

Degree Program Documentation

Master's Program Food Technol- ogy

Part A
TUM School of Life Sciences
Technical University of Munich

General information:

- Administrative responsibility: TUM School of Life Sciences
- Name of degree program: Food Technology
- Degree: Master of Science (M.Sc.)
- Standard duration of study and credits:
4 Semesters and 120 credit points (CP)
- Form of study: full time
- Admission: Aptitude assessment (EV)
- Start: Winter semester (WiSe) 2022/2023
- Language of Instruction: German
- Main location: Weihenstephan (Freising)
- Academic administrator (program design):
Prof. Dr.-Ing. Heiko Briesen
- Contact for further questions (regarding this document):
Team Quality Management
qm.co@ls.tum.de
- Status as of: 31.03.2022

Table of contents

1	Degree Program Objectives	4
1.1	Purpose	4
1.2	Strategic Significance	4
2	Qualification Profile	6
3	Target groups	8
3.1	Target Audience	8
3.2	Prerequisites.....	8
3.3	Target Numbers.....	10
4	Demand Analysis	11
5	Competition Analysis	15
5.1	External Competition Analysis.....	15
5.2	Internal Competition Analysis	16
6	Program Structure	17
6.1	Specialization area: Food Process Engineering and Technology (22 CP in total)	18
6.2	Specialization area: Digitalization (13 CP in total).....	18
6.3	Scientific working methods (35 CP in total)	19
6.4	Elective options (50 CP in total)	19
6.5	Mobility Window.....	20
6.6	Sample Study Plans	21
7	Organization and Coordination	23
8	Enhancement Measures	25

1 Degree Program Objectives

1.1 Purpose

Nowadays, a large proportion of food is not consumed fresh, but in processed form. The demands placed on such foods are constantly increasing. The markets not only demand high-quality and safe products, but also regular innovations. One current trend, for example, is the increasing demand for vegetarian or vegan products. Products made from plant-based protein sources often undergo a variety of complex production steps. But even with established foods (e.g. confectionery such as chocolate, baked goods or preserved products such as milk or fruit juices through to ready meals such as pizza), new types of production processes enable constant improvements in flavor, nutritional content and sustainability aspects.

Manufacturers are aiming for and consumers are demanding ever more energy-efficient production processes as a contribution to conserving resources. Industrial food production therefore plays an important role for society as a whole in the overall food supply chain. Food technology recognizes this importance for society as a whole by focusing on the special features of food production compared to other manufacturing industries. These special features result from the biogenic origin and the associated variability of the raw materials, the special requirements for safety and sustainability and the food-specific processing procedures. These diverse demands on products and manufacturing processes require highly trained specialists with comprehensive expertise in traditional and innovative production systems and plant technologies as well as a profound overview of the entire food value chain, from raw materials to packaging.

The aim of the Food Technology degree program is to train interdisciplinary engineers for industrial food production and food technology research. The task of graduates is the safe operation of food production facilities and the development of new food products and processes. They can advance the scientific understanding of corresponding products and processes, as well as translate the knowledge gained into innovations. Responsible use of resources in terms of sustainable food production is also part of the profile.

1.2 Strategic Significance

For years, the School of Life Sciences (SoLS) has been training process engineers who can design and conceptualize production processes in the food industry. The use of fermentative/biotechnological processes is a connecting element of other related Master's programs at the SoLS (Brewing and Beverage Technology, Pharmaceutical Bioprocess Engineering). However, the focus of those related Master's programs is on the beverage and pharmaceutical industry. The Master's degree program in Food Technology is the consecutive follow-up program to the Bachelor's degree program in Food Technology at the Technical University of Munich (TUM), which is also based at the SoLS. The Master's program builds on this and leads to the acquisition of in-depth process engineering and methodological skills. Students also have the opportunity to specialize in a specific area of food technology and to learn and deepen their independent scientific work in research-oriented topics.

The Food Technology degree program uses the School's structures and expertise in engineering and biotechnology and complements them with a focus on food technology. Process engineering is

a central area of expertise at the SoLS and is represented in the Department of Life Science Engineering. The thematic networking of the individual related degree programs mentioned above also enables students to gain an insight into different sectors of the biotechnology industry and thus acquire interdisciplinary skills.

The integration of the study program bundle into the wider environment of the SoLS offers a particular advantage for the training of food technologists. The Weihenstephan campus has interdisciplinary knowledge of life sciences, especially microbiology, biochemistry and molecular biotechnology. Due to this bundling of competences that are necessary for food technology, qualified graduates can be trained here. Synergies also result from the existing knowledge in the beverage sector and the good cooperation with the School of Engineering and Design and the Nutritional Sciences/Life Sciences degree program for individual courses.

2 Qualification Profile

Students on the Master's degree program in Food Technology receive in-depth training in the field of methodical engineering (together with the related Master's degree programs at the SoLS) and also - specifically for them - in the field of food process engineering/technology. After completing the Master's degree program, students are able to combine the specialist knowledge they have acquired from all areas and apply it in a problem-solving manner. The competences that graduates can demonstrate after successfully completing the Master's degree are listed below.

The content of the following qualification profile corresponds to the requirements of the Qualifications Framework for German Higher Education Qualifications (Hochschulqualifikationsrahmen - HQR) and the requirements contained therein (i) knowledge and understanding, (ii) use, application and generation of knowledge, (iii) communication and cooperation and (iv) scientific self-conception and professionalism. The formal aspects according to the HQF (admission requirements, duration, degree options) are detailed in chapters 3 and 6 as well as in the corresponding subject examination and study regulations.

