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Recommendations for higher education in food chemistry

The authors write this in the name of the Working Party on Food Chemistry (from 1997 on: Food Chemistry Division), Federation of European Chemical Societies

Introduction

The Working Party on Food Chemistry (WPFC) is one of the working parties belonging to the Federation of European Chemical Societies (FECS). Currently, 23 European countries have delegates in this working party, representing approx. 9000 food chemists from both member states of the European Union (EU) and non-member states including Norway, Switzerland and Central and East European countries.

One of the essential targets of WPFC is to prepare a proposal for a harmonized curriculum for food chemists throughout Europe. A WPFC inquiry in many European countries has shown that, even in the EU member states, education and training in food chemistry are extremely unstructured and differ widely. Obviously, the origins of this lack of structure lie in the absence of a consensus, or even consultation, within Europe concerning such curricula. For this reason, WPFC, as the pan-European body of food chemists, felt obliged to present a proposal that would provide a basis for discussions with EU authorities, national bodies for food chemistry and those involved in academia.

Food chemistry is a discipline of increasing importance; indeed, the role of experts trained in food chemistry cannot be over-emphasized. Food chemists have key functions in food inspection and food control, and their professional activities are crucial in protecting the consumer from health risks originating from food and related sources. This is emphasized in EC Council Directive 89/397 on the official control of foodstuffs, which requires that the national authorities of EU member states shall have a sufficient number of suitably qualified and experienced staff in food chemistry as well as in complementary areas.

As a necessary first step, WPFC has identified and defined areas of expertise covered by food chemistry in comparison to neighbouring disciplines in food science. Secondly, WPFC has prepared guidelines which set out the minimum requirements for the higher education of food chemists at university level. These guidelines shall ensure an adequate scientific background for all experts responsible for the chemical analysis of foodstuffs and related materials. In this way, minimum criteria are laid down for the expertise required for the official control according to the EC Council Directive as well as for equivalent activities during processing in food industries. Finally, the Annex illustrates in further detail the very broad range of activities that are carried out by food chemists, if they are educated and trained according to the guidelines given.

The working party stresses the need to harmonize the curricula in food chemistry throughout Europe and to raise the education to a comparable and high level. Such actions, over a period of time, will create a scientifically sound basis for the efficient protection of consumer health in all European countries, and make a significant contribution to increasing the efficiency and competitiveness of the European agro-food industry.

Definitions

Food chemistry is an important element of the poorly defined area of “food science”, which also comprises food physics, food microbiology, food hygiene, knowledge of commodities, etc. In general, food technology is taken as a particular discipline. Nutrition is, in many ways, related to food science but is not an integral part of it.

Within food chemistry, the following areas are of essential importance:

- the study of the properties of foodstuffs in both the raw and processed state;
- the study of the composition of foodstuffs and the properties of their individual components within the total food matrix;
- the study of changes in composition and properties during manufacturing, preparation and storage;
- the development of methods for reliable and reproducible measurement of these changes and of procedures which delay or prevent unwanted changes;
- the assessment of the quality, wholesomeness and safety of foodstuffs, including their nutrient content and sensory properties;
- the development and implementation of methods of analysis for establishing the composition of foodstuffs and for the determination of harmful or otherwise undesirable components in foodstuffs;
- the development, in cooperation with appropriate experts, of adequate food laws designed to protect public health and to promote fairness in trade.

From all these areas, the following definition may be derived:

“Food chemistry is the competent discipline for investigating the composition, structure and properties of unprocessed and processed foodstuffs and their components, for elucidating their chemical and biochemical changes and for analysing essential and undesirable compounds, thereby protecting and enhancing public health and food quality.”

Guidelines for a curriculum in food chemistry

As *minimum requirements* for a complete curriculum in food chemistry, WPFC recommends 2 years of basic studies, 2 years of advanced studies and half a year for preparing a master's thesis, that is a total of 4.5 years.

