

The School of Pharmacy
University of London

MSc in Pharmacognosy **Course Information 2008/9**

Part I

The Centre for Pharmacognosy & Phytotherapy Research

The MSc in Pharmacognosy course is based in the Centre for Pharmacognosy & Phytotherapy Research within the Department of Pharmaceutical & Biological Chemistry.

Course Director:

Professor Simon Gibbons
Room 247
T 020 7753 5913
F 020 7753 5909
E simon.gibbons@pharmacy.ac.uk

Academic Staff:

Professor Michael Heinrich	Head of Centre for Pharmacognosy & Phytotherapy
Professor Simon Gibbons	Professor of Phytochemistry
Dr Deniz Tasdemir	Senior Lecturer in Pharmacognosy and Natural Product Chemistry
Dr Jose Prieto	Lecturer in Pharmacognosy
Professor David Thurston	Head of Department & Head of CRUK Gene Targeted Drug Design Research Group
Professor Monique Simmonds	Head of Biological Interactions Group, Royal Botanic Gardens Kew
Professor Elizabeth Williamson	Head of Pharmacy Practice, Reading University
Professor Peter Houghton	Professor of Pharmacognosy, King's College London
Dr Mike Munday	Academic Director of Studies and Senior Lecturer
Professor Alex Thompson	Head of the Department of Pharmacology
Dr Andy Constanti	Reader in Pharmacology
Dr Brian Pearce	Senior Lecturer in Pharmacology
Dr Rebecca Lever	Senior Lecturer in Pharmacology
Dr Werner Knöss	Head of Department, Federal Institute for Drugs and Medical Devices, Germany

Dr Linda Anderson	Principal Pharmacist, Medicines and Healthcare Regulatory Authority (MHRA)
Dr Colin Wright	Reader in Pharmacognosy, Bradford University
Professor Tony Moffat	Emeritus Professor
Professor Klara Valko	Senior Investigator, GlaxoSmithKline
Dr Min Yang	Lecturer in Pharmaceutical & Biological Chemistry
Dr Mire Zloh	Lecturer in Structural Chemistry
Dr Roger Jee	Senior Lecturer in Pharmaceutical Analysis
Dr John Malkinson	Lecturer in Pharmaceutical Sciences
Dr Robert Watt	Senior Lecturer in Pharmaceutical Analysis
Dr Rosemary Smyth	Teaching and Research Assistant

The MSc in Pharmacognosy Course

The MSc in Pharmacognosy is a 12 month full-time taught postgraduate course intended for those who wish to prepare for PhD-level research in natural product science or to pursue a career in the phytopharmaceutical industry or a government regulatory body. The course provides a broad overview of natural product science, the impact of natural products as medicines, their analysis and their place in various societies.

Specifically the course will cover herbal medicines in healthcare, their safety and efficacy and with examples of natural products as medicines. There will also be lectures on the analysis of natural products and their place in the drug discovery process.

A visit to an industrial manufacturer of herbal medicinal products will also take place. The second semester will cover the Pharmacognosy discipline in further depth with lectures on the use of bioassays, physical methods for example structure elucidation of natural products, marine natural products and traditional systems of medicine.

Course Structure

The MSc is designed to give students a very broad overview of the place of natural products in society. It is the intention to prepare students wishing to pursue a research degree or a place in the developing global phytopharmaceutical industry. This will be met by lectures covering the newest developments in research and the legislation covering herbal medicinal products. All students will undertake a research project which will be either lab or literature based. In both cases the project will be interrogative and give students useful research skills and training.

Some lectures and seminars in the first semester are shared with the MSc in Drug Discovery and fourth year students on the Master of Pharmacy degree. This is because the material is highly relevant and pertinent to the Pharmacognosy course. The teaching in the second semester will be more specialised and there will be some teaching by experts from the Pharmacognosy discipline from the Royal Botanic Gardens, Kew, King's College London and the Universities of Bradford and Reading.

First Semester (September 2008 - January 2009)

The first semester comprises two taught core modules.