Knowledge and Understanding

- Graduates have in-depth knowledge of the physical-chemical and biological relationships in food.
- Graduates know and understand basic process engineering operations that are used to process food.
- Graduates know and understand modern concepts from the field of industrial digitalization, such as plant automation and process control.

Use, Application and Generation of Knowledge

- Graduates can analyze and design individual basic process engineering operations in order to generate and/or maintain desired properties in food products.
- Graduates are able to design entire food production process chains through a combined selection of suitable basic process engineering operations.
- Graduates are able to apply modern concepts from the field of digitalization to specific production processes.
- Graduates are able to analyze and develop food products.
- Graduates can utilize the potential of scientific innovations to further develop or redesign food production processes through knowledge transfer.

Communication and Cooperation

- Graduates are familiar with the typical working methods of the specialized field and the relevant technical vocabulary.
- Graduates are proficient in interdisciplinary communication and are able to work constructively and solution-orientated in a team.
- Graduates are able to prepare, present and communicate research results in a way that is appropriate for the target group.

Scientific Self-Conception and Professionalism

- Graduates are equally qualified for a job in industrial food production as well as for a scientific position at a university/research institution.
- Graduates are able to formulate research questions, design and work on research projects and analyze research results, taking into account scientific findings.
- Graduates are able to select and apply suitable statistical and model-based methods for analyzing and critically evaluating complex data and processes.
- Graduates are able to critically reflect on their actions in their professional environment, especially in relation to society's increasing expectations with regard to sustainable food production.

3 Target groups

3.1 Target Audience

The Master's degree program in Food Technology is aimed at graduates of a **Bachelor's degree program** in engineering or natural sciences (120 CP) of at least **six semesters** at a domestic or foreign university or a **degree of at least equivalent value in the** fields of food technology and biotechnology, bioprocess technology, brewing and beverage technology or a comparable degree program.

The Master's degree program in Food Technology is an advanced and in-depth engineering degree program specifically for graduates of relevant engineering and technical Bachelor's degree programs. The course builds in particular on the TUM Bachelor's degree courses in Food Technology, Brewing and Beverage Technology and Pharmaceutical Bioprocess Technology and offers these Bachelor's students an interesting opportunity for further specialization as well as interdisciplinary specialization. Applicants from other disciplines and career changers are prepared for successful study on the TUM Master's in Food Technology through an aptitude test and individual counselling.

Applicants should deepen their knowledge in the field of food production, processing and development with a view to a future field of activity in the food processing industry, but also want to continue their interdisciplinary education beyond this. A keen interest in manufacturing processes, creative development of products and the quality of food products is a prerequisite.

Future food technologists should be willing to work in an interdisciplinary team in order to be able to work innovatively in a constantly changing industry and contribute responsibly to solving problems affecting society as a whole.

The degree program is currently offered mainly in German in the compulsory subject area and is therefore more suitable for applicants with a very good knowledge of German at TUM. However, there are increasing opportunities to participate in international exchange programs, to integrate a foreign, industrial or research program or to complete electives at a foreign university. Many electives are also offered in English at TUM and the Master's thesis can be written and supervised in English.

The degree program currently has an average of around 10% international students.

3.2 Prerequisites

Applicants must have successfully completed a **Bachelor's degree in food technology** or other **technical engineering specializations**. A solid basic education in mathematics and natural sciences (biology, chemistry, physics, mathematics) is required. In addition, knowledge of basic engineering subjects such as **technical mechanics, fluid mechanics** and **thermodynamics** is required. Furthermore, competences in **food analysis, chemistry and microbiology** - both theoretical and practical - must be demonstrated. The basis for comparison here is the curriculum of the Bachelor's degree program in Food Technology at the SoLS.

The application process includes an **aptitude test in accordance with Annex 2 FPSO**.

In principle, **120 CP** from a relevant Bachelor's degree program are required, whereby **69 CP are** specified as competences from the subject group listed in **Table 1** (in accordance with Annex 2 FPSO).

Table 1 Subject group - prerequisites for the Master's degree program in Food Technology¹

Subject group	CP
Chemistry (organic, inorganic and biochemistry)	10
Mathematics incl. statistics	10
Microbiology	5
Physics	5
Hygienic design and hygienic processing	5
Fluid mechanics	5
Technical mechanics	8
Thermodynamics	6
Food analysis	5
Food chemistry	5
Food microbiology	5
Total	69

Missing competences are additionally acquired through admission requirements. In the event of insufficient subject-specific foundations, modules totaling a maximum of 30 CP from the specified areas of competence can be issued as an admission requirement. These must be completed within one year of starting the program.

Applicants are expected to have the ability to think in an abstract, logical and system-oriented way, as well as a recognizable interest in and background knowledge of issues in the fields of food technology, related disciplines (e.g. beverage technology) and other fields (e.g. engineering, natural sciences, etc.).

As the lectures are largely held in German, prospective students must have sufficient knowledge of German. Foreign students must submit a language certificate recognized by TUM (B2 (Goethe), DSH-2/3, B2 (DSD II), 4 (TestDaF), telc Deutsch C1 Hochschule) together with all other documents by the application deadline.

A good knowledge of English is also required, as specialized literature is often only available in English. B2 is recommended, Abitur level. Students can compensate for deficits in this area through the electives offered during the degree program.

¹ Source: FPSO

3.3 Target Numbers

The SoLS is aiming for an average enrolment of 60 students on the Master's degree program in Food Technology in order to offer students on the Bachelor's degree program in particular an advanced and in-depth study option that will expand their professional development opportunities. In addition, the aim is to increase the number of students from other internal TUM Bachelor's degree programs in engineering and technology and from other German and international universities.

