

The L.J. Minor Foodservice Standards Series

VOLUME 

Standards for Fats & Oils

HARRY W. LAWSON
Cincinnati, Ohio

avi

AVI PUBLISHING COMPANY, INC.
Westport, Connecticut

© Copyright 1985 by
THE AVI PUBLISHING COMPANY, INC.
250 Post Road East
P.O. Box 831
Westport, Connecticut 06881

All rights reserved. No part of this work covered by the copyright hereon may be reproduced or used in any form or by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, or information storage and retrieval systems—without written permission of the publisher.

Library of Congress Cataloging in Publication Data

Lawson, Harry W.

Standards for fats & oils.

(The L.J. Minor foodservice standards series ; v. 5)

Bibliography: p.

Includes index.

I. Oils and fats, Edible—Standards. I. Title.

II. Title: Standards for fats and oils. III. Series.

TX560.03L39 1985 664'.3'0218 85-1288

ISBN 0-87055-467-0

A B C D E 4 3 2 1 0 9 8 7 6 5

Printed in the United States of America

Standards for Fats & Oils

*To all who are involved or plan to be involved in the
vast and complex foodservice industry, and who strive
to achieve high quality foodservice standards*

Preface

This book was written as a basic reference textbook for students in the schools of hotel, restaurant, and institutional management. It is also designed to be a reference and further study guide for cooks, chefs, dietitians, and foodservice management personnel who are already employed in this important industry.

There are many texts available that thoroughly cover, in great depth, the chemistry and technical aspects of fats and oils. However, the author is not aware of any text devoted exclusively to fats and oils for foodservice. Therefore, this book is designed to provide just enough technical background to allow an understanding of how and why certain types of fats and oils work for specific uses in foodservice. This leads to practical applications and standards for the various types of products available for such uses as deep frying, griddling, pan frying, salad dressing, and baking. Tested quantity recipes are included as a further guide to product usage and menu expansion.

This book is divided into three parts. The first part deals with the chemistry and general technical background for fats and oils. Part II covers the major practical applications in foodservice, along with recipes. In Part III, nutrition, dietary considerations, product and recipe development techniques, and sanitary and quality control procedures are considered.

Fats and oils play a very important role in all foodservice operations. This book will provide the information necessary for a good understanding of these products and how they should be used.

I gratefully acknowledge my many friends at Procter & Gamble who provided material; Marge Bomkamp who typed the original manuscript; my devoted wife Betty who provided artwork, proofread copy, and especially provided moral support; and to the others in my family: Ralph, Janie, Robyn, Jan, Sally, and Ken.

Harry W. Lawson

**The L.J. Minor
FOODSERVICE STANDARDS SERIES**

Lewis J. Minor, Editor

School of Hotel, Restaurant and
Institutional Management
Michigan State University
East Lansing, Michigan

Volume 1. NUTRITIONAL STANDARDS

Lewis J. Minor

Volume 2. SANITATION, SAFETY AND ENVIRONMENTAL STANDARDS

Lewis J. Minor

Volume 3. BASIC ACCOUNTING STANDARDS

Jack D. Ninemeier and Raymond S. Schmidgall

Volume 4. EMPLOYEE MANAGEMENT STANDARDS

Robert W. McIntosh

Volume 5. STANDARDS FOR FATS AND OILS

Harry W. Lawson

Contents

Preface	xi
PART I FAT AND OIL TECHNOLOGY	1
1 Definitions and Overview	3
Text	3
2 The Basic Chemical Structure of Fats and Oils	5
Text	5
3 Common Chemical Reactions	12
Hydrolysis	12
Hydrogenation	13
Oxidation	15
Polymerization	18
Interesterification	19
4 Physical Properties	20
General Overview	20
Flavor	22
Melting Point	22
Plasticity	23
Fluidity of Fluid Shortenings	23
Color	24
Oiliness	24
Viscosity	24
Emulsification	24
Specific Gravity	25

