

Student research training and curriculum development through scientific research

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Abstract – The objective of the master curriculum of Food and Agricultural Engineering at the Faculty of Biosciences at University College Ghent, is a competence-oriented education through the integration of technological and scientific research. Some of the most important competences include the ability to set up scientific experiments, interpret literature on scientific subjects and evaluate experimental results in a critical way. In assessing the curriculum, particular attention is given to the relationship between education and research. In this context, the faculty can refer to a large number of research projects in cooperation with governmental and industrial partners. Project leaders are members of the educational staff and students can fully cooperate. The faculty's available infrastructure boasting a lot of pilot scale apparatus resulted in an outstanding relationship with the food industry. The food industry has become an important source of applied technological research topics. These technological projects can be carried out in the in-house technological labs or at the industrial sites. The dissemination of project results into educational topics guarantees the relationship between research and education and enhances the academic level of our master curriculum.

Index Terms – Food technology, Food industry, Technological infrastructure, Research project.

UNIVERSITY COLLEGE GHENT

University College Ghent is an institute for higher education established in 1995 after two large mergers that involved sixteen institutes of higher education. Its education profile is multidisciplinary and it offers a broad range of study programmes on an academic and professional level.

University College Ghent consists of 13 faculties, two of which organize engineering education. One of these focuses on industrial engineering (chemistry, textile, electronics, construction, ...) while the other focuses on bioscience and food technology.

Nowadays, Flanders has 29 institutions of higher education: 22 university colleges and 7 universities. As a result of the implementation of the Bologna agreements by means of the 'Flemish Decree on Higher Education Structures' (October 2004) university colleges offer one or more of the following degrees in different disciplines:

- Professional Bachelors, such as office management, nursing and teacher training;

- Academic Bachelors and Masters, such as applied engineering and biosciences.

The Faculty of Biosciences and Landscape Architecture (one of the 13 faculties of University College Ghent) offers study programmes based on biosciences and agricultural and food sciences. The Department of Food Science and Technology is a subdivision of this faculty.

MASTER OF BIOSCIENCES: FOOD ENGINEERING

The Bachelor of biosciences' programme has been designed to give the candidate general and comprehensive knowledge and insight in the terms, theories, research methodology and data processing of applied biological, technological and nature sciences. The Bachelor's programme enables the student to apply the acquired knowledge in an independent and critical manner. The bachelor student should acquire the attitude to broaden and deepen this knowledge by means of selecting and interpreting scientific information. During his training, the student has to develop sufficient professional and scientific competences to qualify for enrolment in a master's program or enter the professional field.

The master of biosciences is a highly multidisciplinary study programme based on extensive in-depth knowledge. During the master's programme the candidates will study a wide range of subjects and receive training in a wide variety of skills. Masters in biosciences, such as application engineers, should have a well-developed concept of practising science, a widely developed knowledge and a strong ability to integrate new concepts into the area of biosciences.

Apart from the extension of the profession-specific knowledge, the emphasis is on the application of the knowledge obtained and the ability to carry out scientific and technological research independently. The creation of a master's thesis is an essential component and an ideal instrument to evaluate the competences achieved during the training.

THE FIELD OF EMPLOYMENT OF MASTERS OF FOOD ENGINEERING

Graduated masters of Food Engineering have the competences and knowledge to fulfil the role of quality assurance manager, to take the responsibility for quality control and also to be a good process engineer by controlling the food production process in order to reach safe and high-quality products. Most graduates perform

one of the above mentioned functions in the food industry. Some other graduates can be found in related enterprises, specialized in the development and commercialization of processing machinery (valves, separators, heat exchangers, CIP accommodations, etc.) and control equipment (sensors, PID regulators, PLC systems).

The curriculum has been developed in close collaboration with the industry according to the desired level of knowledge and competences a young master in food engineering should achieve during training in order to be useful to his future employer. Despite the focus on personal skills such as communication skills, critical attitude, scientific curiosity, team spirit and leadership qualities, it is a well-established fact that technical knowledge and the ability to use this knowledge to solve technical problems according to products and processes is still one of the most important competences. The industry wants a newly-qualified food engineer to possess this competences at the end of his master training. The familiarity with food processing should be incorporated from the start.