The current graduation rate for students on the Master's degree program in Food Technology is almost 100%.

The brands "Weihenstephan" and the Technical University of Munich contribute to the fact that the degree program is always in high demand at trade fairs. There is also a high level of interest in the degree program at study information days.

Across Germany, a total of around 4,150 students are enrolled on a degree program in food technology (all degree programs) at an almost constant rate each year². The demand from students for an advanced Master's degree is generally stable to declining, as students have access to a wide range of other innovative engineering programs or students are already entering professional life after completing their Bachelor's degree.

Between 2017 and 2021, an average of 70 students enrolled on the Bachelor's degree program at TUM SoLS each year. In the same period, the average number of enrolments for the advanced Master's degree program was 43.

Currently, around 76% of students on the TUM Bachelor's degree program in Food Technology remain at the SoLS to continue on to a Master's degree program.

A more restrictive aptitude procedure introduced in the winter semester 2016/17 probably led to falling applicant numbers and percentage of admissions. The aptitude procedure was revised again for the winter semester 2022/23 with the aim of harmonizing the procedure for all applicants, including TUM external and international applicants, and aiming for a higher enrolment rate for TUM external applicants with prompt applicant feedback.

Table 2 shows the numbers of applicants, admissions and total students between 2017 and 2021.

Table 2: Development of applicant and enrolment figures 2017 - 2021 for the Master's degree program in Food Technology (formerly Food Technology and Biotechnology)

	WS 17/18	WS 18/19	WS 19/20	WS 20/21	WS 21/22
Applications (cases)	112	102	89	81	60
<i>thereof international</i>	20	24	16	<i>n.a.</i>	<i>n.a.</i>
Authorisations (cases)	83	69	61	51	47
Enrolments from applications (cases)	60	47	41	39	28

² Source: Federal Statistical Office, winter semester 2020/21 with a total of 4,123 students

Proportion of enrolments to admissions (cases) in %	72,3	68,1	67,2	76,5	59,6
Students (cases)	179	152	140	136	117
<i>thereof international</i>	13	17	20	21	16

WS = winter semester, enrolment for this degree program only takes place in the winter semester

4 Demand Analysis

The food manufacturing and processing industry covers a wide range of different sectors and is the fourth largest industrial sector in Germany with an annual turnover of 185 billion euros and an export share of 33%. The industry supplies the German market alone with 170,000 different items every day³.

There are currently around 610,000 employees (15% with an academic qualification) working in more than 6,100 companies (most of which are small and medium-sized with fewer than 250 employees) in various areas of the food industry⁴. Around 35% of employees work in companies in the bakery industry, 23% in the meat and meat processing industry, followed by 8% in milk processing. The other 34% of employment opportunities are in the production of beverages, confectionery, fruit and vegetable processing, the production of ready meals, animal feed, food substitutes and additives, tea, coffee, animal and vegetable proteins and dietary foods.⁵

Graduates of the Master's degree program in Food Technology can be deployed in a variety of ways in food-producing companies of all kinds thanks to the wide-ranging training they receive. The core tasks lie in the planning, monitoring, control and evaluation of production processes and the assurance of product quality.

Engineering skills are also required for the partial design of systems and components for manufacturing processes. There are also a wide range of employment opportunities here, as many of the world's leading plant engineering companies are based in Germany. Over 300 German manufacturers of bakery machines, meat processing machines, beverage production machines, dairy technology, confectionery machines, machines and systems for processing plant-based raw materials, packaging machines and machines and systems for manufacturing pharmaceutical and cosmetic products generate around 80% of the total turnover of Germany's entire machinery and plant engineering industry⁶.

As the food industry has a high demand for constantly new, innovative and price-sensitive products, graduates are also deployed in product development in a variety of ways. In addition, there is a growing need for well-rounded graduates who are interested in working in research and development

³ Source: Federal Association of the German Food Industry, 2021

⁴ Source: Federal Association of the German Food Industry, 2021

⁵ Source: Federal Statistical Office, 2021

⁶ Source: [German Engineering Federation](#), 2021

to help develop solutions that better capitalize on future market trends and growth opportunities. Industry associations see a growing need for innovative technologies and products in the categories of convenience, functional foods, protein substitutes and personalized dietary solutions. In addition, trends in packaging materials, technologies, digitalization and sustainability are driving the need for well-rounded graduates.

There are other fields of activity in industrial laboratories, industrial associations, public research institutions and state and federal government departments.

Graduates can also be employed in upstream and downstream areas such as the entire logistics chain, supply chain management, the raw materials, food supplements, enzymes and additives industries.

In addition, graduates of the Master's degree program are offered management positions in commercial enterprises.

For those interested in working more intensively in research and teaching, TUM also offers the opportunity to do a doctorate after successfully completing the Master's program.

