
edited by
Howard R. Moskowitz

Food Instrumental
and Sensory
Measurement
Texture

FOOD TEXTURE

Instrumental and Sensory Measurement

Edited by

Howard R. Moskowitz

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Preface

This book presents an overview of texture research. It differs from the traditional approaches to texture, which concentrate primarily on the objective or instrumental measurement of texture, and pay only scant attention to the subjective impressions. Rather, this book deals extensively with the subjective aspects of texture, along with objective measurement.

The last decade has seen accelerated growth in texture research. Food texture has attracted researchers from many disciplines, providing a promising cross-fertilization of ideas and approaches. The chapters in this book carry on and extend that tradition, with the authors approaching texture issues from many disciplines, including physics, food science, psychophysics, sensory analysis, home economics, product development, marketing research, and quality control.

The book is divided into three parts, representing the diversity of points of view on texture research. These are:

Physical measures of texture (Peleg; Stanley; and Timbers and Voisey, respectively)

The relation between physical and subjective measures (Kokini and Cussler; Christensen; Vickers; and Drake)

Subjective measures of texture (Cardello and Maller; Cooper; Drewnowski; Schur; and Moskowitz and Jacobs).

PART I: PHYSICAL MEASURES OF TEXTURE

Peleg presents an extensive and valuable contribution to the physics of texture. His contribution deals with texture from the viewpoint of classical rheology. The chapter deals with the different texture measures, and the physics underlying their measurement. Stanley presents a complementary approach, from the viewpoint of a food scientist interested in the microstructure of food, and its relation to perceived texture. He presents case histories showing how one can trace textural phenomena back to the microstructure. Finally, the chapter by Timbers and Voisey provides the reader with a close-up look

at the Ottawa Texture Measuring System, an instrument used in conventional texture measurement. The authors recount the history of the instrument, the machine's physical configuration, and the use of the data.

PART II: THE RELATION BETWEEN PHYSICAL AND SUBJECTIVE MEASURES

Kokini and Cussler begin this section with an overview relating to physical and subjective measures, showing how one can adequately model texture perception by a two-step process. The first step consists of understanding the physics of materials at the receptor site, and the second step consists of properly measuring subjective responses. The combination of these two steps makes it possible to predict (and engineer) subjective texture perceptions more accurately.

Christensen and Vickers deal with two other major areas. Christensen presents an extensive review on the perception of subjective viscosity. She makes the point that human judges can perceive significantly smaller differences in solution viscosity than those recorded by a viscometer. Christensen also raises the issue of differences in perception when stimuli are sensed orally (normal for food) versus tactually. Research data show that the investigator must use several measures of viscosity for predicting subjective ratings, not just measurements of one shear rate and shear stress. The human judge alters the physics of the judging situation by dynamically modifying the forces applied, as a function of the viscosity (and other rheological properties) of the stimulus.

Vickers has spent the last decade of research assessing the auditory components of texture perception, especially those dealing with crispness and crunchiness. She begins with a review of the literature, which had its start in the tactile aspects of crispness and crunchiness. However, Vickers shows, quite definitively, the role played by auditory sensations as textural signals. The key here is still the unappreciated role of sound as a key element contributing to texture perceptions.

Drake ends this section with a speculation on the discipline of food psychorheology. His chapter presents an overview of what researchers attempt to accomplish, and several aspects (and difficulties) encountered when researchers have to integrate data from physics, psychology, and food science. He emphasizes the very critical point that the discipline of food texture lacks a true theory.

PART III: SUBJECTIVE MEASURES OF TEXTURE

This section begins with an extensive overview by Cardello and Maller, dealing with the different scaling procedures used at the U.S. Army Natick Research, Development and Engineering Center. They deal with developing measures for the texture of fin fish, using a variety of approaches. Topics include development of attributes, erection of scales with both expert and consumer panelists, and different methods for scaling attribute perceptions. These methods include perceptual mapping, which shows how similar (in a subjective sense) are the texture profiles of various fin fish. Cardello and Maller's primary goal is to integrate the consumer and expert panels as a measurement tool to create viable fish products for military—and nonmilitary—consumption.

Cooper provides a comprehensive review of methods used by the dairy industry for texture grading. These methods developed in parallel with the procedures of food science and sensory psychophysics. Cooper illustrates the scaling procedures for specific product categories, including milk, cream, butter, cheese, and so on. Although sensory analysis is growing in the dairy industry, the author recognizes the need for newer methods. Relatively few new methods have been introduced, despite the long research history. According to Cooper, "the field of texture evaluation in dairy products is wide open."

