

## **Significance of physical knowledge during education of food technologists and food engineers**

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**Abstract.** The paper deals with the following topics:

- importance of food physics
- physical methods in instrumental food analysis
- physical techniques in modern food processing
- main topics in BSc level education, concerning basic physics, general and inorganic chemistry, electrotechnics, measurement technique and automation
- main topics in MSc level education, concerning instrumental food analysis, food physics, process control, measurement theory, research planning

### **Keywords:**

BSc, food engineer,  
food science, MSc,  
physics, technology,  
university education

Conclusion: without high level of knowledge in physics the food engineers can not fulfil the expectations of modern food processing technologies.

## **INTRODUCTION**

It is a well known (and widely accepted) fact, that people are different, countries and states are different, education systems are different, expectations and knowledge-levels are different. However, there is no question about the importance of physics – as a basic subject - in education of food technologists and food engineers (1)(2)(3). They need to learn food science (a lot of subfields, like food chemistry, food microbiology, food technology, food analysis, food machinery, unit operations

in food processing), but without appropriate knowledge in physics - dominantly food physics – there is no chance to be a well-educated engineer, a good specialist of food industry (4)(5). The BSc and MSc programs are based on many subjects, belonging to physics. The proper education (build up) of a food engineer is rather similar to house building: we need strong fundament (e.g. physics), walls (e.g. unit operation) and roof (technology). However without correctly made fundament and walls where to put the roofs?

### **IMPORTANCE OF FOOD PHYSICS**

The meaning of the word physics (in greek) is nature, and physics is the mother and fundament of other natural and technical sciences, like chemistry, geology, unit operations, machinery, automation, measurement technique, architecture, electronics, nuclear technique, astronomy even robot-technique. Of course it is clear, that the background to physics is mathematics, and the next steps of the system (in teaching, as well) are the following: the fundament to chemistry is physics, and the fundament to biology is chemistry. It is evident that today – in consequence of differentiation and integrations – there are many subsiences, and interdisciplinary sciences (6). Food physics - as a rather new, but rapidly and efficiently developing subsience – is a typical interdisciplinary science, a real and stable bridge between food science and applied physics (7) (8) (9). Without high level of knowledge in physics the food engineers can not fulfill the expectations of modern food processing technologies (10)(11)(12).

### **PHYSICAL METHODS IN INSTRUMENTAL FOOD ANALYSIS**

Classical chemical methods for food analysis are today used mainly only for preparation of the samples, however many different instrumental methods were developed and applied for the measurements. The classification of the methods is the following:

- optical methods
- separation techniques
- magnetic techniques
- radioanalytical methods
- electroanalytical techniques

- rheological methods
- thermal techniques

In these mentioned groups there are many physical techniques, giving the opportunity to perform nondestructive measurements – eventually „in vivo” measurements, or non-invasive techniques, as well – so to get the data about the composition, physical and chemical parameters of the foodstuffs without chemical treatment. Let us mention e.g. the following techniques: dielectrometry, oscillometry, infrared spectroscopy (like NIR-NIT method), calorimetry, DSC, PAS, ESR, NMR, XRF, PIXE, INAA, penetrometry, plastometry, viscosimetry.

### **PHYSICAL TECHNIQUES IN MODERN FOOD PROCESSING**

The technology hill – the methods, applied in the past, present and techniques of the future for food processing – is a figure, beginning with the oldest systems (e.g. smoking, dehydration) and as a function of time (via e.g. freezing, irradiation, microwave treatments) we are at the door of application of the newest techniques (e.g. pulsed technology, high pressure technology, application of powerful electrical and magnetic fields) in the food industry (13). Obviously the food technologists and food engineers have to be able to apply these techniques and even take part in the development of the processing methods. And this innovation is not possible without good knowledge in physics.

### **TOPICS OF THE EDUCATION PROGRAM AT BSC LEVEL**

Let us mention some important topics of the Faculty of Food Science at

University of Budapest in the subjects of Basic Physics, General and Inorganic Chemistry, Electrotechnics, Measurement Technique and Automation:

mechanics, statics, dynamics, hydraulics, rheology, rheological models, optics, colour measurements, spectral image processing, physical and chemical properties, states of matter, structure of atom, radiations, electromagnetic spectrum, microwave, electricity, current, potential, charge, resistance, impedance, capacitor, inductor, conductivity, electric motors, generators, transformers, accumulators.

#### **TOPICS OF THE EDUCATION PROGRAM AT MSC LEVEL**

Let us mention some useful and necessary topics of the Faculty of Food Science in the subjects of Instrumental Food Analysis, Food physics, Process Control, Measurement Theory, Research Planning:

different analytical (optical, electro-analytical, thermal, separation, magnetic, rheological, radioanalytical) techniques for composition determination, mechanical, optical, electrical, thermal properties of foodstuffs, infrared spectroscopy, heat and mass transport, conductivity, permittivity, impedance spectroscopy, light emission, reflection, CIELAB system, modern measurement techniques, computer aided systems, computer aided design, error of measurement, data evaluation, statistics, validation, experiment planning, pneumatic, hydraulic, electrohydraulic, electropneumatic, hydropneumatic systems, TTL and PLC systems, control and regulation, control of food processing technologies

#### **CONCLUSION**

Physics is a basic subject, fundament to understand food science, unit operations, food technology, measurement technique, automation. It is evident, that without high level of knowledge in physics the food technologists and engineers can not fulfill the expectations of modern food processing. In other words: without this knowledge they can not take part successfully innovation, R+D activities, creation of new technological lines, even in the everyday processing of food products using up-to-date technologies.

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