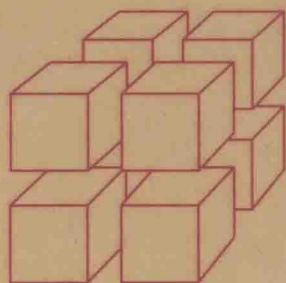


---

# PROTEIN ADDITIVES IN FOODSERVICE PREPARATIONS

Joseph Rakosky, Jr.



# Protein Additives in Foodservice Preparations

JOSEPH RAKOSKY, JR., Ph.d.

Food Industry Consultant

J. Rakosky Services

Morton Grove, Ill.

An **avi** Book

Published by Van Nostrand Reinhold

New York

An AVI Book

(AVI is an imprint of Van Nostrand Reinhold)

Copyright © 1989 by Van Nostrand Reinhold

Library of Congress Catalog Card Number 88-5409

ISBN 0-442-22676-4

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.

Printed in the United States of America

Designed by Carla Bolte

Van Nostrand Reinhold

115 Fifth Avenue

New York, New York 10003

Van Nostrand Reinhold International Company Limited

11 New Fetter Lane

London EC4P 4EE, England

Van Nostrand Reinhold

480 La Trobe Street

Melbourne, Victoria 3000, Australia

Macmillan of Canada

Division of Canada Publishing Corporation

164 Commander Boulevard

Agincourt, Ontario M1S 3C7, Canada

16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

### **Library of Congress Cataloging-in-Publication Data**

Rakosky, Joseph, 1921—

Protein additives in foodservice preparations/Joseph Rakosky, Jr.

p. cm.

Bibliography: p.

Includes index.

ISBN 0-442-22676-4

1. Proteins in human nutrition. 2. Soy products. 3. Food additives. I. Title. II. Title: Protein additives in foodservice preparations. TX553.P7R28 1988

641.5'7—dc19

88-5409

CIP

# **Protein Additives in Foodservice Preparations**

To Dr. L. J. Minor, food scientist, teacher, and businessman, through whose encouragement this book was written.

To my associates and colleagues, from whom I learned much over the years.

To my daughter, Beth Meyer, who not only read and corrected my manuscript, but through her desire to understand the subject matter, caused me to modify some of my explanations.

To my wife, Mary, who tolerated the time I spent in seclusion preparing this material.

# Preface

I have 30 years' experience working with soy products—their production and use in processed foods. Much of this time was spent in the marketing department of a large soy-processing company as director of technical marketing services. In this capacity, I became quite familiar with many competitive products and became adept at recognizing their advantages and disadvantages as compared to soy proteins. Because of this broad background in soy protein products, I have often used soy products in examples and explanations. However, there will be cases where one protein, other than soy, will have functional properties that others do not have. In these instances, I endeavored to bring out such differences. This text was written with the beginning foodservice student in mind. My goal was to give guidelines and necessary basic information to allow the student to make intelligent recipe-adjustment decisions when proteins are introduced into food preparations. I avoided deep technical explanations because it is not necessary for the foodservice student to have such detail. If such technical information is needed or desired, the student is encouraged to consult the references given and to seek out the depth desired.

In covering the subject of protein additives in foods, it is apparent that limits must be set as to what is a protein additive, that is, what is the lowest protein level acceptable for a product? I arbitrarily set that lower limit at 25 percent. For this reason, practically all of the cereal products are eliminated, except those specially processed concentrates and isolates that have their origins in certain cereal grains.

## **xiv PREFACE**

The introduction of new protein products is a frequent occurrence. Some have prospects of being used commercially in a relatively short time; others appear to have only curiosity appeal. Here, too, limits must be set. For the most part, I considered only those products that are being used most widely in the last several years. This should not be too much of a handicap since a newly developed product will probably be similar to one or more of the proteins already being used. If there are marked differences, the company promoting the product will be sure to point out that difference.

