

**CENTER FOR INTERNATIONAL PROGRAMS**

**COURSE NAME:** Biology of edible insects: A sustainable food source

**COURSE CODE:** ENV 3050

**TOTAL CONTACT HOURS:** 60

**INSTRUCTOR:** Dr. Francisco Gonzalez

**COURSE DESCRIPTION**

This entomology course explores the use of insects as food sources for human and animal feeding. In an era of a food crisis, climate change, habitat loss, air pollution and so many environmental problems, the look for more sustainable solutions is pushing to look back into ancient traditions, technical strategies and the scientific integration of both to supply the nutritional needs for human development. One of these possible solutions is the use of insects as food sources. Entomophagy is the practice of consuming edible insects. Latin America, South Asia, and African countries have engaged on entomophagy since ancient times. However, this is a disappearing practice. This course is theoretical and practical look at the origins of entomophagy, its current state and how to use it for a sustainable future. This course will be based on the study of multimedia, literature, visits and practical contact with edible insects whenever possible. Therefore, this course is aimed at any professional with an interesting sustainability, gastronomy, anthropology, and biology.

This is a course of Environmental Sciences (theoretical and practical) and answers the following question:

**How can entomophagy solve worlds feeding needs?**

To answer this question the following aspects will be studied:

- Basic concepts of insect biology
- The story of entomophagy
- World hunger and the importance of entomophagy
- Current state of entomophagy
- Main edible insects
- Edible insects gastronomy
- Insect nutritional values
- Insect derived products
- Food technology applied to edible insects
- Edible insects and health risks
- Public acceptance and marketing
- Business models based on entomophagy

Along the course the following abilities and skills will be promoted:

- Analyze the historical perspectives of edible insects
- Understanding of the context, reasons and motivations for rescue of entomophagy
- Creativity for gastronomy
- Development of strategical thinking sensitive for sustainable development.

The following values and attitudes will be promoted in the students:

- Respect for the environment and human groups (farmers, aboriginal people).
- Logical and critical thinking.
- Innovation in a tropical setting.
- Goal-oriented thinking.
- Team work and leadership.
- Empathy and sensitivity.

### Competencies, criteria and evidence

The following defines the competencies (specific and general), the criteria and the performance evidence for their evaluation in this course.

Competency type	Criteria	Performance evidence
<b>Specific</b>  Understands the concept of entomophagy and the need for its application for sustainable development, and at the same time can relate this knowledge with his/her future career.	He/she i can explain the concepts of entomophagy.	Mind Maps
	He/she is able to explain how entomophagy has evolved along the years at global and regional level.	Mind maps
	He/she distinguish the different controversies regarding eating insects	Round Table
	Identifies opportunities and threats related to entomophagy on his/her own profesional area as well as understanding the current state of several related areas.	Essay
	The students are able to propose and design a edible insect project and to test a prototype with available resources.	Project
<b>General</b>		
Integrate concepts, nomenclature and key elements from the course to be used in his/her upcoming professional life.	Learning to learn	Mind Maps / Round Table
Develops the skills and techniques to communicate and transfer knowledge through visual, oral and wrtitten forms.	Written, visual and oral communication.	Essay / Project
Incorporates and shares knowledge interpersonally to achieve a common goal through team work and leadership.	Team work and leadership.	Project
Integrates knowledge and logical thinking in a respectful way to review his/her own work and others.	Respect for others and empathy. Conflict solving. Sensitivity and assertive criticism. Logical thinking.	Round Table / Presentation Project

## Contents

### Subject 1. What is Entomophagy?

- Definition of entomophagy
- Edible insects in ancient societies
- Edible insects in modern times

### Subject 2. Edible insects as sustainability tool

- World food crisis
- Climate change and environmental concerns
- Edible insects impact in the environment
- Effects of entomophagy in pest control

### Subject 3. Rescue of entomophagy

- Edible insects in the European markets
- Edible insects in North America
- Edible insects South East Asia

### Subject 4. Principles of Insect Biology

- Insects anatomy
- Insects life cycles
- Insect orders
- Recognition of edible insects

### Subject 5. Main edible insects

- Most consumed insects
- Insect recipes and uses
- Processing of insects as food sources

### Subject 6. Insects and nutritional value

- Edible insects as sources of proteins
- Calculation of insect nutritional value
- Insect derived products

### Subject 7. Food technology and entomophagy

- Design of insect based products
- How to improve insect acceptance through technology?
- Analysis of edible insect products and companies

### Subject 8. Health risks

- Insect secondary metabolites
- Human allergies

### Subject 9. Edible insects as industries

- Edible insect mass production
- How to start an insect biofactory
- Derived industries
- Sustainable approach to bioprospecting

### Subject 10. Entomophagy challenges and the future

- Public acceptance and marketing of insect derived products.