The *basic studies* should include lectures and a thorough practical training in the fundamentals of general, inorganic, organic and physical chemistry, completed by courses in physics, mathematics, statistics and biology. Because of its underpinning role in food chemistry, analytical chemistry merits a central position. Wherever possible, this basic education should largely follow the curriculum for students in chemistry

(diploma) at the respective university. In this way, the students may decide only after 2 years whether they prefer to continue with chemistry or specialize in food chemistry.

During the 2 years of *advanced studies*, the curriculum should emphasize that chemical food analysis mostly deals with complex substrates or trace determinations; complementary disciplines should continue to be included, providing a broad scope for attainment of knowledge and expertise.

Within the overall frame of an adequate total of credit units, WPFC recommends the division of lectures and practical training as follows:

Subject	Lectures	Practical work
Food chemistry, food biochemistry, chemical food analysis, sensory analysis, etc.	50 – 60 %	65 – 70 %
Food microbiology	10 – 15 %	10 – 15 %
Food toxicology, nutrition science, etc.	5 – 10 %	5 – 10 %
Food legislation and regulations	5 – 10 %	-
Food technology	5 – 10 %	5 – 10 %
Special areas of interest	0 – 15 %	0 – 15 %

The total of credit units should be adequate to advanced studies in comparable natural sciences. The degree obtained (Masters, Diploma, etc.) should always contain a thesis taking half a year to complete, preferably with scientific experimental work.

Annex: portrait of a food chemist

Food chemists in industry

In the food industry, food chemists are the experts who ensure safe, nutritious and tasty foods for the consumer. They are primarily active in research, development and quality control laboratories. Their tasks comprise, amongst others, the optimum choice of raw materials by examining their suitability, processing quality and safety, the cooperation in the development of new products and the improvement of preparation techniques, the inspection of the operational process and the quality of end products. Within this framework, the food chemist:

- has the responsibility for the quality and wholesomeness of the products of the factory, including their nutrient content, sensory properties and conformity with legal regulations;
- performs the control of processing according to the specifications and good manufacturing practice (GMP) in order to achieve optimal properties and to avoid unwanted components, to which chemical, physicochemical, enzymatic, immunological, microbiological and sensory methods are applied;
- contributes to the optimization of process engineering in order to preserve valuable ingredients, also from the viewpoint of energy saving and with regard to the demands of environmental protection;
- examines and assesses raw materials and end-products from the viewpoints of quality, nutrition physiology, microbiology and food legislation;
- develops new products and technologies, and establishes standard operation procedures in accordance with food legislation;
- specifies new raw materials and packaging materials, and tests them for suitability;
- establishes quality assurance systems and parameters which guarantee the demands of constant quality;
- advises marketing and advertising;
- inspects drinking water and process water and assesses the waste water;
- cooperates in the setting up of culture and breeding contracts in order to avoid contamination of raw materials, e.g. by residues and contaminants;
- develops new and improved analytical methods and checks their performance;
- participates in committees and working groups in the food industry.

Food chemists in the service of the government

For examinations and judgements within official food inspection and control systems, food chemists are active in the laboratories of the *chemical and food inspection services*. Their tasks primarily include the protection of consumers against health risks, as well as against fraud and misleading information. Within in this overall framework, food chemists are responsible for:

- examination of foodstuffs, using chemical, physicochemical, enzymatic, immunological, microbiological and sensory methods, and assessment of results of analysis according to food regulations;
- examination of drinking water and process water, and assessment of their chemical composition;
- investigation of levels of residues and ubiquitous contaminants in foodstuffs and drinking water;
- development of new and improved methods of food analysis and implementation and validation of analytical techniques, e.g. within the framework of national and international standardization bodies;
- organization of sampling programmes taking into consideration food factories and import companies, and participation in the inspection of food processing plants, wholesale markets and other companies;
- provision of expert opinions for authorities, public prosecutors and courts;
- examination of materials for environmental protection purposes such as soil, waste material and waste water, and assessment of the results;
- education and training of food inspectors as well as of food advisors and other disseminator of knowledge.