Drewnowski approaches texture from an entirely different perspective, namely that of the basic physiological psychologist, interested in the interaction of the senses with the human "body state." In his chapter, Drewnowski deals with the sensory perception of sweetness and creaminess, and their interaction in generating ratings of overall liking. He introduces the concept of designed experiments to optimize texture and taste perceptions. Designed experiments and response surface methods provide a road map, showing the product developer how to generate specific desired consumer perceptions (either of sweetness, creaminess, or acceptance), by systematically varying the physical stimulus. Drewnowski illustrates this approach using a model system comprising only two variables, but the method has application for product development (as Moskowitz and Jacobs show in their chapter), and has application for evaluation of products by normal individuals, and individuals with altered physiological states.

Schur deals with texture from the viewpoint of product development. She provides an overview of the methods that manufacturers use to ensure texture integrity. Like Stanley, Schur uses case histories to discuss texture issues, but presents the answers to texture problems from the standpoint of product engineering and development, rather

than basic research. Schur's major interest lies in the issues that arise when a product's texture is "off target," and what the manufacturer needs to do to put the texture profile back on target. Texture problems arise with many foods, including yogurts, protein foods, and foods that are either new to the consuming public, or are processed under new methods with as yet unknown constraints and problems.

Moskowitz and Jacobs finish the book with an exposition of designed experiments, product screening, and product optimization. They introduce the concept of "sensory preference segmentation" to cluster consumers on the basis of how the consumers' liking ratings covary with sensory attribute level. The chapter provides a detailed look at the optimization method for total panel data, for selected segments, and for constraints such as cost. Moskowitz and Jacobs also introduce the method of direct measurement of attribute importance by the scaling of "annoyance." Rather than instructing consumers to rate importance of texture (and other attributes) directly, which may cause confusion, they provide consumers with statements about product defects (including textural, taste, appearance, and aroma defects). For each, the consumer rates "annoyance" on a scale. The higher the annoyance rating, the more important the attribute.

Given these contributions, many of which represent new ideas and approaches to texture, it is the editor's hope that the volume will stimulate further thinking, exploration, and research into both the basic aspects of texture and the applied product development areas. Both domains need a better understanding of texture, from the points of view of the physical stimulus at the receptor site, the way the human judge processes texture information, and the correlation of subjective ratings with physical measure. Such understanding will provide researchers with better science, and manufacturers with better products.

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FOOD TEXTURE

Contents

| | |
|---------------------|-----|
| <i>Preface</i> | iii |
| <i>Contributors</i> | ix |

Part I: Physical Measures of Texture **1**

| | |
|---|----|
| 1. The Basics of Solid Foods Rheology <i>Micha Peleg</i> | 3 |
| 2. Food Texture and Microstructure <i>D. W. Stanley</i> | 35 |
| 3. The Ottawa Pea Tenderometer and the Ottawa Texture Measuring System: The Evolution of a System for Quality Control and Food Texture Research <i>Gordon E. Timbers and Peter W. Voisey</i> | 65 |

Part II: The Relation Between Physical and Subjective Measures **95**

| | |
|--|-----|
| 4. The Psychophysics of Fluid Food Texture <i>Jozef L. Kokini and Edward L. Cussler</i> | 97 |
| 5. Perception of Solution Viscosity <i>Carol M. Christensen</i> | 129 |
| 6. Crispness and Crunchiness—Textural Attributes with Auditory Components <i>Z. M. Vickers</i> | 145 |
| 7. Food Psychorheology: A Speculation on Difficulties <i>Birger Drake</i> | 167 |

Part III: Subjective Measures of Texture **175**

| | |
|---|-----|
| 8. Sensory Texture Analysis: An Integrated Approach to Food Engineering <i>Armand V. Cardello and Owen Maller</i> | 177 |
|---|-----|

| | | |
|-----|--|-----|
| 9. | Texture in Dairy Products and Its Sensory Evaluation <i>Hester R. Cooper</i> | 217 |
| 10. | Fats and Food Texture: Sensory and Hedonic Evaluations <i>Adam Drewnowski</i> | 251 |
| 11. | Texture Integrity: Challenge for Research and Development <i>Sylvia Schur</i> | 273 |
| 12. | Consumer Evaluation and Optimization of Food Texture <i>Howard R. Moskowitz and Barry E. Jacobs</i> | 293 |
| | <i>Index</i> | 329 |

I

Physical Measures of Texture