Module 1: Therapeutic Uses of Plants

Herbal Medicinal Products in Healthcare - Dr Jose Prieto

Herbal Medicinal Products (HMPs) are medicines in their own right, and patients often use them in combination with other therapies. New European directives have finally harmonised the registration and the quality and efficacy for these particular medicines, where the active principles are not a single chemical entity, but a complex mixture of compounds with intricate biological activities and chemical features. Pharmacists play a unique role in advising their customers about the benefits and risks of HMPs in healthcare. This lecture will focus on how to advise patients in Community Pharmacy. The students will become familiar with the standards of quality and efficacy of HMPs, their interaction with other drugs and their possible side effects. However, HMPs will still co-exist in Community Pharmacies with unlicensed herbal remedies and food supplements, so the quality, efficacy and limitations of these products will be also explained in this context.

Quality and Efficacy of Herbal Medicinal Products - Dr Jose Prieto

This lecture will focus on how to advise patients in Community Pharmacy on the use of the most important HMPs. The students will become familiar with the clinical evidence of efficacy of HMPs, their traditional and modern indications, the pharmacological basis of their efficacy, their interactions with other drugs and their possible side effects.

The Implications of the European Traditional Use Directive - Prof Knoess

Prof. W. Knoess is head of Special Therapeutics at the German Federal Agency for Medicines and Medical Devices, the largest European regulator in the field of herbal medicines, homeopathic preparations and other forms of pharmacognostically relevant products. He covers aspects of regulating herbal medicinal products in Europe, most notably as it relates to licensed medicines and those which are covered under the EU' Traditional Herbal Medicines Directive.

Quality of herbal medicinal products from a regulatory perspective - Dr Linda Anderson

Dr. Linda Anderson leads the MHRA's efforts in the field of herbal medicines and is an expert in the quality and safety of HMPs. She focuses on the quality and safety of herbal medical products in the UK and on measures to ensure that patients have access to such products

Traditional Chinese Medicine (TCM) – Dr Colin Wright

These lectures will cover the following topics and will serve as an introduction to the lectures given by Dr Wright in semester 2 on TCM:

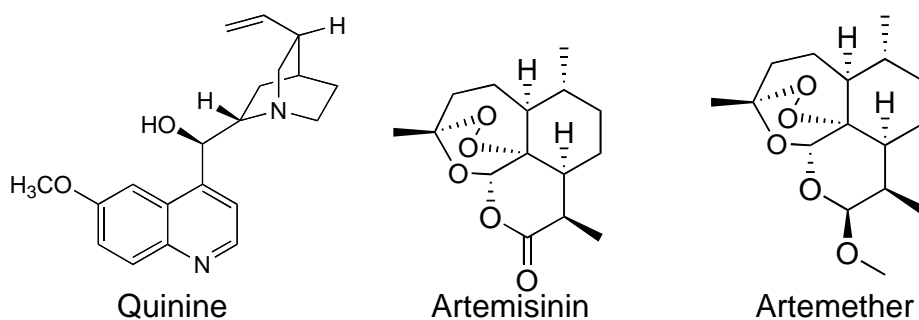
- A brief introduction to the principles and practice of Traditional Chinese Medicine
- Introduction to some commonly prescribed Chinese herbal drugs

Antiprotozoal Natural Products - Dr Deniz Tasdemir

Infectious parasitic diseases, such as malaria, trypanosomiasis and leishmaniasis still threaten the lives of millions of people in tropical and subtropical regions. The main goal of these lectures is to discuss the importance of natural products in antiprotozoal drug discovery and development. Not only in history, but also currently, natural products play an important role in the treatment of malaria, the most prevalent parasitic disease worldwide. Therefore, the emphasis will be on malaria and natural products, which have acted as antimalarials themselves, and served as template compounds for the design of semi-synthetic and synthetic antimalarial agents currently used in the clinic.

A short introduction on the most important protozoal diseases. Introduction on global malaria situation, life cycle of the malaria parasite, strategies to combat malaria, current malaria therapy regimes and the resistance issue.

Different classes of antimalarial natural products with different origin (plants, marine organisms, bacteria) e.g. alkaloids (quinine, marine manzamines, and cryptolepines), terpenes (artemisinin, quassinoids), polyketides (peroxyplakoric acid type endoperoxides from marine sponge *Plakortis*) and phenolics (licochalcone A) will be delivered. The origin of these chemotherapeutics, mechanism of action (known and possible), therapeutic indices, the route of application, and side effects will be covered. Some of these compounds have also antitrypanosomal and/or antileishmanial effects, which will also be highlighted. A great emphasis will be given to quinine, which is still used as fast acting (i.v) antimalarial agent. Quinine has served as a lead compound for many synthetic antimalarials, e.g. chloroquine and mefloquine. Another blockbuster drug is artemisinin, which is described by WHO as the best drug ever discovered against malaria. The yearly consumption of artemisinin is about 30 tonnes, which is basically met by extraction from the Chinese plant *Artemisia annua*. The problems and the alternative methods for the supply issue of artemisinin will be discussed. Semisynthetic derivatives, such as artemether, arteether and artesunate have been developed to improve the drawbacks of artemisinin. OZ277, a synthetic drug, which was developed on the basis of artemisinin pharmacophore is also orally bioavailable and is currently in clinical trials.