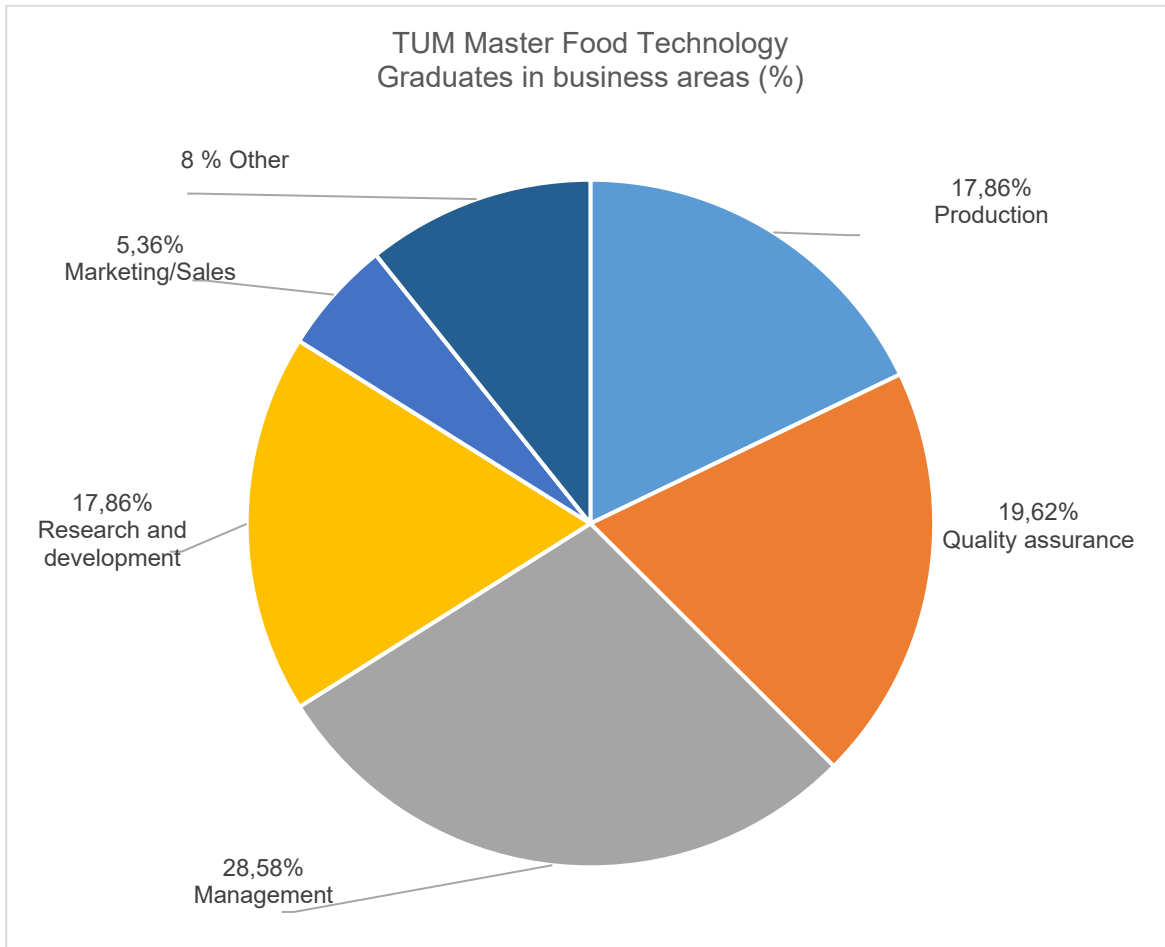
A TUM graduate survey conducted in 2020/21 underpins the positive picture of the career situation for Master's graduates of the Food Technology degree program.

TUM graduates have very good career opportunities on the labor market. Regular graduate surveys (since 2018) have shown that almost all graduates have found a suitable job after completing their Master's degree program. Almost 40% of graduates find a job within the first 3 months of graduating, with almost 85% within the first 6 months.

The majority of graduates (75%) find a career in production companies in the food industry, in plant construction and in research and development. Graduates also find entry-level opportunities in the chemical and pharmaceutical industries.

Around 18% of graduates find an interesting field of work in production and planning, around 20% in quality assurance, 29% in management/leadership, 18% in research and development and around 15% in areas such as marketing and sales, IT, the legal department and purchasing (Figure 1).

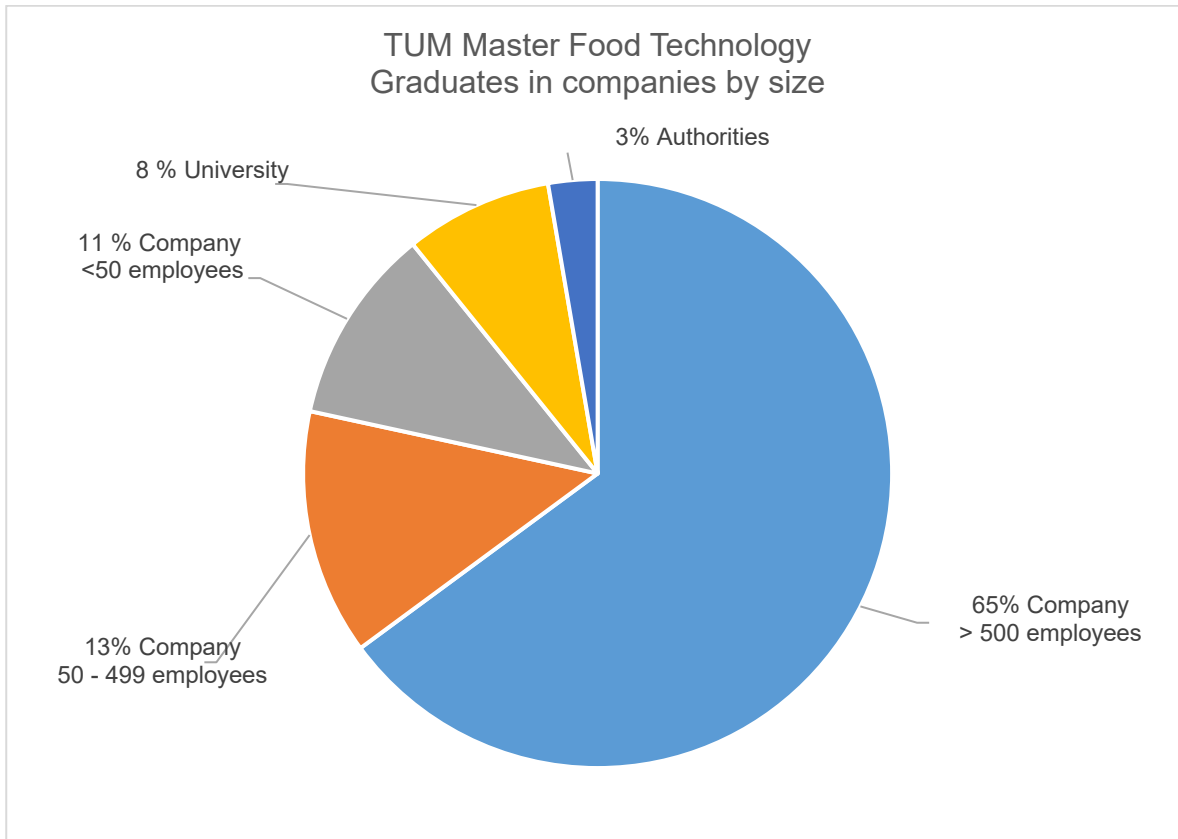
Figure 1: Entry-level occupations of graduates of the Master's degree program in Food Technology by degree in %