As protein additives are discussed in specific applications, the student will note that emphasis is placed on guidelines. Rarely do I give specific formulations. Every company supplying protein additives usually has model formulations for various applications. In most cases, these formulations are simply suggested starting points for developmental work. Because the company cannot anticipate conditions under which their products will be used, they will not warrant their product's performance. Thus, a disclaimer almost always is printed with the formulation, especially if the formulation is printed with the company logo. Because of this and because I do not endorse any company or product, I avoided offering suggested formulations. The student should contact companies supplying protein additives and ask them for samples of their products and formulations. In most cases, the companies will be anxious to comply with the request and will even offer assistance in arriving at an acceptable recipe.

By sharing my experiences, I trust that the guidelines and principles given will help the student to successfully utilize protein additives in various foods in a relatively short time.

Although this text was written with the foodservice student in mind, the material covered and the approaches used also should be helpful to food technologists working in developing countries. The suggestions, guidelines, and mathematical procedures should be helpful in guiding the technician in modifying native foods for the desired benefits, particularly in protein fortification and in making foods more affordable.

# Contents

Preface	xiii
<b>1. PROTEIN ADDITIVES: USE AND REGULATIONS</b>	<b>1</b>
Food Additives and Ingredients	2
Value of Additives in Food Products	5
Regulatory Agencies and Foodservice	7
The Food and Drug Administration (FDA)	8
Standard of Identity	9
Common or Usual Name for Nonstandard Foods	9
Adulteration	10
Misbranding	12
The U.S. Department of Agriculture (USDA)	12
The Agricultural Marketing Service (AMS)	12
The Food and Nutrition Service (FNS)	13
The Food Safety and Inspection Service (FSIS)	13
The <i>Federal Register</i> and the <i>Code of Federal Regulations</i>	14
Protein Sources	16
Animal Sources	16
Vegetable Sources	16
Commercially Available Proteins	18
Animal Proteins	18
Milk	18



## **viii CONTENTS**

Gelatin	18
Egg Products	18
Fish Protein Concentrate (FPC)	19
Vegetable Proteins	21
<b>2. PROTEINS, AMINO ACIDS, AND DERIVATIVES</b>	<b>25</b>
Amino Acids	26
Peptide Bonds	30
Protein Characteristics	31
Protein Structure	33
Simple Proteins	34
Complex Proteins	35
Protein Classification	36
Modified Proteins	37
Heat Modifications	38
Enzyme Modifications	40
Chemical Modifications	41
Enzymes	42
Composition	43
Naming Enzymes	43
Factors Affecting Enzyme Activity	44
<b>3. NUTRITIONAL CONSIDERATIONS</b>	<b>47</b>
Basic Nutrition	48
Inorganic Nutrients	48
Organic Nutrients	49
Carbohydrates or Sugars	50
Fats and Oils	50
Proteins	56
Vitamins	56
Nutrient Evaluation	56
Protein Quality	57
Quality Evaluation	60
Protein Efficiency Ratio (PER)	60
Amino Acid Score (AAS)	62
Limiting Amino Acids	64
Counting Calories	66
Calculating Caloric Content	67
<b>4. FUNCTIONAL PROPERTIES AND ECONOMICS</b>	<b>71</b>
Functional Properties	71
Classification	73

Sensory Properties	74
Color	74
Heat	74
Texture and/or Form	75
Taste and Flavor	76
Hydrational Properties	76
Wettability	76
Solubility and Dispersibility	77
Influence of Heat on Solubility	78
Heat-Altered Products	80
Surfactant Properties	85
Economics	93
Unit-Protein Costs	94
Product Image	95

## **5. BAKERY PRODUCTS 97**

Why Modify a Baking Recipe?	97
Federal Standards	98
Modification Guidelines	100
Protein Additives for Bread-Type Products	104
Nonfat Dry Milk (NFDM)	104
Vital Wheat Gluten	106
Soy Protein Products	108
Variety Breads	110
Cakes	113
Cookies	119

