



# UNIVERSITÀ DEGLI STUDI DI PALERMO

<b>DEPARTMENT</b>	Scienze Agrarie, Alimentari e Forestali
<b>ACADEMIC YEAR</b>	2019/2020
<b>BACHELOR'S DEGREE (BSC)</b>	AGRIFOOD SCIENCES AND TECHNOLOGIES
<b>SUBJECT</b>	BIOMATERIALS FOR FOOD PACKAGING
<b>TYPE OF EDUCATIONAL ACTIVITY</b>	B
<b>AMBIT</b>	50129-Discipline della sicurezza e della valutazione degli alimenti
<b>CODE</b>	18502
<b>SCIENTIFIC SECTOR(S)</b>	ING-IND/22
<b>HEAD PROFESSOR(S)</b>	BOTTA LUIGI                      Professore Associato                      Univ. di PALERMO
<b>OTHER PROFESSOR(S)</b>	
<b>CREDITS</b>	6
<b>INDIVIDUAL STUDY (Hrs)</b>	90
<b>COURSE ACTIVITY (Hrs)</b>	60
<b>PROPAEDEUTICAL SUBJECTS</b>	
<b>MUTUALIZATION</b>	
<b>YEAR</b>	3
<b>TERM (SEMESTER)</b>	1° semester
<b>ATTENDANCE</b>	Not mandatory
<b>EVALUATION</b>	Out of 30
<b>TEACHER OFFICE HOURS</b>	<b>BOTTA LUIGI</b> Monday    15:00    17:00    Ufficio (Ed. 6, terzo piano) Thursday   15:00    17:00    Ufficio (Ed. 6, terzo piano)

DOCENTE: Prof. LUIGI BOTTA

<b>PREREQUISITES</b>	In order to understand the topics and to easily achieve the learning goals of the teaching course, the student must be confident with the following subjects: Physics and Mathematics; General chemistry; Organic chemistry.
<b>LEARNING OUTCOMES</b>	<p>Knowledge and understanding: The student, at the end of the teaching course, will know the main classes of biomaterials compatible with the food packaging. The student will have full knowledge of biodegradable and non-biodegradable materials, obtained by renewable sources and by biological origin. The student will also be able to program the main processing methods and chemical-physical characterizations.</p> <p>Applying knowledge and understanding: The student will be able to choose the most suitable biomaterials and appropriate packaging systems for each type of food product, depending on the specific characteristics of the product and of its shelf life.</p> <p>Making judgements: After completing the teaching course, the student will be able to critically evaluate the suitability of a biomaterial for food packaging applications. Moreover, the student will be able to choose sustainable packaging, taking into account the environmental impact and the cost-benefit analysis.</p> <p>Communication: The student will acquire the capability to communicate and express problems inherent the course topics. The student will be able to highlight questions related to the preparation and processing of different biomaterials, exposing the information in an adequate technical language. The student will also be able to expose the results of a scientific research, to propose suitable biomaterials and packaging systems and to explain eventual project plans connected with them.</p> <p>Lifelong learning skills: At the end of the course, the student will have learnt how to choose the most suitable biomaterial for the packaging of a specific food product, by evaluating properties and functions. The learned skills in this course will allow to have the awareness to be able to make supported choices when realizing potential projects.</p>
<b>ASSESSMENT METHODS</b>	<p>The evaluation will be based on an oral examination that consists in at least three questions on topics described during the teaching classes. It aims to assess the competences and the knowledge learnt during the course. The questions will verify: acquired knowledge; elaboration capability; talking capability; ability to build autonomous connections not bound to the referring textbooks; capability to produce autonomous evaluations inherent the course topics; capability to understand the applications connected with the discipline areas; capability to connect the discipline topics with the referring professional and technological context.</p> <p>The final assessment is on a 30 basis according to the criteria reported below: 30-30+: excellent knowledge of the topics, excellent language and vocabulary, good analytical capability, the student is able to apply knowledge to solve the proposed problems 26-29: Good management of the topics, nice language and vocabulary, the student is able to apply knowledge to solve the proposed problems 24-25: basic knowledge of the topics, fair language and vocabulary, limited capability to apply autonomously knowledge to solve the proposed problems 21-23: the student does not show full management of the main topics while possessing the knowledge, satisfactorily language and vocabulary, poor capability to apply autonomously the acquired knowledge 18-20: minimal basic knowledge of the main topics and of the technical language and vocabulary, poor or no capability to apply autonomously the acquired knowledge.</p> <p>The exam will be not passed if the student will show a not acceptable knowledge of the topics.</p>
<b>EDUCATIONAL OBJECTIVES</b>	<p>The aim of the course is to provide a multidisciplinary approach to the knowledge of biomaterials and of packaging systems for food products, in order to fully understand all the problems regarding the food packaging and design the best solutions in accordance with current standards, benefit-cost ratio and a sustainable development.</p> <p>In the first part of the course, it will be provided the rudiments of material science and technology, which are required to describe physical and chemical properties of biomaterials and the related packaging systems. Thereafter, it will be studied the issues and the technologies for processing biomaterials and manufacturing biomaterial based packaging. Finally, it will be studied the food packaging technology aimed for extending the shelf life of packaged food products.</p>
<b>TEACHING METHODS</b>	Lectures and laboratory.
<b>SUGGESTED BIBLIOGRAPHY</b>	<ul style="list-style-type: none"><li>- E. Chiellini editor. "Environmentally Compatible Food Packaging". Woodhead Publishing Limited, Cambridge (2008).</li><li>- L. Piergiovanni, S. Limbo. "Food packaging. Materiali, tecnologie e qualità degli alimenti". Springer-Verlag Italia (2010).</li><li>- R. Coles, D. McDowell. M. Kirwan, editors. "Food Packaging Technology".</li></ul>

**SYLLABUS**

<b>Hrs</b>	<b>Frontal teaching</b>
2	Introduction. Terminology. Goals and characteristics of food packaging. Food packaging statistics.
4	Chemical properties of food packaging materials. Chemical structure of materials. Biodegradability.
6	Physical properties of food packaging materials. Surface properties. Thermal properties. Mechanical properties. Electromagnetic properties.
7	Barrier properties of food packaging materials. Gas and water vapour permeation. Migration from packaging to foods. Legislation on materials and articles intended to come into contact with food.
5	Paper and paperboard packaging. Cellulosic fibres. Corrugated cardboard. Coated cardboard. Pulp molded. Cellophane. Package types
14	Biopolymers and biopolymeric food packaging. Introduction to polymeric materials. Properties of biopolymers. Modification of biopolymers. Main biopolymer used for food packaging applications. Processing methods of biopolymers and manufacture of biopolymeric packaging.
3	Flexible multilayer food packaging. Manufacture of biopolymeric multilayer packaging. Liquid packaging cartons. Barrier properties of multilayer packaging.
4	Packaged product quality and shelf life. Factors affecting product quality and shelf life. Role of packaging.
3	Modified atmosphere packaging (MAP). Vacuum Packaging. Main gases used in MAP.
6	Active and smart biobased food packaging.
<b>Hrs</b>	<b>Workshops</b>
6	Extrusion and co-extrusion. Film blowing. Mechanical tests.