Marine Natural Products as New Drug Leads - Dr Deniz Tasdemir

These lectures aim to highlight the impact of marine natural products in the past, current and future drug discovery and development studies carried out in both academia and industry. The very first marine natural products, spongouridine and spongothymidine were reported from the Caribbean sponge *Cryptotethia crypta* in the 1950s. These two compounds have served as drug templates for several synthetic antiviral agents, such as acyclovir (Zovirax) and AZT (anti-HIV), which are still widely used in the clinic. The *real* marine natural product chemistry studies started in the early 1970s, and the chemical novelty and bioactive potential of these metabolites have been realized rapidly. Currently there are more than 20 marine metabolites in clinical trials, and many more are in preclinical trials. Since marine natural products are generally very toxic, cancer has been the mainstream of marine chemistry research. These lectures will provide a general overview of marine chemistry. General features and the type of predominant chemical classes produced by a few important marine animal phyla, sponges, tunicates, corals will be discussed from an evolutionary point of view. Most importantly, it will highlight several marine natural products (or their semi-synthetic derivatives) that are currently in clinical trials.

Content:

- Introduction, advantages and the challenges in marine natural product chemistry. The supply issue and the possibilities to overcome this problem.
- Ethnopharmacological information on marine organisms, particularly the marine invertebrates.
- Important marine phyla and their chemical profiles
- Marine-originated natural products in clinical trials: the anticancer drugs, aplidin (PharmaMar), Yondelis (PharmaMar), HTI-286 (Wyeth Ayerst), Bryostatin 1 (GPC Biotech), discodermolide (Novartis); immune modulator KRN-7000 (Kirin Brewery Co); the analgesic Conotoxin MVIIA (Elan Pharmaceuticals), and the Alzheimer drug GTS-21 (Thaisho Pharmaceuticals). The origin of the metabolites, mechanism(s) of action, and current status in clinical trials (phase I, II, III) will be covered. Bryostatin 1 is a very good example to explain the supply issue and difficulties in determining the natural and biosynthetic origin of marine natural products. Bryostatin 1 is a macrocyclic lactone (polyketide) obtained originally from the bryozoan *Bugula neritina*. However, recent biogenetic studies indicate that not the bryozoan, but a symbiotic bacterium living inside of the bryozoan might be the producer. The early preclinical trials have been conducted on this compound obtained from wildly collected *B. neritina*. Since the bryozoan *Bugula neritina* is cultivable, the NCI-USA has invested \$1M for in-sea and on-land aquaculture of this animal. Finally, the necessary amounts for phase I and II clinical trials was met by chemical synthesis.

Plant Antiinfective Agents – Prof Simon Gibbons

These lectures will cover the commonly used herbal antiinfective agents such as Umckaloabo (*Pelargonium sidoides* and *Pelargonium reniforme*), Lemon balm (*Melissa officinalis*), Garlic (*Allium sativum*), Tea Tree (*Melaleuca alternifolia*), Bearberry (*Arctostaphylos uva-ursi*) and Cranberry (*Vaccinium macrocarpon*).

Additionally, promising single chemical entity antimicrobials will also be discussed and these will include certain flavonoids, acylphloroglucinols and polyacetylenic natural products. A seminar on the uses of plants as a source of new antibacterials and resistance modifying agents will also be given.