## **6. PASTA PRODUCTS 123**

Macaroni and Noodle Product Standards	126
School Lunches: Protein-Fortified, Enriched Macaroni-Type Products	129
Why Modify Pasta Products?	131
Considerations of Protein Additives	133
Gum Gluten	134
Nonfat Dry Milk	134
Soy Flour	135
Egg White	135
Whole Egg	135
Enriched Macaroni Products with Fortified Protein	136

## **x CONTENTS**

<b>7. PROCESSED MEATS</b>	<b>141</b>
Why Grind Meats?	141
Meat Components	142
Types of Processed Meats	143
Regulations Governing the Use of Additives	144
Standards of Identity or Composition	144
Prior Approval of Additives	147
Poultry Product Inspection	148
Product Labeling	149
Reasons for Using Protein Additives in Processed Meats	149
Protein/Fat Relationships	150
Additive Forms	150
Milk Proteins	150
Soy Proteins	151
Ground-Meat Products	152
Regulations	152
Blending Meats	153
Procedures in Utilizing Protein Additives	154
Processing Recommendations	156
Additive Forms	157
Hydration Level	157
Hydration Time	158
Level of Extension	158
Processing Procedure	159
Factors Affecting Shelf Life of Comminuted Meats	159
School Lunch Program	161
Sausage Products	166
Frankfurter as a Model Sausage	166
Protein Additives in Model Sausage	171
Economic Considerations	171
Protein Additive Substitutions	172
Sausage Types	172
Sausage Regulations	173
Restructured Meat Products	174
Pumped Meats	180
<b>8. DAIRY-TYPE APPLICATIONS</b>	<b>185</b>
Regulatory Aspects	187
Filled Milk	188
Dairy Products: Modified and/or Simulated	190
Beverages	191
Filled Milk	191
Soy milk	192

Coffee Whiteners	195
Whipped Toppings	200
Frozen Desserts	203
Federal Standards	204
Frozen Custard	207
Ice Milk	207
Mellorine	207
Sherbet	207
Water Ices	208
Standard Versus Nonstandard Frozen Desserts	210
Cheese Analogs	210
Markets	211
Regulatory Aspects	213
Tofu	226
<b>9. DIETARY AND MISCELLANEOUS USES</b>	<b>231</b>
Protein Fortification	232
Increasing Protein Level	232
Improving Protein Quality	234
Dietary Uses	240
Hypoallergenic Foods	241
Low- or Reduced-Calorie Foods	241
Low-Sodium and/or Salt-Containing Foods	242
Snack Foods	242
Market	243
Fortification	245
Compositional Calculations	246
Miscellaneous Uses	249
Soups, Sauces, and Gravies	251
Index	253

## CHAPTER 1

# **Protein Additives: Use and Regulation**

Foodservice in the United States is big business and is getting bigger. The National Restaurant Association (NRA) reported that foodservice sales more than doubled in the past decade: from \$42.7 billion in 1970 to \$114.0 billion in 1980. As reported by Ellis (1985), sales were estimated to be \$191 billion for the year 1985, resulting in an annual growth rate of 10.87 percent. Based on this information, projected foodservice sales in 1990 will amount to \$320 billion.

It is interesting to note that about two-thirds of the foodservice sales is in commercial feeding operations (Ellis 1985). For a breakdown of the part the various sectors play in making up the 1985 projection, in both the commercial and the noncommercial segments, see Table 1-1.

As might be surmised, all foodservice operations are very competitive and, as a result, the pressure is on to function profitably and to attract customers, particularly in the commercial segments. One way this can be done is to offer customers good, wholesome, tasty foods at reasonable prices. For this reason, ways and means are usually sought to keep costs in line without sacrificing appeal. This is especially true for institutional feeding operations, where businesses are usually forced to stay within budgetary limits that, more often than not, do not keep pace with inflation.