Source: Graduate survey (2018, 2020, n=39)

Surveys in the same period regarding the size of the companies in which TUM graduates found a job (see Figure 2) showed that the majority, 65% of graduates, found a job in large companies, only 13% in medium-sized companies and 11% in small companies. In comparison, around 8% of respondents indicated a job in research and development, teaching at a university or research institute and around 3% at a public authority.

Figure 2: Entry-level companies by number of employees of graduates of the Master's degree program in Food Technology by degree (and universities) in %



Source: Graduate survey (2018, 2020, n=39)

5 Competition Analysis

5.1 External Competition Analysis

Food technology can be studied at universities and colleges worldwide. In the field of food science and technology, TUM ranks 37th out of the 300 most important international universities worldwide.
7

Around 80 universities and colleges in Europe offer a Master's degree in Food Science and Technology.

In Germany, around 27 universities and colleges offer students the opportunity to obtain a Master's degree in the food sector. However, only four degree programs with an engineering or technical focus are roughly comparable to a Master's in Food Technology. In addition to the TUM Master's in Food Technology at the Weihenstephan campus, these are the Master's programs in Food Technology at the University of Bonn, the Technical University of Berlin and the University of Hohenheim. Of these four, TUM ranks first⁸ and second⁹ respectively.

The TUM SoLS, at the Weihenstephan campus, traditionally has a good international reputation. Weihenstephan food technologists are successfully employed throughout Germany and Europe in leading positions in German and international food companies, plant and mechanical engineering companies, laboratories and in research and development.

The TUM Master's degree course in *Food Technology* prepares students comprehensively for a career in engineering, quality assurance, production optimization, production management and also in research and development.

The Master's degree program in *Food Technology* is currently the only engineering and scientific degree program in the food sector in Bavaria. In addition to this degree program, students in Bavaria can also study Food and Health Sciences (as a Master's in four semesters) at the University of Bayreuth and Food Quality, as a Master of Engineering (M. Eng.) in three semesters at the Weihenstephan-Triesdorf University of Applied Sciences. However, these three degree programs are not directly comparable in terms of their focus.

Studying at TUM offers students access to innovative interdisciplinary subjects from the entire TUM catalogue and to a diverse network of internationally recognized TUM scientists as potential supervisors for the Master's thesis and further scientific work as part of a doctorate.

⁷ [Global Ranking of Academic Subjects 2021](#)

⁸ [Global Ranking of Academic Subjects 2021](#)

⁹ [Best Global Universities for Food Science and Technology in Germany 2022](#)

5.2 Internal Competition Analysis

There is no comparable Master's program at the TU Munich.

The following Master's degree programs at the SoLS are most closely related: **Brewing and Beverage Technology** and **Pharmaceutical Bioprocess Technology**. Parts of the engineering specialization are taken in the Food Technology degree program together with these two degree programs. Despite the relationship and the structural and content-related similarities within process engineering and the methodological subjects of automation and control engineering as well as scientific computing, a specialization in the chosen subject area arises during the course of study. The food technology and process engineering content taught in the Master's degree program in Food Technology is only found in this program and thus enables a clear specialization.

There are also two other degree programs at TUM that are similar to the Master's degree program in Food Technology in terms of the basic principles of the natural sciences. The Master's degree program in *Nutrition and Biomedicine* and the Master's degree program in *Food Chemistry*.

The English-language Master's degree program in **Nutrition and Biomedicine** focuses on the interplay between human biology, nutritional science and medicine. However, there is a complete lack of application-orientated, engineering and process engineering knowledge, which is necessary for understanding production processes and the associated technical requirements. There is no specialization in the production and development of food and its requirements.

The Master's degree program in **Food Chemistry** focuses more on the structure, composition and analysis of food. Here, too, there is a lack of essential content in the areas of process engineering, plant engineering and process automation.

6 Program Structure

Formal structure

The four-semester Master's degree program in Food Technology is designed as a full-time course with 120 CP. The degree program builds consecutively on the Bachelor's degree program in Food Technology offered at the SoLS. While the Bachelor's program is also characterized by a broad scientific education and predominantly lays the foundations for the desired engineering orientation of the course, the Master's program focuses more on deepening specialist and methodological engineering skills. The structure of the degree program is shown in **Figure 3**.

In the first three semesters, compulsory and elective modules totaling 90 CP must be completed. The fourth semester is reserved for the Master's thesis (30 CP). The compulsory and elective modules include lectures as well as tutorials, project work and internships.