5 Sources of Fats and Oils	26
Butterfat	26
Lard	27
Tallow	27
Soybean Oil	29
Cottonseed Oil	29
Sunflower Oil	29
Coconut Oil	30
Peanut Oil	30
Olive Oil	31
Corn Oil	31
Safflower Oil	31
Palm Oil and Palm Kernel Oil	31
6 Processing Technology	33
Extracting the Oil	33
Oil Purchase	34
Oil Receiving	35
Refining	35
Bleaching	36
Hydrogenation	37
Winterizing (Fractionating)	39
Deodorizing	39
Plasticizing	40
Packaging	43
7 Analytical Tests	44
Active Oxygen Method (AOM)	44
Color, Lovibond	45
Free Fatty Acids (% FFA)	45
Iodine Value (IV)	46
Monoglyceride	46
Peroxide Value (PV)	47
Smoke Point	47
Flavor	47
Frylife	48
PART II UTILIZATION OF FOOD FATS FOR FOODSERVICE	49
8 Deep Fat Frying	51
The Importance of Deep Fat Frying in Foodservice	51
The General Mechanism of Deep Frying	52
Fat Changes and Reactions During Frying	52
Good Frying Practices	57
The Frying Fat	58
Food Preparation	62
Proper Use of Frying Equipment	64
Troubleshooting	66
Frying Equipment	73

Pressure Fryers	73
Troubleshooting Information for Pressure Frying	78
Filtration of Fats and Oils	79
Procedures for Frying Major Food Items	85
Quantity Recipes for Deep-fried Foods	109
9 Griddling and Pan Frying	113
Foodservice Griddling	113
Pan Frying	121
Quantity Recipes for Griddling and Pan Frying	122
10 Salad Oil/Cooking Oil	126
Salad Types	127
Basic Parts of a Salad	128
Preparation of the Major Components	129
Pointers for a Good Salad	130
Major Salad Dressings	131
Standards for Producing High-quality Dressing	132
Quantity Recipes for Salad Dressings	133
11 Baking Technology	139
Cake Baking: General	139
Functions of Ingredients in Baking	140
Cake-making Technology	145
Basic Cake Formulas (Quantity Cake Recipes)	146
Icing/Frosting Technology	150
Standard Icing Formulas	152
Pie Dough Technology	154
Pie Crust Formulas	156
Cookie Technology	157
Typical Formulas	159
Sweet Dough Technology	162
12 Doughnut Technology	170
The Mechanics of the Deep-frying Process	170
Doughnut Classification	173
Principles of Good Doughnut Production	174
Principal Characteristics of Doughnut-frying Shortening	179
Quantity Recipe Section	179
13 All-Purpose Baking	185
Importance of Shortening	185
Quantity Recipes	186
PART III DIETARY CONSIDERATIONS AND RESEARCH AND DEVELOPMENT TECHNIQUES	191
14 Nutritional Aspects of Fats and Oils	193
Caloric Functions	194
Noncaloric Functions	194

Essential Fatty Acids	195
Metabolism of Fats and Oils	195
Fat Level in the Diet	196
Diet and Cardiovascular Disease	196
Diet and Cancer	197
Effect of Hydrogenation Processing	200
Other Areas of Current Research Interest	200
Kosher Dietary Regulations	204
15 Research and Development	207
The Design of Successful New Food Products	208
Other Factors in New Product Development	211
Sensory Testing	212
Flavoring Shortenings and Oils: Scope, Personnel Selection, and General Condition	214
Mechanics of Flavoring	216
The Theory of Flavor Perception	216
Flavor Discrimination and Classification	218
Bibliography	220
Index	223

Part One

FAT AND OIL
TECHNOLOGY

1

Definitions and Overview

This book is a study of fats and oils, with special emphasis on their use in the foodservice industry. In order to set meaningful standards for these products, it is necessary to have a good understanding of fats and oils and how they should be used.