The overall cost of food and beverage purchases in 1981 was about 40 percent of gross sales. Employee wages and benefits amounted to about 30 percent, leaving another 30 percent for overhead and profit. (Percentages are based on data given in the NRA's fact sheet for 1981. Percentages were rounded off.) It

## 2 CHAPTER 1

does not seem likely that there can be very much left for profit if there is a large debt to be paid off for equipment, fixtures, buildings, taxes, and so forth. It is interesting to note from the 1985 projections by the NRA that the cost of food-service purchases was estimated to be \$74.7 billion, which is slightly under the 40 percent figure.

One way to cut costs is to look at the efficiency of the operation. This might involve finding a more efficient use of employees, equipment, and even scheduling. Another way is to look at the cost of the food. Should the portions be cut? Is there a way to lessen costs of a particular food preparation? The latter question does not apply so much to retail operations as it does to institutional ones where fractional savings are significant, because large volumes are usually involved (see the following list for considerations in cutting foodservice costs).

- Efficient use of
  - Employees
  - Equipment
  - Scheduling
  - Space
- Cost of raw materials
- Size of portions
- Cost of food preparation
- Substitution of ingredients
- Cost of packaging
- Cost of storage and delivery

When cost considerations are given to different food preparations, with few exceptions, the animal-protein ingredient is the most expensive. In many instances, it is virtually impossible to replace all the animal-protein product with a less expensive protein product if that product is ordered by a specific name, such as “filet mignon.” However, in institutional feeding it would be doubtful that such an item would be served very often, if at all.

There are many ways that food preparation costs can be cut. In this text we will focus on what can be done to improve products and cut costs through the use of various protein additives.

## FOOD ADDITIVES AND INGREDIENTS

When considering food formulations and recipes, we invariably are confronted with the terms *additive* and *ingredient*. When is a food an additive? When is it an ingredient? It is unlikely that there will be any confusion over the term *ingredient*. It is more likely that *additive* will be confusing in the minds of many, particularly when there is a school of thought that believes “all additives are bad

**Table 1-1 Estimated 1985 Sales by Foodservice Outlets**

	Estimated Sales (\$ billion)
Commercial Segments	
Separate eating places	107.4
Hotels and motels	7.0
Recreational	5.6
Retail hosts	5.4
Separate drinking places	1.2
Subtotal	126.6
Noncommercial Segments	
Primary and secondary schools	12.3
Colleges and universities	5.4
In-plant and in-office	12.6
Vending machines	11.6
Health-care facilities	12.9
Military	5.2
Airlines	2.5
Other noncommercial	1.9
Subtotal	64.4
<b>TOTAL</b>	<b>191.0</b>

Source: Ellis 1985.

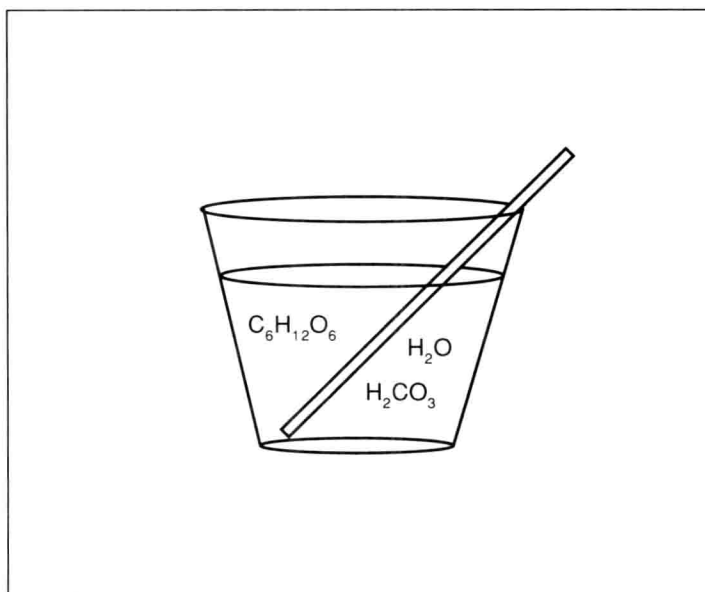
because they are chemicals.” The implication is that all chemicals are bad. It would appear that this definition fails to acknowledge that food in its natural state is made up of chemicals, both inorganic and organic (Fig. 1-1).