The degree program is offered in German. However, scientific project topics can optionally be worked on and supervised in English. Students can take elective modules in English.

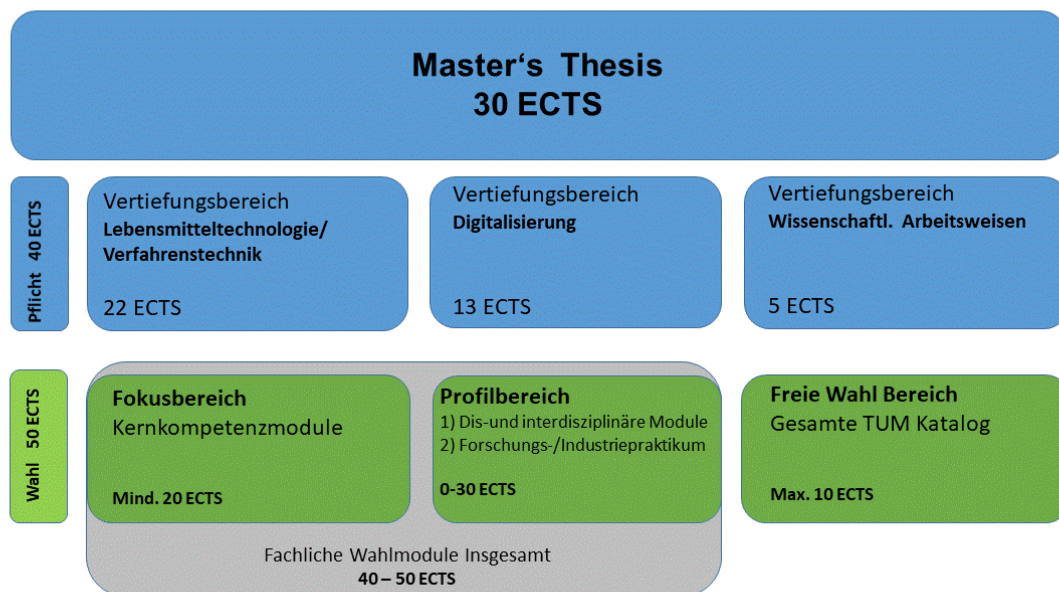
A total of 35 CP must be completed in compulsory modules to acquire the specialist core competences formulated in chapter 2 in the specializations of food process engineering/technology and digitalization. Modules totaling 35 CP are aimed at acquiring skills in the areas of scientific self-image/professionalism and communication and cooperation, which primarily cover the Master's thesis but also the food technology seminar.

Students hone their own skills profile through elective modules totaling 50 CP. The elective area is divided into three areas: Focus Area, Profile Area and Free Choice Area.

The desired engineering profile is ensured by selecting the modules in the focus area. The profile area is thematically broader and also allows students to acquire related competences (e.g. legal and economic competences).

As part of the profile area, students also have the option of acquiring in-depth scientific or practical skills worth a maximum of 10 CP through an individual research internship or an industrial internship of 6 or 10 weeks. Students choose their own areas of interest and are supervised internally at TUM.

Figure 3: Structure of the Master's degree program in Food Technology



6.1 Specialization area: Food Process Engineering and Technology (22 CP in total)

The complexity of the food production process requires students on the Master's program to undergo in-depth academic training in engineering.

In the module **In-depth chapters of food technology** (6 CP), current topics from science and research are addressed, deepened and supplemented with specialized knowledge. Students are also sensitized to currently relevant key research areas. They learn about new food concepts and their processing options.

The process engineering program starts at the same time. The basic operations and concepts of mechanical/dispersive and thermal process engineering are taught in a **process engineering** module (9 CP), which is relevant for the entire degree program. When teaching these basic operations (e.g. filtration, distillation), the focus is on the abstract, formal description. It is shown which laws these processes follow and how these can be summarized in model equations for calculability.

In the **Food Process Engineering** module (7 CP), all process engineering operations relevant to food production are dealt with in depth and applied to specific issues. The basic operations from mechanical and thermal process engineering, which are necessary for understanding, are assumed.

6.2 Specialization area: Digitalization (13 CP in total)

The demand for automation, individualization and digitalization is particularly high in the area of food production. In order to meet the requirements of Industry 4.0 (especially digitalization), graduates need extensive methodological knowledge.

This is taught in an application-oriented manner in the **Automation and Control Engineering** module (8 CP). Not only are the theoretical competences taught, but practical exercises also ensure the application-oriented acquisition of competences.

Students acquire advanced mathematical methodological skills in the **Scientific Computing** module (5 CP). Students learn methods and algorithms for data analysis and simulation of processes that go beyond the more statistical methods taught in the Bachelor's program.

6.3 Scientific working methods (35 CP in total)

The basis for independent scientific work is laid in the **food technology seminar** (5 CP), which focuses on scientific methodology and literature research. Students should deepen their knowledge of the scientific tools learnt in the course of the Bachelor's thesis. They learn to present and discuss results they have researched themselves and to assess their social implications.

In the final **Master's thesis** (30 CP), students must demonstrate that they can independently and competently develop, practically implement and scientifically analyze a complex topic from the field of food technology. By choosing a topic, students can set their favored focus and thus further sharpen their own profile.

In seminars and final theses, students are repeatedly confronted with the responsibility of their own actions. Through reflection with supervisors and fellow students, students learn to categorize their actions in an overall social context, for example with regard to sustainability, which is playing an increasingly important role in the field of food technology.

6.4 Elective options (50 CP in total)

In addition, students can deepen their skills through a wide range of elective modules totaling 50 CP, depending on their inclinations and personal goals. Industrial and research internships can also be taken for credit.

