Phytochemical Analysis (4th Year-2nd Semester) (1201427)

<table>
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<tr>
<th>Credit hours</th>
<th>2</th>
<th>Level</th>
<th>4th year</th>
<th>Pre-requisite</th>
<th>1201425 + 1201315</th>
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</thead>
<tbody>
<tr>
<td>Coordinator/ Lecturer</td>
<td>Prof. Mohammad Hudaib (Coordinator)</td>
<td>Office number</td>
<td>316 A</td>
<td>Office phone</td>
<td>23303</td>
</tr>
<tr>
<td>Course website</td>
<td><a href="http://www2.ju.edu.jo/sites/academic/m.hudaib/default.aspx">http://www2.ju.edu.jo/sites/academic/m.hudaib/default.aspx</a></td>
<td>E-mail</td>
<td><a href="mailto:m.hudaib@ju.edu.jo">m.hudaib@ju.edu.jo</a></td>
<td>Place</td>
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**Course Description**

The course provides student with basic information on analytical and instrumental methodologies used in plant sciences and natural products investigations; in particular their use in herbal drugs identification and evaluation. This encompasses methods and techniques relevant to the extraction, separation, purification, identification and evaluation (qualitative and quantitative) of natural products and their derived substances and secondary metabolites such as alkaloids, phenols, terpenoids as well as products of primary metabolism (e.g. sugars, fatty and amino acids). Will be also covered topics related to analysis of plant-derived extracts and plant products used as food, pharmaceutical, and/or medicinal substances, where emphasis will be placed upon chemical, spectroscopic and chromatographic evaluation. Methods of analysis used to evaluate selected herbal drugs approved and included in herbal pharmacopoeias and compendial sources will be given and discussed. The student will also realize the importance of chromatography in natural product analysis; in drug discovery, drug identification and characterization. The proper selection of the best chromatographic technique and conditions to resolve certain separation problems will be covered and discussed. The course will also include some examples of common and recent applications of liquid and gas chromatography in phytoanalysis.
Learning Objectives
1. Understanding the definition, basics and types of analytical and instrumental methodologies used in plant analysis and natural products investigations.
2. Understanding the strategies used for proper selection of active plant candidates for plant-based drug discovery.
3. Recognizing the different methods and techniques of herbal sample preparation, extraction, separation, purification, identification and evaluation (qualitative and quantitative) and the suitability of each technique to a particular phytochemical group or natural material.
4. Recognizing the necessity and the methodologies of natural products standardization; marker definition and types, and their implementations in herbal drug analysis.
5. Recognizing the variables of chromatographic process and the best way and conditions to conduct in order to achieve the best results.
6. To get familiar with some common and specialized chromatographic techniques (e.g. hyphenated systems), methods, and official applications like pharmacopoeial herbal drug analysis (identification, assay, related substances, etc.).

Intended Learning Outcomes (ILOs):
Successful completion of the course should lead to the following outcomes:

A. Knowledge and Understanding: Student is expected to
A1. Acquaint the appropriate knowledge about approaches and strategies applied for proper selection of active plant candidates for plant-based drug discovery.
A2. Understanding the entire drug discovery approach, from plant selection to drug development the every stage of it and the type of knowledge and expertise needed for successful conduction.
A3. Acquaint knowledge of the science of separation and its roles in pharmacy and medicine.
A4. Understand the principles, basics and variables of extraction processes.
A5. Understand the principles, basics, variables and types of chromatography and its various techniques.

B. Intellectual Analytical and Cognitive Skills: Student is expected to
B1. Recognize the strategies applied for appropriate selection of potentially active plant candidate.
B2. Recognize the correlation between chemistry (physicochemical properties) of natural drug constituents and the appropriate phyto-analytical method.
B3. Recognize the types, process details and variables, and applications of extraction methods and the appropriate method selection for a particular type of phytochemical group.
B4. Recognize the concept and the know-how of herbal drug standardization.
B5. Recognize the context and importance of herbal drug standardization, method validation, official requirements, methodology and conduction.

C. Subject-Specific Skills: Student is expected to
C1. Be able to conduct some common medicinal plant selection approaches, in particular the ethnopharmacological surveys and analysis of collected data to get some important parameters like ICF (informant consensus factor) and PUV (plant use value).
C2. Be able to select and conduct the best appropriate extraction method and procedures for a particular phytochemical group – containing natural herbal material.
C3. Be able to develop, conduct and evaluate the appropriate chromatographic techniques selected for analytical - qualitative and quantitative –evaluation of pharmaceutical herbal finished product or crude natural drug material.

C4. Be able to apply the different official and non-official chromatographic methods for purpose of natural drug identification and assay, and to write the appropriate reports of the final results.

C5. Make standardization of and validation for analytical and chromatographic methods applied in pharmaceutical phyto-analysis.