Methods in Natural Product Drug Discovery – Prof Simon Gibbons

These lectures will cover the methods used in the isolation and characterisation of biologically active compounds from natural sources. In detail these lectures will cover the following areas:

- Common phytochemical methods and bioassay guided isolation and in particular: extraction, separation methods (isolation) and structure elucidation
- Chemical diversity and its importance
- Industrial approach to natural drug discovery
- Assay (target) selection, project teams, dereplication
- Natural product libraries and new approaches
- Case studies – examples of drugs from natural sources
- Phytochemistry of herbal medicines

Anticancer Drugs from Plant and Microbial Sources – Prof Simon Gibbons

Plants and microbes continue to be the mainstay of cytotoxic drugs and somewhere between 60-80% of all therapeutically used anticancer drugs are derived from natural sources. Three areas in these lectures will be covered:

- Plants as a source of anticancer drugs. These will cover camptothecin and its analogues, taxanes, betulinic acid, podophyllotoxin derivatives and the vinca alkaloids.
- Anti-neoplastic drugs from microbial sources. Collection strategy, the anthracyclines, bleomycin and dactinomycin.
- Cancer chemopreventive agents. The distinction between cancer chemotherapy and cancer chemoprevention, examples of chemopreventive agents and the importance of antioxidants in food.

Ethnobotany and Ethnopharmacy – Prof Michael Heinrich and Prof Monique Simmonds

A number of these topics will be covered to include: complementary/alternative medicine, traditional medical systems, quality and safety of herbal medicinal products, and ethnobotany and drug development.

Core lectures and seminars will include

- Ethnobotany and ethnopharmacy
- Discussion Forum – Traditional Medicine in Health Care
- QC, standardisation, dosage forms, safety
- Traditional Chinese Medicine – quality control and phytochemical analysis

For example, various criteria are used to assess the quality of herbal medical products. Using the European Pharmacopoeia, methods used to assess the quality of HMPs are compared and examples include:

- Content of essential oil in fennel, cumin, anise, and star anise and methods to analyse this
- HPLC and TLC analysis of alkaloids in Datura, henbane and other Solanaceous drugs
- Microscopic characteristics of peppermint, sage, and thyme
- Differentiation of sennoside containing botanical drugs (senna, cascara, aloe and others) using TLC methods
- Standardisation of botanical drugs – special prerequisites based on the Eur. Pharmac.

Another core topic will be plants used in indigenous societies. The interest in ethnopharmacological research has had a checkered history. Large drug companies had a considerable interest in this process during the 1990s but have moved to other groups of compounds in the first years of the new millennium. Examples used include galanthamine from snowdrop, an important Alzheimer's medication. Recently, renewed interest in natural products and their sources has become apparent. As well as from technological improvements, modern laboratory techniques, and enhanced understanding of pharmacological targets, the impetus has also come from continual deforestation. Recent studies and publications on ethnopharmacology have stimulated many lines of interdisciplinary research and core outcomes of this discussion are used to highlight the complex process of drug development.

Module 2: Pharmaceutical Analysis

This module will cover certain elements of the drug discovery and development process. It introduces the basis of the pharmaceutical industry through examining previous successes and current methods of drug discovery. This material will be taken jointly with the MSc in Drug Discovery students but only selected lectures which are directly relevant to Pharmacognosy will be taken. Specifically these will include:

Introduction to Drug Targets and the Molecular Basis of Disease - Dr Mike Munday

Provides a revision of basic macromolecular structure and the types of cellular

components that constitute drug targets. The molecular basis of disease is considered with examples of genetic and multifactorial clinical conditions and the mechanism of action of certain drugs in their therapy.

History of Drug Discovery and Lead Identification- Prof David Thurston

The identification of drugs for human use has a long and fascinating history with its origins in witchcraft and magic through to the present time where techniques such as computer modeling, combinatorial synthesis and high-throughput screening are

used. This section begins with a discussion of how ancient civilizations utilized a combination of witchcraft, magic and materials extracted from plants, animal and humans to attempt (usually unsuccessfully) to cure diseases. A number of natural products with genuine therapeutic activity such as salicin from willow bark (as an anti-inflammatory) and honey (as an antibacterial) were discovered in this period and will be described in more detail. Discussions will then move to a later period where chemical techniques, although in their infancy, were used to isolate and structurally elucidate well known natural products such as the major plant alkaloids. Discussion will then move to more modern times describing how modern drug leads are identified by a number of different techniques including combinations of molecular modeling, combinatorial libraries and high-throughput screening. The delivery of this module is supplemented by guest lectures from experts in pharmacohistory and from drug discovery experts in the pharmaceutical industry.