A study programme can meet this requirement by the establishment of partnerships:

- with scientific partners such as universities and research centres;
- technological partners from the food industry itself.

The partnerships' success is guaranteed by the department's in-house technological facilities which serve as a training centre for students and a service centre for the industry. This is important as it creates a 'real-time' perception of food industries and assures that the knowledge is kept up to date.

RESEARCH AND 'ACADEMISATION'

Although the Faculty of Biosciences of the University College Ghent already had a strong research tradition in some areas and boasted a number of research groups of international excellence, the Bologna declaration and the academisation process increase the need for education embedded in a strong research environment, both qualitative and quantitative.

Not only is the number of researchers at University College Ghent increasing, the link with the Ghent University in terms of research is also strengthened through the Ghent University Association of which both institutions are members. In order to ensure the quality of research and the efficient allocation of the internal financial means for research, an internal Research Fund was created. This fund allows a coherent research policy independent of the external funding that is granted to our researchers. At the same time a Research Council was set up consisting of active researchers representing the different faculties of University College Ghent and representatives from the research council of Ghent University.

This council advises the management of the institute on the Research Fund's allocation, follows up the academisation process, stimulates research in the faculties and the coherence of the ongoing research. The valorisation of

research by patenting, and raising spin-offs grows in importance and is certainly a challenge for the future.

The present research activities will be reinforced, broadened and revalued scientifically by adhering to a research policy which is characterized by:

- setting up research groups in the fields of agriculture (plant production and crop protection, animal production) and feed and food technology;
- preserving and further increasing the scientific staff;
- developing the research facilities;
- setting up multidisciplinary research programs resulting in the improvement of the research capacity and resources;
- further intensifying the cooperation with university research entities;
- stimulating the participation in university research programs.

PARTNERSHIPS WITH THE UNIVERSITY

As mentioned before, the creation of the Ghent University Association has enhanced the collaboration between the University College Ghent and the Ghent University in several fields of research.

In our faculty, the Department of Food Science and Technology of the University College Ghent is associated with the Department of Food Quality and Safety of Ghent University and an association research group has been established. The research focus of both departments is on food processing and food technology. Through the Ghent University Association the fundamental research at the Department of Food Quality and Safety is combined with the experience and the infrastructure present at the Department of Food Science and Technology. Both departments' knowledge and competences in the field of Food Technology has been united in the association research group and as a result of this process a new centre of knowledge has been created.

In this framework, several Ph.D research projects have been initiated. These projects' main goals are:

- to perform innovative and qualitative research in the field of food technology;
- to enhance the link between research and education;
- to involve the master students and stimulate them to develop research skills.

Through the management of the research projects, the teaching staff are kept up to date with new developments which, in turn, offers them the opportunity to use this research experience for educational purposes.

RELATIONSHIP BETWEEN RESEARCH AND ENGINEERING EDUCATION

A close interaction between research and education is essential for education at high-standard academic level. The creation of research-oriented surroundings with on-site research and experimental facilities, offers the possibility of

gaining research experience and also serves as a basis for embedded academic education.

Our staff members are active in both areas which means that the most recent insights and scientific discussions penetrate in the educational programme. As a result of their involvement in research the critical attitude and analytical ability of the students are stimulated. Other already partially achieved goals in the academisation process are:

- University staff are involved in specialized courses in the curriculum of the master of Food Engineering;
- Staff members of the University College perform research at university laboratories equipped with complementary equipment.

TECHNOLOGICAL ACCOMMODATION

The department has a number of technological laboratories equipped with pilot plants which enable real process simulation. The faculty has technological laboratories for dairy technology, cereal technology, brewery and feed technology, industrial chemistry and fermentation technology.

Table I gives an overview of some technological production and control equipment in these laboratories.