D. Transferable Key Skills: Students is expected to

D1. Work in a team as a work-group and discuss results with other colleagues.

D2. Know how to conduct literature survey and to get the required information about for example chromatographic processes, analytical methods, problem solving and trouble shooting; as well as how to use the collected data, of others’ research, to prepare a scientific report.

ILOs: Learning and Evaluation Methods

<table>
<thead>
<tr>
<th>ILO/s</th>
<th>Learning Methods</th>
<th>Evaluation Methods</th>
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<tbody>
<tr>
<td>A. Knowledge and Understanding</td>
<td>Lectures and Discussions</td>
<td>Exam and Quiz</td>
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<tr>
<td>B. Intellectual Analytical and Cognitive Skills</td>
<td>Lectures and Discussions</td>
<td>Exam, Quiz</td>
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<tr>
<td>C. Subject-Specific Skills</td>
<td>Lectures, Discussions, and Assignments</td>
<td>Exam, Quiz, and Assignments</td>
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<tr>
<td>D. Transferable Key Skills</td>
<td>Discussions, Assignments and Presentation</td>
<td>Quiz and Assignments</td>
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Course Contents

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<thead>
<tr>
<th>Content</th>
<th>Reference</th>
<th>Week</th>
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<tbody>
<tr>
<td>1. Plant Selection and Drug Discovery</td>
<td></td>
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<tr>
<td>a. Random selection</td>
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<td>b. Ethnopharmacology</td>
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<td>c. Chemotaxonomy</td>
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<tr>
<td>d. Geographical</td>
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<td>e. Computer-based selection methods</td>
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<td>f. Literature information selection technique (LIST)</td>
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<tr>
<td>2. Collection strategies and plant identification</td>
<td>1 &amp; 2</td>
<td>1-3</td>
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<td>3. Sample preparation (drying, garbling, powdering, etc..)</td>
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4. **Extraction of natural products**  
   a. Principles and Applications  
   b. Methods of extraction  
   c. Solvent extraction  
   d. SFE (types of super critical fluids, advantages, and applications)  
   e. Galenical preparations and other extraction methods  
   
   *Quiz 1 + Assignment*

5. **Quality control of herbal drugs: identification and characterization of main phytochemical groups by chemical and instrumental methods:**  
   a. Carbohydrates and lipid  
   b. Alkaloids  
   c. Terpenoids  
   d. Steroids and cardiac glycosides  
   e. Flavonoids and tannins  
   f. Quinones and Anthraquinones  
   
   *Midterm Exam*  
   ~9-10th week  
   (Faculty calendar)  

6. **a. Standardization of herbal drugs: Examples on compendial monographs for selected natural products and medicinal plants.**  
   b. Method Validation (Text and Methodology)  
   
   *Quiz 2 + Assignment*

7. **Separation Techniques and Chromatography (special emphasis on natural products analysis)**  
   a. Principles, Methodologies and Types  
   b. Chromatography  
      i. Principles, Methodologies, Classifications, and Types  
      ii. Quantitative and Qualitative Applications  
   
   *Final Exam*  
   16-17th week  
   (University calendar)  

**Projects and Assignments**  
Student should submit a report about specific topics, methods, techniques, and/or applications assigned to him/her during the course. He/She may be asked to present his/her report during lecture.
### Evaluation

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Point %</th>
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<tbody>
<tr>
<td>Midterm Exam</td>
<td>40</td>
<td>9-10&lt;sup&gt;th&lt;/sup&gt; week: Faculty calendar</td>
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<td>Quiz 1 + Assignment 1</td>
<td>5</td>
<td>~7&lt;sup&gt;th&lt;/sup&gt; Week</td>
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<tr>
<td>Quiz 2 + Assignment 2</td>
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<td>~11&lt;sup&gt;th&lt;/sup&gt; Week</td>
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<tr>
<td>Final Exam</td>
<td>50</td>
<td>16-17&lt;sup&gt;th&lt;/sup&gt; week: University calendar</td>
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</tbody>
</table>

### References:

1. Trease and Evan's Pharmacognosy (by W.C. Evans)

2. General references of Drug Discovery Approaches, e.g.:

3. General references of Phytochemical Analysis, e.g.:

4. General references of Instrumental and Chemical Analysis, e.g.:
   1. Principles of Instrumental analysis. *D. Skoog*
   2. Pharmaceutical Analysis. *K. Conners*
   3. Undergraduate instrumental analysis. *James W. Robinson*
   4. Pharmaceutical Analysis. *D. Watson*
   5. The Analysis of Drugs in Biological Fluids. *J. Chamberlain*
   6. BP, USP, EP

5. Herbal pharmacopoeias (e.g. GCE Monographs, WHO monographs, BHP, AHP)