Methods of Pharmaceutical Analysis and Drugs of Abuse

A basic knowledge of the analytical techniques required to detect and identify compounds and to determine their physicochemical properties is essential. Furthermore, such analysis is critical in subsequent quality control of drugs and medicines. In this module students will study the theoretical basis and practical use of a wide range of techniques, including ultraviolet, visible and infra-red spectroscopy and the development of spectroscopic techniques in trace metal analysis (Dr Roger Jee). The principles of HPLC and its use and importance in the elucidation of drug properties is taught (Prof Klara Valko, GSK R&D). The use and importance of NMR in molecule identification and modelling is introduced (Dr Mire Zloh) and the applications of mass spectroscopy and an introduction to proteomics is provided (Dr Min Yang). Drugs of abuse will be covered by Prof Anthony Moffat.

First Semester Practical Classes:

- 3hr practical "Analysis of Cardiac Glycosides"
- 3hr practical "Herbal Medicinal Products"
- 3hr practical "HPLC" uses reverse phase HPLC to determine purity of a drug
- 3hr tutorial based introduction to NMR and mass spectrometry equipment.
- 3hr practical "Natural Drugs of Abuse"

Second Semester (January - April 2009)

There are two modules for the second semester:

Module 1: Methods in Pharmacognosy (MP)

This module comprises four sections in the following areas:

Bioassays in Pharmacognosy - Dr J Prieto

Modern Pharmacognosy is the discipline which studies both the chemistry and the biological activities of Natural Products. This module will focus on how to address the evaluation of these biological activities. Bioassays are extensively used in the search of new natural sources of drugs (*screening*) and to isolate new chemical entities from a complex mixture of natural products (*bioassay-guided isolation*). This module will provide our students with a solid basis on the design, application and

interpretation of results of the more important bioassays currently in use in Pharmacognosy. The module will also give insights into contemporary aspects of the pharmacology of natural products including dereplication processes, metabolomics, fingerprinting and footprinting, and on-line bioassays.

Method: The section will combine lectures, discussions on selected articles, and practical demonstrations in the lab.

Contents of the module:

- Introduction. Design of screening. Bioassay-guided isolation of natural products.
- Statistical manipulation, interpretation and presentation of results.
- Preparation, and solubilisation of extracts and single entities.
- Toxicological assays.
- Anticancer, antimicrobial, antiparasitic assays.
- Anti-inflammatory assays.
- Antioxidant assays.
- Dereplication. Metabolomics. *Fingerprinting* and *Footprinting*. On-line bioassays.

Natural Product Structure Elucidation – Prof Simon Gibbons

Being able to work out the structures of both natural and synthetic compounds is a valuable skill, particularly if the compound is biologically active. In this section a small series of lectures will be given on the use of Nuclear Magnetic Resonance (NMR) experiments to elucidate structure. Emphasis will be given on what information these experiments give rather than a theoretical approach. The following experiments will be described: ^1H , ^{13}C , DEPT135, COSY, NOESY, HMQC/HSQC and HMBC experiments.

A workshop will be run in this section to give students the opportunity to work out the structures of natural products using spectra from these experiments. This section will be of great utility to those wishing to pursue research in natural product chemistry.

Natural Products in Neurodegenerative Disease - Prof Peter Houghton

This section will comprise 4 areas:

- Alzheimers disease and other neurodegenerative diseases with acetylcholine deficiency. Treatment with natural cholinergic compounds and acetylcholinesterase inhibitors. Detection methods.
- Laboratory – TLC to detect acetylcholinesterase inhibition. Spot 3 TLC plates and put into tanks to develop. 1 plate each to detect true and false AChE inhibitory effects, 1 to spray with chromogenic reagent e.g. Dragendorff's.
- Laboratory – remove TLC plates from tanks and visualise. Record results.
- Lecture – Detailed study of acetylcholinesterase inhibitors of different chemical types, especially alkaloids in clinical use, including theories of action on active sites of enzyme.
- Discussion about results and other issues arising from lectures etc

- Lecture – Parkinsonism – neurochemical aspects, treatment of dopamine deficiency with L-DOPA, ergot alkaloids and derivatives, monoamine oxidase inhibitors

Natural Product Lead Discovery - Prof Monique Simmonds

In the course some examples of the use of ecological and ethnobotanical information will be provided as well as DNA based phylogenies in both drug discovery and furthering our understanding of the chemistry of traditionally used medicinal plants.

Module 2: Therapeutic Natural Products and Ethnopharmacology (TNPE)

This module comprises four sections in the following areas:

Ayurveda - Prof Elizabeth Williamson

This section will include two lectures on Traditional Asian medicine, particularly Ayurveda, followed by a workshop in which students can ascertain their constitution according to Ayurveda. Students will then be able to select a suitable dietary regime and herbal medicines which are intended to help them with minor ailments.