Fats and oils constitute one of the three major categories of food products. The other two are proteins and carbohydrates. Fats and oils are essential nutrients of the human diet and are concentrated sources of energy. They supply about 9 kcal/g, as compared with about 4 kcal/g from protein and carbohydrates.

In any study of human nutritional requirements, the contribution of each of these major food categories must be understood in order to set up dietary standards for individuals. Knowledge of vitamins and minerals as well as the function of oxygen, water, fiber, and trace elements is also essential.

Fats and oils occur naturally in many of our foods, such as dairy products, meats, poultry, nuts, fish, and vegetable seeds. In the foodservice industry, fats are very important in the processing of many of the "eating out" favorites. Examples include french fried potatoes, grilled and pan-fried eggs, salad dressings, an infinite variety of breads and rolls, and dessert items.

Manufactured foods such as dairy products, margarine, snacks, prefried poultry, fish and meat, peanut butter, and crackers contain significant quantities of fats and oils. Many of these and other foods are important to various segments of the foodservice industry.

All fats and oils are predominantly tri-fatty acid esters of glycerol, commonly

referred to as triglycerides. The term "lipids" is more all-inclusive and includes triglycerides, sterols (including cholesterol), phosphatides, mono- and diglycerides, free fatty acids, fatty alcohols, waxes, terpenes, fat-soluble vitamins, and others.

This book is confined to the study of food fats and oils. Inedible products include some types of waxes, tallows used in soapmaking, drying oils for paints, and lubricating oils.

Fats and oils are basically insoluble in water but soluble in most organic solvents, such as carbon tetrachloride, petroleum ether, and ethyl ether.

The term "fat" generally refers to substances appearing to be solid or semi-solid at normal room temperature (70°–75°F; 21.1°–23.9°C). "Oils" are liquid at or below these temperatures. However, these terms are used interchangeably. Examples of fats include vegetable shortenings, butter, margarine, and lard. An example of an oil is cottonseed, soybean, sunflower, or corn oil.

Food fats can also be divided by their origin, either plant or animal. Typical examples of plant derivatives include soybean, cottonseed, sunflower, and safflower oils, whereas fats of animal origin include lard and butterfat.

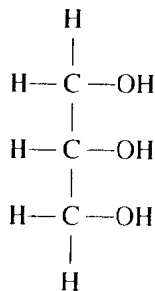
Fats and oils provide about 43% of the caloric needs of people in the United States. This is another important reason to have a good understanding of these products as they relate to the foodservice industry.



The Basic Chemical Structure of Fats and Oils

The carbon atom is the basic element in food chemistry, including fats and oils. Carbon atoms, with a valence of four, tend to bond together with other carbon atoms to form molecules with long chains. Furthermore, carbon's ability to form bonds or react with other elements such as hydrogen, oxygen, iodine, nitrogen, and phosphorus is fundamental to understanding the chemistry of fats and oils.

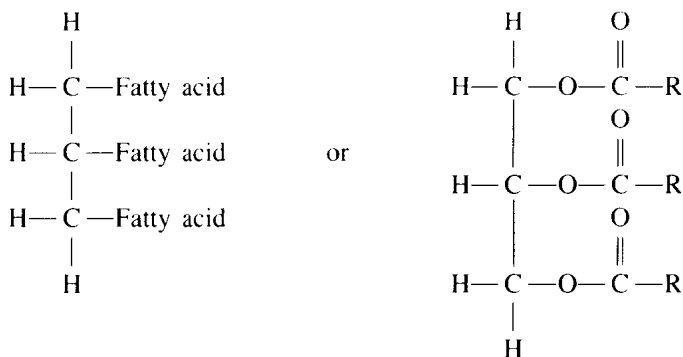
Basically, fats and oils may be considered as mixtures of triglycerides. This is the manner in which they are composed naturally.