To most people in the food business, additives are needed because of their beneficial effects. Hence, they are considered to be good. But it is possible to use an additive to achieve a beneficial effect in one instance and an adverse effect in another. A good example of this is the use of a preservative that is toxic to both bacteria and man. Fortunately, using such additives is unlikely in food processing because of our strict laws.

The term *additive* will mean different things to different people. We need to understand these meanings not only because we will be discussing additives but also because we need to be familiar with the regulations governing the use of additives.

According to *Webster's Ninth New Collegiate Dictionary* (1983), an additive is “a substance added to another in relatively small amounts to impart or improve desirable properties or suppress undesirable properties.” An ingredient is “something that enters into a compound or is a component part of any combination or

## 4 CHAPTER 1



**Figure 1-1.** Chemical cocktail (sweetened soda water).

mixture.” It follows that an additive is an ingredient, but an ingredient is not necessarily an additive because of the quantity of the material being used in the formulation or recipe. Even this does not hold true, however, because there are certain “ingredients” used in small quantities that, if left out, would cause the preparation to fail. Leavening agents are good examples. Obviously, there are no clear-cut differentiations.

This text will consider examples where a food protein product will be used as an additive in a formulation to achieve a beneficial effect, yet that same product can be the major component in another formulation. A good example is gelatin, which can be a minor component in giving body to a soup but is a major component in a gelatin dessert.

When considering additives from the health-safety standpoint, it is an extremely complicated situation for regulatory agencies to come up with legal definitions. Nevertheless, such a definition is given in Section 201(s) of the Federal Food, Drug and Cosmetic Act (1979):

The term “food additive” means any substance the intended use of which results or may reasonably be expected to result, directly or indirectly, in its becoming a component or otherwise affecting the characteristics of any food (including any substance intended for use in producing, manufacturing, packing, processing, preparing, treating, packaging, transporting, or holding food; and including any source



of radiation intended for any such use), if such substance is not generally recognized, among experts qualified by scientific training and experience to evaluate its safety, as having been adequately shown through scientific procedures (or, in the case of a substance used in food prior to January 1, 1958, through either scientific procedures or experience based on common use in food) to be safe under the conditions of its intended use; except that such term does not include—

- (1) a pesticide chemical in or on a raw agricultural commodity; or
- (2) a pesticide chemical to the extent that it is intended for use or is used in the production, storage, or transportation of any raw agricultural commodity; or
- (3) a color additive; or
- (4) any substance used in accordance with a sanction or approval granted prior to the enactment of this paragraph pursuant to this Act, the Poultry Products Inspection Act (21 USC 451 and the following) or the Meat Inspection Act of March 4, 1907 (34 Stat. 1260), as amended and extended (21 USC 71 and the following); or
- (5) a new animal drug.

According to the act, a food additive is any substance that can become a component of a food. This would include substances purposely or inadvertently added that will affect the food in some way. Also, the additive may be intentionally or unintentionally added during any part of processing and subsequent food handling. An interesting inclusion is radiation that may be a part of the process. In the definition, there are certain exclusions because they are regulated in a specific way.

Generally, most of the protein additives discussed in this volume have prior sanction approval, are “Generally Recognized as Safe” (GRAS), or are currently being considered for GRAS inclusion. In the latter case, qualified experts can declare a substance GRAS. It then can be used in a food, unless, of course, it can be shown that the product is unsafe or is questionable. This is the basis on which many of the products found in health-food stores find their way to the shelves.

For the most part, foodservice operators need not concern themselves about using additives if they use well-known, widely accepted products or if they deal with reputable suppliers.

### **Value of Additives in Food Products**

The only reason a person would consider using a protein additive, or any additive, is because its use would result in a benefit in some way.

- Would the food taste better?
- Would it be more juicy and flavorful?
- Would it look more appealing?