Graduates acquire individual, in-depth specialist skills from various flexibly selectable areas of food technology, which reflect a high degree of interdisciplinarity and allow them to develop an individual profile.

The elective area is divided into a **focus area**, a **profile area** and a **free choice area**.

The focus area consists of an elective catalogue closely related to the core competencies of the degree program. Graduates must earn a minimum of 20 CP from the focus area.

The profile area also consists of a predefined catalogue of options. It expands the range of options to include related disciplinary and interdisciplinary areas that serve to sharpen graduates' individual profiles. Research and industrial internships can also be included in the profile area. A total of between 0 and 30 CP can be earned in the profile area, whereby a maximum of 10 CP can be credited for an internship.

In the free choice area, students can choose courses from the entire program (subject-specific or interdisciplinary) from which they expect to acquire useful skills. The selection is only limited by the fact that a maximum of 10 CP can be taken as a free choice.

Students have the optional opportunity to gain their first industrial experience as part of creditable industrial internships. This gives them an initial insight into their chosen industrial sector, familiarizes them with characteristic working methods and enables them to link these with the content of their studies. As a result, they are later able to act on the labor market and can reflect on their own competence profile in the relevant fields of activity, continuously expand it and place the set work goals in a professional and socially meaningful context.

In optional university internships or seminars, which are often carried out in groups, students acquire the ability to solve problems in a team and acquire communication skills and team spirit. In common, frequently practiced learning groups, students motivate each other to complete examinations quickly and successfully. This enables them to recognize potential conflicts in a group, overcome them using suitable methods and thus develop a suitable solution process that leads to success. Thanks to the self-organized and individually selectable composition of the course, Master's graduates are able to assess their own weaknesses and strengths and learn to set themselves realistic work goals.

In addition to the above-mentioned elements firmly anchored in the degree program, which build and train skills such as commitment and a sense of responsibility, there is also the opportunity to gain extended experience within the framework of student activities (e.g. through activities in the student council, in the Weihenstephaner Industrierunde). Participation in TUM-wide associations and working groups can give students a broad view of interdisciplinary fields of interest.

6.5 Mobility Window

A mobility window was created in the 3rd semester of the degree program. This semester is characterized by an almost complete absence of compulsory courses. The majority of elective credits are taken here. These elective credits can also be earned by taking suitable courses at foreign universities. The compulsory module **Food Technology Seminar** to be completed in the 3rd semester can also be completed by taking an equivalent foreign course. However, if this is not possible, this coursework can also be completed without attendance at TUM, as this module is predominantly characterized by self-study.

6.6 Sample Study Plans

The general study program schedule over the standard period of study of 4 semesters is shown in **Figure 4**.

Figure 4: General study plan for the Master's degree program in Food Technology

Semester	Modules						CP/PL
1.	Automation and Control Engineering (required) 4 CP	In-depth chapters of food technology (required) 6 CP	Process Engineering (required) 9 CP	Elective module 1 5 CP	Elective module 2 6 CP		30/4
2.		Scientific Computing (required) 5 CP	Food Process Engineering (required) 7 CP	Elective module 3 5 CP	Elective module 4 5 CP	Elective module 5 4 CP	30/6
3.	Food Technology Seminar (required) 5 CP	Elective module 6 5 CP	Elective module 7 5 CP	Elective module 8 5 CP	Elective module 9 5 CP	Elective module 10 5 CP	30/6
4.	Master's Thesis 30 CP						30/1

Legend

- Dark blue = required module Master's thesis
- Grey = required modules
- Light blue = elective modules

CP = Credit Points, PL = Examination

The sample study plan (**Figure 5**) is one of the many options for students to put together their study plan.

Figure 5: Exemplary curriculum of the Master's degree program in Food Technology

Semester	Modules						CP/PL
1.	LS30006 Automation and Control Engineering (required) 4 CP	LS30012 Advanced Chapters in Food Technology (required) K 6 CP	LS30010 Process Technology (required) K 9 CP	WZ5281 Cereal Process Engineering (Choice - Focus) K 5 CP	WZ5063 Basics in Programming (Election - Profile) INSTRUCTOR 6 CP		30/4
2.		LS30007 Scientific Computing (required) K 5 CP	LS30015 Food Process Engineering (required) K 7 CP	LS30025 Practical Apparatus Engineering in Life Sciences: A Project in the Makerspace (Election - Profile) PA 5 CP	WZ5134 Process Simulation (Election Focus) K 5 CP	WZ5133 Sensory Analysis of Food (Option - Profile) K 4 CP	30/6
3.	LS30016 Food Technology Seminar (required) WA 5 CP	LS30020 Research Internship (Option - Profile) B 5 CP	WZ5088 Packaging Technology - Mechanical Processes (Choice - Focus) K 5 CP	LS30028 Marketing in the Consumer Goods Industry (Election profile) K 5 CP	WZ5005 Materials Engineering (choice - focus) K 5 CP	LS30029 Process Analysis and Digitalization (choice - focus) K 5 CP	30/6
4.	WZ5907 Master's Thesis W 30 CP						30/1
Legend	Dark blue = required module Master's thesis Grey = required modules Light blue = elective modules focus area optional modules			Green = Profile area Orange = optional module free choice area			SE = Seminar; CP = Credit Points; PL = Examination; SL = Study achievement; K = Written exam; LL = laboratory work; PA = project work; PRÄ = presentation; W = scientific paper

Due to the 50 CP available for electives, including a creditable internship, there are very diverse and flexible opportunities for students to specialize and take subjects from the focus, profile and the entire TUM catalogue, which cannot be listed here in full.

