absorbed by humans)
Cholesterol Oxidase	Upto 50%	Quality of milk is maintained (oxidation product- 4-cholesten-3-one)
Complexation		
Saponin, digitonin, cyclodextrin	Upto 90%	Does not affect components of MFGM apart from cholesterol.
Chemical (Not suitable for milk and milk products)		

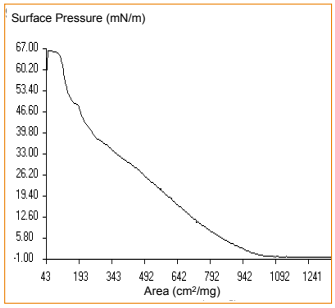
RESULTS OF OUR PRELIMINARY STUDIES

Sample preparation

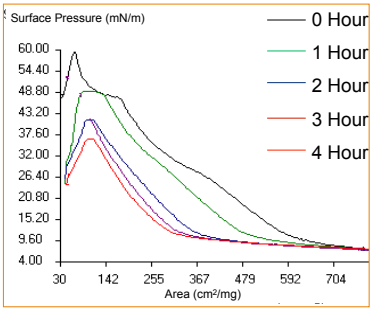
a. 1% MFGM solution was prepared in MilliQ water (control)
b. 1% methyl β-cyclodextrin (MCD) was used for cholesterol extraction from above solution

Compression Isotherm

a. π/A diagrams were established using FW2 (Lauda, Lauda-Königshofen, Germany)
b. Constant compression rate of 90 cm^2/min was used and reading were taken after every hour (x4)
c. Film elasticity was determined at pressure > 20mN/m



Compression isotherm of MFGM monolayer



Compression isotherm of MFGM & MCD (at O, 1, 2, 3 & 4 hours)

Sample	Film Elasticity (mN/m)
MFGM	25.92
MFGM + MCD (0 Hour)	18.04
MFGM + MCD (1 Hour)	9.45
MFGM + MCD (2 Hour)	10.07
MFGM + MCD (3 Hour)	12.75
MFGM + MCD (4 Hour)	9.22

CONCLUSION

1. Film elasticity measures resistance to change in film area.
2. Film elasticity of the MFGM-BCD film was found to decrease with time. Thus, removal of cholesterol reduces resistance to mechanical disturbances which is required for good foam and emulsion stability.

FUTURE PROSPECTS

1. Most suitable method to remove cholesterol from dairy products : Complexation Process
2. Role of cholesterol in membrane can be studied by:
   a. Studying the effect of cholesterol removal on suface properties – Interfacial measurements, Study of monolayers, Interfacial rheology, Zeta potential
   b. Studying effect of cholesterol removal on techno-functional properties- Droplet size distribution, emulsion stability, microscopic examination, viscosity, foaming properties

For more information contact at priyanka.malik@student.ulg.ac.be