The occupations mentioned above are closely related to those in the *Military Health Services*.

Food chemists have also important positions in *enforcement services* and *executive authorities*. These include reporting to the responsible ministries and subordinate offices as well as to the local authorities which have to execute food law. Within this framework, the food chemist is involved in:

- supervising the circulation of foodstuffs and introducing the measures which, based on the results, are necessary;
- providing authoritative comments and statements for authorities, public offices and courts,
- developing strategies for the effective and economic supervision of the circulation of foodstuffs, and attempting to implement these;
- the preparation of law and governmental regulations at both national and European levels;
- informing the public about the performance of the official inspection of foodstuffs.

Food chemists in research and at universities

In food research, food chemists are primarily involved in university institutes of food chemistry and biochemistry, but also in governmental and industrial research institutes. Within this scope the role of the food chemist includes:

- isolation of components of foodstuffs and elucidation of their structures, functions and interrelationships;
- study of reactions occurring in foodstuffs and in their components during storage and processing, as well as the influence of additives, packaging, etc.
- development of methods for the examination of the composition and purity of foodstuffs and for the detection of undesirable components;
- elaborating methods for the analysis of contaminants and residues in foodstuffs and environmental substrates and for elucidating the ways of contamination;
- advising scientific committees with respect to the scientific results and the meaning of these for the public;
- working on the scientific training of food chemists.

With respect to the university-based tasks, the food chemist:

- imparts theoretical knowledge to students in biochemistry, analytical chemistry and food chemistry concerning
 - the production, composition and functional properties of foodstuffs,
 - the reactions of their ingredients during production, processing and storage,
 - the mode of action of food additives and the influence of contaminants,
 - the appropriate regulations and their application to scientific problems;
- familiarizes students with practical knowledge regarding chemical examination and applies this knowledge to problems of food analysis and technology;
- gives guidance to postgraduate students and evaluates their scientific progress.

Food chemists in an independent private laboratory

Private food chemists are active in independent trade laboratories. As a rule, they are appointed publicly by an industrial or trade board as trade chemist or as an expert in the field of food chemistry. One of their primary tasks is the provision of professional advice to manufacturers, importers, trade partners and other clients. Within this framework, the food chemist:

- examines foodstuffs, semifinished products, raw materials including drinking water, and packaging materials, using chemical, physicochemical, enzymatic, immunological, microbiological and sensory methods, and assesses the results;
- provides nutritional advice to food producers and catering services;
- investigates the influence of the environment on the production and storage of foodstuffs and assesses the results;
- acts as an adviser to food producers with respect to technological and hygiene problems;
- advises the trade with respect to food regulations and problems of hygiene;
- examines and assesses check samples which are a matter of dispute.

Apart from this, food chemists find an expanding sphere of work in the complex area of environmental analysis. Within this framework, their responsibilities include the examination of water, soil and other environment samples as well as the assessment of the results.

Food chemists in other fields

Food chemists have a good background for studying problems in related fields of natural sciences, as they are educated thoroughly in analytical chemistry and biochemistry as well as in microbiology, technology, toxicology, nutrition science, and the relevant legislation. For this reason food chemists, for example are also involved:

- in companies for auditing and certifying food processing plants;
- in federations of the food industry;
- in agricultural inspection and research institutes,
- in the laboratories of the chemical and pharmaceutical industries;
- in agencies for the protection of the environment;
- in research, development and quality control laboratories of industries producing cosmetics and other consumer products;
- in laboratories of the water and waste water industry;
- in laboratories for chemical toxicology or clinical chemistry;
- in institutes for forensic analysis or criminal investigations;
- in organizations representing current consumer interests towards politicians;
- in institutions providing nutritional advice and information for the consumer.