TABLE I
LABORATORY INFRASTRUCTURE

Laboratory	Production process	Control facilities
Feed Technology	- Electrical steam unit - Steam regulation unit with PID equipment - semi-automated feed production line	- end product control equipment - chemical and texture analyses
Dairy Technology	- pasteurization unit - separator - homogenizer, - yoghurt, cheese and butter production unit - spray dryer - concentration unit	- process and end product control equipment - chemical and textural analyses
Cereal Technology	- pilot scale cleaning and milling machinery - pilot scale baking facilities	- raw material and end product control - specific texture analyses on dough and baked products
Brewery	- 100 L scale brewing facility	- end product analyses
Industrial Chemistry	- distillation, gas adsorption, solvent extraction equipment	- chemical product analyses

I. Advantages

In-house equipment used for training, gives students the ability to perform process simulations and to test their theoretical knowledge in a production environment. They can take decisions, evaluate the results, give feedback on the gathered information and learn about the impact of the different process parameters.

The faculty's technological facilities also create the possibility for partnerships with the food industry.

Small-scale production units exhibiting high similarity with in-field food production also create opportunities to carry out technological research such as process and formula optimization, product development, trouble shooting, etc.

The institute's objective is to profile itself as a knowledge centre, gathering the theoretical knowledge using its indoor facilities of process simulation and control.

The available pilot plants are very appropriate tools for the food industry. They facilitate process and product development and reduce yield losses and/or production time.

The knowledge centre itself can create an in-house environment where the theoretical scientific and technological background can be explored to solve practical problems and to advise on specific situations in the industry.

Table II gives an overview of the number of projects carried out at the department of Food Science and Technology by order of the food industry. A distinction is made between process optimization and quality control, as the former is more specifically related to the production process, whereas the latter focuses on the end product quality as a result of a controlled process.

Among these advantages we must certainly not forget the financial aspect. As a result of these industrial research projects the institute is able to sustain its budget to keep this infrastructure up to date and thus invest in the future of the curriculum.

TABLE II
NUMBER OF INDUSTRIAL PROJECTS FOR THE LAST FEW YEARS
CLASSIFIED PER TECHNOLOGICAL FIELD

Field	Scope	Academic year					
		2001	2002	2003	2004	2005	2006
Dairy	Process optimization	5	5	7	6	5	1
	Quality control	4	4	0	2	2	3
Feed	Process optimization	1	5	2	9	14	7
	Quality control	2	1	3	6	4	3
Cereal	Process optimization	6	3	2	2	2	4
	Quality control	19	9	11	10	19	23

II. Disadvantage

One should realize that good technological accommodation for in-house training may be difficult to acquire and to maintain. Pilot or lab scale plants are expensive and the cost to keep them operational may be substantial.

Due to rapid technological evolution some machinery should also be rebuilt or replaced after a decade already, in order to cope with the present state of the art of production and controlling facilities.

ACKNOWLEDGMENT

FOOD INDUSTRY PARTNER IN THE CURRICULUM DEVELOPMENT

The opportunities mentioned above such as the relations with the industry can be fully exploited by involving the companies in the organization of the curriculum.

I. Courses

Partners in the field of food production or research are best qualified to assure a good technological and academic level of education.

For students this is an interesting part of the curriculum as they will receive 'real time' information on new technological and product developments, regulatory impact on production, important problems related to changing market situations, etc.

II. Industrial visits and training sessions

The best way for staff and students to feel related to present-day industry is to participate in the industry and get a feel of on-line training.

The food industry offers the possibility to visit production plants and to take a closer look at technological infrastructure and at laboratories for quality control and product development. A curriculum lacking field visits may be regarded as incomplete.

One may also conclude that the earlier the first contact with the industry is scheduled in the curriculum, the better this will influence a student's training.

III. Master's thesis

A master's thesis gives the students the opportunity to solve technological problems during their study, to get to know their future employer, to get to know the 'real world', to test their knowledge and to apply this knowledge to practical situations.

A number of research topics proposed by the food industry, results in several subjects for master's theses and contributes to the achievement of the required competences.

CONCLUSION

The curriculum of the master of Food Engineering seeks to achieve a wide range of competences which will guarantee future employment and which meet the food industry's expectations.

To its students it strives to convey excellent communication competences and technological and engineering skills such as a profound knowledge of production processes. It also wishes to install a 'trouble shooting' attitude.

Students engaged in research projects with the industry, and working in a technological environment will have a good chance of reaching this goal.

Embedding the education in scientific research through a partnership with Ghent University, enables the continuous scientific curriculum development.

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