The catalogues are constantly updated and expanded. Current information is available online on the degree program website and in the module handbook. Further support with specific curriculum planning, the integration of industrial and research internships or a stay abroad is offered by the student advisory service.

7 Organization and Coordination

The Master's program Food Technology is offered by the TUM School of Life Sciences, the Department of Life Science Engineering at the Weihenstephan campus. Professors from all areas of the Department of Life Science Engineering are involved in teaching and supervising scientific work. In addition, modules in elective areas are offered and supported by the **School of Engineering and Design** at the Garching Campus and the **School of Management**, Munich Campus.

Student advising is provided by the Campus Office in cooperation with the Chair of General Food Technology.

The following administrative tasks are performed partly by the TUM Center for Study and Teaching (TUM CST) and its administrative units, partly by offices in the schools or departments:

- Student Advising: Student Advising and Information Services (TUM CST)
studium@tum.de
 +49 (0)89 289 22245
 Provides information and advising for prospective and current students (via Hotline/Service Desk)
- Departmental Student Advising: Team Student Advising
brewing-foodtec.co@ls.tum.de
 +49 (0)8161 71 6515
- Academic Programs Office (within department/school), Infopoint, etc: Campus Office Weihenstephan
campus.office@ls.tum.de
- Study Abroad Advising/ Internationalization: TUM-wide: TUM Global & Alumni Office
internationalcenter@tum.de
 Departmental: Student Advising Team
international.co@ls.tum.de
- Gender Equality Officer: Prof Aphrodite Kapurniotu
akapurniotu@mytum.de
- Advising – Barrier-Free Education: TUM-wide: Service Office for Disabled and Chronically Ill Students (TUM CST),
handicap@zv.tum.de
 +49 (0)89 289 22737
- Admissions and Enrollment: Admissions and Enrollment (TUM CST)
studium@tum.de
 +49 (0)89 289 22245
 Admissions, enrollment, Student Card, leave of absence, student fees payment, withdrawal

- Aptitude Assessment (EV) TUM-wide: Admissions and Enrollment (TUM CST)
 Departmental: Student Advisory Service Team
 Dr Sabine Köhler
application.co@ls.tum.de
 +49 (0)8161 71 3336
- Semester Fees and Scholarships: Fees and Scholarships (TUM CST)
beitragsmanagement@zv.tum.de
- Examination Office: TUM-wide: Central Examination Office (TUM CST)
 Departmental: Team Examination
 Campus Office Weihenstephan
campus.office@ls.tum.de
- Departmental Examination Office: TUM School of Life Sciences;
 Campus Office Weihenstephan
 Team Examination Matters
examination.co@ls.tum.de
- Examination Board: Prof. Dr.-Ing. Heiko Briesen (Chairman)
 Eva Guyot (Secretary)
- Quality Management –
 Academic and Student Affairs: TUM-wide: Studies and Teaching -
 Quality Management (TUM CST)
www.lehren.tum.de/startseite/team-hrs/
 Departmental: Team Quality Management
qm.co@ls.tum.de Campus Office Weihenstephan
- Internship: Advising in all matters relating to study practice
 and internship semester
<https://www.praktikantenamt-weihenstephan.de/>
 +49 (0)8161 / 71 3710

8 Enhancement Measures

In order to standardize the name of the Bachelor's degree program, it was changed to "Food Technology" (previously "Technology and Biotechnology of Food").

A structural standardization was achieved with regard to process engineering training. All degree programs included in the study program bundle (Food Technology, Brewing and Beverage Technology, Pharmaceutical Bioprocess Technology) include an overarching basic education oriented towards basic process engineering operations, which is complemented by a clear subject-specific education (here: module "Food Process Engineering"). In terms of content, this already existed before, but was reflected differently in the various degree programs with regard to the titles of the modules.

In the methodological competences, structural homogeneity was achieved across the degree programs related to food technology in the degree program bundle. All degree programs in the degree program bundle now jointly take the modules in the specialization area of digitalization (see section 6.2).

The transfer of certain essential content to the Master's program had become necessary due to previous changes that had already been implemented in the Bachelor's program. This had already been taken into consideration when planning the previous Bachelor's conversion. Specifically, the two central modules "Process Engineering" and "Process Automation and Control Engineering" were transferred to the Master's program with adapted depth. Regardless of the necessity of the shift in terms of the timetable, positioning the two subject areas in the Master's program is also expedient in terms of their complexity.

In order to create greater freedom of choice for students to create their own profile despite these additional modules, the other required content has been strongly prioritized towards the core competencies. For example, the modules "Rheology" and "Simulation of Production Systems" are no longer required. These modules, which continue to offer a particularly suitable skill set for the degree program, have instead been incorporated into the focus elective area (see section 6.4. for a distinction between the various elective areas). The obligation to complete industrial placements has also been uniformly waived in all degree programs of the degree program bundle. However, industrial placements can still be included as elective modules according to the students' inclinations. Other subject-specific content that was previously taught in separate modules (Food Bioprocess Technology, Innovative Food Concepts, Micro-Macro Structures in Food) has been partially integrated into the modules "In-depth Chapters of Food Technology" or "Food Process Engineering" in order to maintain the teaching of the respective core competences in these areas. The required module "Physical Chemistry" was discontinued, as it was determined after analysis that the knowledge required for the overall acquisition of skills for the degree program had already been acquired in the Thermodynamics module in the Bachelor's degree program.

All of these interventions have led to students being given significantly more options for organizing their own individual studies. It should be particularly emphasized that the prioritization has made it possible to create a mobility window in the third semester.