## Methodology

This is a course of active interaction between the students and the professor, where knowledge is developed through the participation of both parts. Attendance is compulsory, although two unexcused absences are allowed.

Assistance to visits is compulsory. Emergency absence will be excused when proper documentation is provided.

This course utilizes the PBL (problem-based learning) and the TBL (team-based learning) as educational strategies. This means that students are expected to solve research questions individually and in groups through the different activities planned by the professor. Additionally, students will learn and perform critical analysis of their own as well as others work.

### **Performance activities**

The following activities will be used as evaluating evidence of student performance :

- Mind Maps: the students will prepare, summarize, extract and present the most important aspects related to the subject assigned.
- Round Tables: the students will prepare arguments and questions to participate in each one of subjects designated as controversial presenting different aspects of the same subject.
- Essay: each student will correlate the acquired knowledge with his or her own studies and predict applications on their professional careers.
- Project: students will analyze, gather literature, consult experts, prepare and present a project proposal. In parallel, they will study the assignment of other students of the class and prepare to be their reviewers during the final presentation date.

### **Educational Resources**

Lessons will take place in a laboratory/classroom with the essential equipment for teaching and learning of this subject. There is going to be a visit to an edible insects production laboratory. Visits will also include most of the essential elements for learning. Reading material will be provided by the professor and the university. In case of other needed literature the student will have the availability of the university library to check books and online resources.

### **Evaluation**

The evaluation of the course will be based on the performance evidence (items) produced by the student and the examination by the teacher using the criteria mentioned above. The following shows the details of each one.

The following extends on the evaluation criteria of each part:

**Mind Maps**

This strategy helps to learn, summarize, code, organize, memorize, analyze and discriminate among the different aspects of new knowledge. Mind maps will be produced in small groups and will be presented to the class. This activity will take place twice and the subjects will be given by the teacher. Each mind map will have a value of 10% and the evaluation criteria will be the following:

Items	Percentage
Mind Maps	20%
Round Tables	10%
Essay	10%
Class assignments and participation	30%
Project	30%
TOTAL	100%

Indicator	Excellent (100-90%)	Very Good (89%-80%)	Good enough (79%-70%)	Insufficient (69% o menos)
The main idea and concepts are represented by clear images and relations Value 3	The full image is direct, relevant and unambiguously represent the main idea and concepts	The full image is close to represent the main idea and concepts	The full image contains related concepts but their relation is not clear	The full image does not represent the assigned main idea and concepts

Starts from the centre and then irradiates the concepts and ideas related to the main subject Value 2	Full agreement with the indicator	Follows the idea of the indicator but some sides are not evenly distributed	The main idea is not in the centre, but some other ideas are properly distributed	The main idea is not centred and the others are not properly distributed
There is a clear hierarchical organization of the ideas and concepts Value 1	Full agreement with the indicator	Most of parts follow a clear hierarchy	At some parts the hierarchy is not clear	The hierarchy is not properly used
Uses lines, arrows, icons, images or any others to differentiate and clarify different categories and to form relationships among ideas Value 2	Full agreement with the indicator	Most of visual aids are properly used and transfer a sense of organization	Some of the visual aids cause confusion or are not used properly	The visual aids cause confusion and are not used properly making the map unintelligible
The quality of the final map is of the best standards: visually attractive, with no spelling mistakes, organized and clear Value 2	Full agreement with the indicator	Design and contents are attractive but there are spelling mistakes	Design and contents are not in their best form, there are multiple spelling mistakes, unknown acronyms and instead looks like a draft	Design and contents are not inviting at all and there are multiple spelling mistakes, acronyms and others that are unintelligible

### **Round Tables**

This strategy promotes research techniques, logical and critical thinking and oral transfer of knowledge among peers. There will be three round tables that will allow students to comprehend and to participate in the discussion of controversial subjects related to entomophagy. The week previous to the session, the teacher will provide basic literature for the students to prepare, but each group is responsible to extend in the knowledge for better performance during the round table. Each round table session will have a value of 10% and the evaluation criteria will be the following:

<b>Indicator</b>	<b>Excellent (100-90%)</b>	<b>Very Good (89%-80%)</b>	<b>Good enough (79%-70%)</b>	<b>Insufficient (69% o menos)</b>
The students read the literature and further read other associated literature that they found	The student has a clear knowledge of what scientific literature has to say about the subject	The student has a wide knowledge of the assigned literature and	The student read the assigned literature but	The student did not read any material for the round table

Value 3	(assigned and self-found)	some other references	did not look for anything else	
All the students of the group have discussed the subject and know the most important aspects of their participation in the round table Value 2	Full agreement with the indicator	Most of students discussed the subject and know the main points of their participation in the round table	Students read the literature but did not discuss among them the participation in the round table	The students did not read and did not discuss the subject
Students have prepared appropriate questions for other groups and are able to argue against or in favour of each position Value 5	Students respectfully and critically formulated questions to discuss with other groups and are able to formulate positions about the subjects	Students have prepared questions for others and can defend their own positions	Students have prepared questions but are not able to defend a position	Students did not prepare for the questions round.

### Essay

This assignment aims to make students reflect, integrate and think logically of the relevance of the course in respect to their own professional careers. This essay will be individual and will have a value of 10% of the final mark. The criteria will be evaluated as follows:

Indicator	Excellent (100-90%)	Very Good (89%-80%)	Good enough (79%-70%)	Insufficient (69% o menos)
The essay includes 10-12 pages that contain: cover page (1 page), introduction (1 page) essay body (7-9 pages), conclusions (1 page) and references (as many pages as needed)	The essay fully includes all the necessary parts	All the most relevant information is included	Some less important information (such as some references) might be missing	Any fundamental part is missing

Value 1				
The introduction clearly states the main facts of the background, the research question that the essay aims to answer and the objectives of the essay Value 2	Full agreement with the indicator	Some aspects of the background and research questions are not completely clear at the beginning	Although the background is not so clear, the main question and objectives are clear	The background, research question and objectives are not clear
The essay follows a logical order with interconnected ideas that respond to the objectives of the essay Value 5	Full agreement with the indicator	Most of parts follow a clear hierarchy	At some parts the hierarchy is not clear	The hierarchy is not properly used
There is a clear argumentative input that correlates literature, theory and the personal learning experience of the student Value 5	Full agreement with the indicator, the student manifests an opinion based on literature and own observations whenever possible	The student the student manifests an opinion based on literature and own observations in some particular cases	There is some input of personal opinion at some level	There is not personal argumentative opinion or the opinion does not have a verifiable base
Grammar and spelling follow high standards Value 2	Full agreement with the indicator	There are some grammatical or spelling mistakes	There are multiple grammatical and spelling mistakes	There are many grammatical and spelling mistakes that make reading difficult
Conclusions are fact-based, clear and reflect the opinion, findings and position of the author Value 5	Full agreement with the indicator	Conclusions reflect at some degree authors opinion in the light of the findings	Conclusions are fact based but do not state the opinion of the author	Conclusions do not indicated the opinion of the author and are not logical from the findings of the essay



References are properly cited (APA format) and all references are from verifiable, serious sources (preferably scientific journals, books, avoiding websites) Value 3	References are properly cited on text, properly described in the references section and all sources are from scientific sources (natural and social sciences books and journals)	Most of references are properly cited and obtained from scientific sources	At least the most important sources in which the essay is based on are properly cited and obtained from scientific sources	The student based his/her essay in a non-scientific reference and/or did not follow the citation format (APA)
The essay follows the following specifications: Font Arial 10, 1.5 spacing, titles and subtitles properly categorized following a logical order (bold, capital letters, italics, etc.), scientific names are italics, figures and tables properly presented Value 2	Full agreement with the indicator	There are a few of format changes but do not compromise the understanding of the document	Some changes in the format compromise the understanding of the document	The student did not follow the recommendations of format

### **Project**

This assignment aims to familiarize students with real-life cases of an entomophagy project. At the same time, it promotes cooperative work and constructive criticism. To do this, the students will pick a model insect, take notes along the course of different elements that they can use to come up with a sustainable solution / project that will be presented in a report and an oral presentation to the rest of the class. This is a team-based project and will have a value of 30%. It will be evaluated as follows:

<b>Indicator</b>	<b>Excellent (100-90%)</b>	<b>Very Good (89%-80%)</b>	<b>Good enough (79%-70%)</b>	<b>Insufficient (69% or less)</b>
The report includes: cover page (1 page), introduction (1 page), methodology (1-2 pages), recommendations (1-5 pages), supporting information and references (as many pages as needed) Value 1	The report fully includes all the necessary parts	All the most relevant information is included	Some less important information (such as some references) might be missing	Any fundamental part is missing

<p>The introduction clearly states the main facts of the background and the main problem to solve</p> <p>Value 2</p>	<p>Full agreement with the indicator</p>	<p>Some aspects of the background and the main problem to solve are not completely clear at the beginning</p>	<p>Although the background is not so clear, the main question and objectives are clear</p>	<p>The background, and the main problem to solve are not clear</p>
<p>The methodology states clearly what was the strategy followed to find solutions to this problem</p> <p>Value 5</p>	<p>The methodology details all the resources used to come up with solutions (experst consulted, literature, data bases, online tools, etc.)</p>	<p>The methodology is detailed in some aspects but not in others</p>	<p>The methodology at least mentions (with no details) the main sources used to come up with solutions</p>	<p>The methodology does not state the sources for the solutions proposed</p>
<p>The recommendations are realistic, ready to implement, detailed but explicit, are based on scientific sources and demonstrate analysis, discussions and extensive use of the available resources</p> <p>Value 5</p>	<p>Full agreement with the indicator</p>	<p>Most of recommendations are explicit and ready to implement with verified scientific sources</p>	<p>Some recommendations are not clear, realistic or ready to implement, but most are based on scientific sources</p>	<p>The recommendations are not relevant or based on scientific sources</p>
<p>Grammar and spelling follow high standards</p> <p>Value 2</p>	<p>Full agreement with the indicator</p>	<p>There are some grammatical or spelling mistakes</p>	<p>There are multiple grammatical and spelling mistakes</p>	<p>There are many grammatical and spelling mistakes that make reading difficult</p>
<p>Supporting information provides all the necessary data for the client to proceed. For example, if microorganisms, genes or tools are recommended, the most important information must be provided in this section (sequences, similar studies, specific protocols, etc)</p> <p>Value 5</p>	<p>Full agreement with the indicator, all the recommendations are supported with a wide range of supporting data</p>	<p>Supporting information is extensive in the most important recommendations</p>	<p>There is some relevant supporting information</p>	<p>There is not supporting information</p>

References are properly cited (APA format) and all references are from verifiable, serious sources (preferably scientific journals, books, avoiding websites) Value 3	References are properly cited on text, properly described in the references part and all sources are from scientific sources (natural and social sciences books and journals)	Most of references are properly cited and obtained from scientific sources	At least the most important sources in which the essay is based on are properly cited and obtained from scientific sources	The student based his/her essay in a non-scientific reference and/or did not follow the citation format (APA)
The project report uses the following specifications: Font Arial 10, 1.5 spacing, titles and subtitles properly categorized following a logical order (bold, capital letters, italics, etc.), scientific names are italics, figures and tables properly presented Value 2	Full agreement with the indicator	There are a few of format changes but do not compromise the understanding of the document	Some changes in the format compromise the understanding of the document	The student did not follow the recommendations of format
The students are able to confidently present their recommendations for an edible insect project, including background, main problem to solve, their methodology to find answers and the recommendations, as well as being able to review the research assignment of another group of students Value 5	All the students are able to properly show and defend all the parts of their assignment in a talk, and at the same time to evaluate, review and give feedback to another group	Students can show and defend their assignment, but are not properly evaluating the research of the classmates, or the other way around	Students can barely show and defend the logic behind their research and can barely evaluate others	Students cannot properly defend their research or evaluate others

### Bibliography:

Ramos Y, J. (2009). Anthro-entomophagy: Cultures, evolution and sustainability. *Entomological Research*, 39(5), 271-288.

Shelomi, M. (2015). Why we still don't eat insects: Assessing entomophagy promotion through a diffusion of innovations framework. *Trends in food science & technology*, 45(2), 311-318.

House, J. (2016). Consumer acceptance of insect-based foods in the Netherlands: academic and commercial implications. *Appetite*, 107, 47-58.