Introduction to Food Manufacturing Engineering

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*To the memory of my father; to my wife,
Patricia, for her unconditional support;
and to my family.*

T.L.N.

Preface

Food science refers to an integrated science, encompassing comprehensive aspects of the processing of all sorts of bioresources including agricultural, livestock, and marine products into food or food ingredients. Also included are the methods of preparation as well as the effects on the human body resulting from the ingestion of the prepared food products, and in this way food science contributes to the betterment of health and the enrichment of life for mankind. In order to achieve these ultimate goals, food-manufacturing knowledge for processing bioresources into food and food ingredients is therefore indispensable.

The discipline of food manufacturing includes both food processing or food technology, which refers to the study of the objectives and principles of the respective unit processes along the production flow of a food or food ingredient; and also food engineering, which covers the study of a long list of principles common for operations in food-manufacturing processes such as heating and agitation. The former study conforms to actual food-manufacturing flows and thus is readily comprehensible, whereas the latter has high versatility covering the common principles of operations for most food-manufacturing processes. Although many textbooks on food processing are easily accessible, textbooks on food engineering are scarce at the present time, and even those available on the market include a vast array of topics and thus many of them are unsuitable for beginners. Hence, a simple textbook intended for undergraduate students majoring in food-related disciplines other than engineering—for instance, food science, food technology, or nutrition—is highly desirable.

From the standpoint of academics and researchers in the fields of agriculture and engineering, we therefore drew up a plan for this particular book for undergraduate students studying agriculture and engineering. This volume is meant to be an introduction to food engineering in which common principles for food-manufacturing-process operations are taught. Food engineering itself is rather an abstract and hard-to-understand discipline. Therefore, we have endeavored to initially set forth food-manufacturing flows and pay careful attention to quantitatively detailing and explaining the manufacturing operations involved from an engineering point of view. Because the text is considered an “extreme” introductory book to

food engineering for beginners, it does not cover all food-engineering-related fields. Rather, it is written for its readership to gain an engineering perspective on the subject and consolidate the foundation of knowledge such that the readers, when necessary, can better understand other more structured and systematically written textbooks on food engineering.

Food engineering deals with a great number of mathematical formulas and numerical values. Because it is difficult for one to acquire such knowledge merely through reading, we have focused on introducing as many example problems and exercises as possible. Furthermore, in many cases graphic representation of data better explains a phenomenon, making it simpler to understand. Graph construction is the most basic but it is seldom covered in lectures at university level, resulting in many students not being able to draw proper graphs. We have illustrated how proper figures are produced and included many sample questions and exercises of which the solutions are obtainable from constructed figures. When it comes to dealing with mathematical formulas and numerical values, practicing problem solving will definitely foster a better understanding, and it is of utmost importance to actually try to put the graphs on paper. Although it has become common for these problem-solving steps to be done on a computer nowadays, one could hardly get a good grasp of the knowledge by just tapping the keyboard and looking at the monitor. On that account, a great deal of thought has been put into selecting the sample questions and exercises such that solving the problems will necessitate sketching and computing with a scientific calculator.

In food engineering, one studies the common principles for process operations, and the knowledge is not limited to food manufacturing but is applicable as well in other areas—for instance, the chemical, pharmaceutical, and environmental industries. Readers are expected to acquire the basic concepts through this textbook and subsequently further deepen the level of understanding via other systematic reference materials.

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