

CONTENTS

Preface

A. THE NATURE AND HISTORY OF FATS AND WAXES

I. Historical and General	3
1. Introduction	3
2. Definitions	4
3. History	5
4. Sources	6

B. CLASSIFICATION AND STRUCTURE OF THE FATTY ACIDS

II. Classification and Nomenclature	15
1. Introduction	15
2. Nomenclature	16
3. Saturated Fatty Acids	20
4. Unsaturated Fatty Acids	24
5. Substituted Fatty Acids	38
III. Isomerism	44
1. Introduction	44
2. Structural Isomerism	45
3. Stereoisomerism	55

C. PHYSICAL PROPERTIES OF THE FATTY ACIDS

IV. Crystal Properties	81
1. Introduction	81
2. Crystallography	81
3. X-ray Diffraction	83
4. Polymorphism	92
5. Thermal Properties and Crystal State	103
6. Application of Crystal Property Data for the Identification of Natural Acids	128
V. Spectral Properties	130
1. Introduction	130
2. Raman Spectra	133
3. Visible Absorption	135
4. Infrared Absorption	136
5. Ultraviolet Absorption	140
VI. Thermal Properties	155
1. Introduction	155
2. Heats of Formation and Combustion	156
3. Vapor Pressure and Related Properties	161

VII.	Solubility of Fatty Acids and Solution Properties	175
	1. Introduction	175
	2. Miscible Aqueous Systems	176
	3. Immiscible Aqueous Systems	181
	4. Solutions of Fatty Acids in Nonaqueous Solvents	190
VIII.	Properties of the Fatty Acids in the Liquid State	210
	1. Introduction	210
	2. Density, Molar Volume, and Dilation	210
	3. Viscosity	222
	4. Surface and Interfacial Tension	230
	5. Refractivity and Refractive Index	234
	6. Specific Conductivity	240
	7. Dielectric Constant	243
D. CHEMICAL REACTIONS OF THE FATTY ACIDS		
IX.	Salts of Fatty Acids	249
	1. Introduction	249
	2. Ionic Reactions	250
X.	Esterification and Interesterification	254
	1. Introduction	254
	2. Classification of Esters	255
	3. Esters of Aliphatic Monohydric Alcohols	255
	4. Esters of Other Monohydric Alcohols	270
	5. Esters of Polyhydric Alcohols	272
	6. Interesterification	292
XI.	Alkylation and Alkoxylation	314
	1. Alkylation	314
	2. Alkoxylation	315
XII.	Pyrolysis	318
	1. Decarboxylation of Saturated Acids	318
	2. Pyrolytic Decomposition of Unsaturated Acids	320
	3. Pyrolytic Decomposition of Mixed Fatty Acids	321
	4. Pyrolytic Decomposition of Monoesters	323
	5. Pyrolytic Dehydration	324
	6. Polymerization of Fatty Acids and Monoesters	328
	7. Polymerization of Dibasic Acids	332
XIII.	Halogenation	334
	1. Introduction	334
	2. Addition Reactions	334
	3. Substitution Reactions	347
XIV.	Hydrogenation and Hydrogenolysis	359
	1. Introduction	359
	2. Saturation of Double Bonds by Hydrogenation	361
	3. Reduction of Carbonyl Groups	374
	4. Reduction of Triple Bonds to Double Bonds	386
XV.	Oxidation and Hydroxylation	387
	1. Introduction	387
	2. Oxidation with Nitric Acid	388

3. Oxidation with Chromic Acid	389
4. Oxidation with Potassium Permanganate	392
5. Oxidation with Hydrogen Peroxide and Per Acids	410
6. Oxidation with Ozone	424
7. Oxidation with Periodic Acid	428
8. Oxidation with Lead Tetraacetate	429
9. Products and Mechanisms Involved in Chemical Oxidation of Un- saturated Fatty Acids	434
XVI. Oxidation by Atmospheric Oxygen (Autoxidation)	451
1. Introduction	451
2. Development of the Concepts of Autoxidation	453
3. Ethylene Oxide Hypothesis	459
4. Cyclic Peroxide Hypothesis	461
5. Hydroperoxide Hypothesis	473
XVII. Biological Oxidation	478
1. Introduction	478
2. β -Oxidation	479
3. ω -Oxidation	480
4. Multiple Oxidation	481
5. Dehydrogenation and Oxidation	482
XVIII. Nitrogen Derivatives of Aliphatic Acids	484
1. Classification	484
2. Aliphatic Amino Acids	485
3. Acid Amides	489
4. Hydrazides and Azides	495
5. Aliphatic Nitriles	496
6. Aliphatic Amines	506
7. Nitrogen Addition at the Double Bond	516
XIX. Sulfur Derivatives of the Fatty Acids	520
1. Thio Acids and Esters	520
2. Fatty Acid Sulfates and Sulfonates	521

E. SYNTHESIS OF FATTY ACIDS

XX. In Vitro Synthesis of Fatty Acids	529
1. Introduction	529
2. Malonic Ester Synthesis	533
3. Acetoacetic Ester Synthesis	533
4. Robinson-Robinson Synthesis	536
5. Arndt-Eistert Synthesis	537
6. Synthesis of Fatty Acids from Aldehydes and Aldehyde Esters	539
7. Synthesis of Fatty Acids from Hydrocarbons	540
8. Synthesis of Hydroxy and Keto Acids	547
9. Synthesis of Alkyl- and Aryl-Substituted Acids	551
10. Synthesis of Unsaturated Acids	554
XXI. Biosynthesis of Fatty Acids	561
1. Introduction	561
2. Synthesis of Fatty Acids by Plants	563
3. Synthesis of Fatty Acids by Animals	569

F. ISOLATION AND IDENTIFICATION OF FATTY ACIDS

XXII. Separation of Fatty Acids	575
1. Introduction	575
2. Saponification and Esterification	576
3. Distillation	582
4. Solubility Methods of Separation	595
5. Chromatographic Separation	615
XXIII. Identification of Individual Fatty Acids	619
1. Introduction	619
2. Identification of Saturated Acids	619
3. Identification of Unsaturated Acids	321
4. Characteristic Derivatives of Saturated and Unsaturated Acids	325
Author Index	333
Subject Index	349