Glycerol

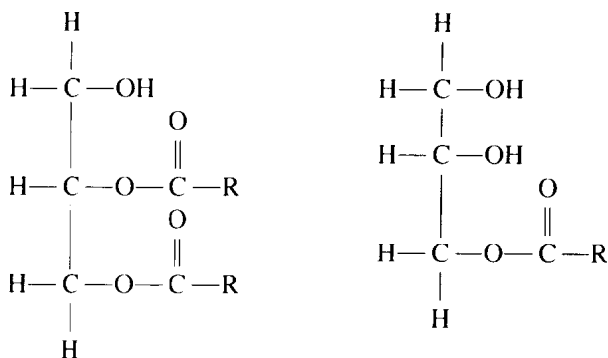
The glycerol molecule has three carbon atoms, together with five hydrogen atoms and three OH⁻ or hydroxyl groups. It should be noted that there are four

bonds or linkages to each of the three carbon atoms. When three fatty acids are combined with one glycerin molecule, we have a triglyceride.



Triglyceride

“R” is the chemist’s method of abbreviating portions of long-chain molecules such as those of fatty acids. If only two fatty acids are attached to a specific glycerin molecule, we have a diglyceride; if only one fatty acid is attached, the molecule is a monoglyceride. Each carbon atom continues to have four linkages.



Diglyceride

Monoglyceride

Any fatty acid not linked to a glycerol molecule in a fat or oil is referred to as a “free fatty acid.” The major component of all fats is made up of triglycerides, which represent over 95% of the weight of most food fats in the form in which they are consumed.

Some unrefined oils contain high levels of free fatty acids. A typical level for crude soybean oil is from $\frac{1}{2}$ to $1\frac{1}{2}\%$. Crude palm oil may contain 3–5% free

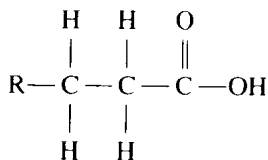
fatty acids. Refined fats and oils that are ready for use in foods usually have a free fatty acid level of less than 0.05%.

Some of the more common fatty acids found in naturally occurring fats and oils are butyric, lauric, palmitic, oleic, stearic, and linoleic. A 1-lb can of shortening, for example, contains millions of fat molecules consisting of mixtures of the various fatty acids attached to the glycerol molecules. The relative number of these various fatty acids and their particular placement on the glycerol molecules determine the various characteristics of the fat product. The processing techniques employed also affect a product's physical and performance characteristics. All fats and oils are built from a relatively small number of fatty acids.

Some fats are solid at room temperature, while others are liquid. Those that are liquid at room temperature are called oils or fluid fats. These liquid oils/shortenings are sometimes referred to as "unsaturated" fats. This does not mean that all of the fatty acids in that particular product are unsaturated, but merely that there is generally a high proportion of unsaturated fatty acids, which render this specific product liquid. For example, soybean oil has a preponderance of unsaturated fatty acids, making it a liquid, whereas lard has a greater proportion of saturated fatty acids, making lard a solid fat at room temperature. Coconut oil is a somewhat special case in that it is liquid to just about 78°F (28°C) in spite of the fact that it contains 85–95% saturated fatty acids.

Chain length, or the number of carbon atoms in a fatty acid, also has a great influence on whether a fat is solid or liquid. Most fatty acids have from 4 to 22 carbon atoms, primarily in even numbers. The products containing high proportions of the longer-chain fatty acids (14–22 carbon atoms) are more likely to be solid at room temperature, whereas those containing more of the shorter-chain fatty acids (4–12 carbon atoms) are more likely to be liquid. Coconut oil is very high in lauric acid, which contains 12 carbon atoms, and about 60–65% of the fatty acids are of 14 carbon atoms or less. This is the reason for its liquidity at relatively low temperatures. Therefore, the most important factors that render a product solid or liquid are the average fatty acid chain length and the amount of saturated in relation to unsaturated fatty acids.

The processing techniques employed and the ultimate crystal structure of the product also have an effect on the product's final form. This will be discussed in Chapter 6.



Saturated Fatty Acid