Traditional Chinese Medicine – Dr Colin Wright

Lectures will cover topics such as: evidence for synergism/antagonism in TCM herbal prescriptions and the potential for adverse effects and interactions of Chinese herbs with other herbs or with drugs (2 hours).

A seminar will focus on the use of locally grown *Artemisia annua* for the treatment of malaria – students would be asked to read one or more research papers which would then be critically discussed in the group (2 hours including 1 hour reading time- students could be provided with the papers in advance).

Other topics such as the potential of TCM materia medica as a source of new drugs will also be discussed.

New Developments in Malaria Research and Antimalarial Natural Product Drug Discovery - Dr Deniz Tasdemir

Malaria is the number one infectious parasitic disease causing more than 1 million deaths and 300 to 500 million clinical infections annually. This module will focus on the current biological targets for antimalarial drug discovery. Specifically, emphasis will be given to the recently completed (2002) *Plasmodium falciparum* genome sequencing project, and some novel targets emerged from this work. This includes the discovery of a plastid-like organelle, the so-called apicoplast, and the biochemical pathways occurring therein, such as non-mevalonate (non-MVA) isoprene, type II fatty acid (PFAS-II) and heme biosyntheses, which are all prokaryotic in nature and are absent from humans. Additionally, some eukaryotic pathways found in *Plasmodium*, e.g. protein kinases will be discussed.

Method: The module will combine lectures, workshops, discussions on selected articles, and practical demonstrations in the lab.

Contents:

- Introduction and discussion on current antimalarial targets.
- *Plasmodium falciparum* genome sequencing project and its impact in malaria research.
- Novel (prokaryotic) targets emerged from the genome projects and their natural inhibitors.
- Plasmodial non-MVA (DOX/MEP pathway). Fosmidomycin.
- Plasmodial FAS-II system and its differences to the human FAS-I system.
- Triclosan and flavonoids as *Pf*FAS-II inhibitors.
- Plasmodial shikimic acid pathway and its inhibitors.
- Antibiotics as antimalarial agents.
- Eukaryotic targets identified in *Plasmodium* and the inhibitors.
- Importance of natural products in antimalarial combination therapy.

Marine Natural Products, Drugs from the Sea - Dr Deniz Tasdemir

Rational: The oceans cover more than 70% of the earth's surface and represent the greatest biodiversity. Ecological pressures have led to the evolution of marine secondary metabolites to bind/inhibit specific macromolecular (protein) targets of their enemies. Therefore, they are highly privileged structures and show better drug-like properties. Although marine natural products represent a relatively untapped resource for new drug development, over 5,000 novel compounds have been isolated from marine organisms during the past decade. This module will provide more practical insights on the collection of marine organisms and the isolation and characterization of marine natural products. On the other hand, the ecological

functions of these metabolites will be presented, as ecological interactions underlie the chemical diversity and toxicity of marine compounds. The module will also cover more specific subjects in marine chemistry, such as marine microbes, marine toxins and marine sponges and their potential of in drug discovery in depth.

Method: The module will combine lectures, workshops, discussions on selected articles, and practical demonstrations in the lab.

Content:

- Introduction into marine natural product chemistry: Collection, documentation and storage methods of marine organisms. Extraction, partition and isolation strategies for marine natural products. Special challenges in the isolation and the characterization of marine natural products.
- Marine chemical ecology and natural product research.
- Marine microorganisms as source for novel drugs and drug candidates.
- Marine toxins.
- Marine sponges in the search for biologically active substances.

Ethnobotany – Its Place in Society and in Drug Discovery – Prof Michael Heinrich

In this part of the course we discuss some examples of ethnopharmacological research as it has been conducted during the last two centuries and look at the current role of this discipline in drug discovery (especially with respect to the American and European markets) and for the further development of these phytotherapeutical resources for local use in the countries of origin (ethnopharmacology).

Examples from 19th century research on curare (Humboldt and Bernard), from the 20th century on hallucinogenic mushrooms (Wasson), on Mexican Indian indigenous plants (our own research) and of current industry based research are used to illustrate the development of this discipline and to highlight the challenges for the future.

Importantly, biomedicine still does not reach large segments of the world's population, esp. the poor and the rural ones. More than ¾th of the world population rely on 'traditional medicine' for their 'daily health care needs' and they often want to rely on it as one of several options to choose from. Medicinal plants are now considered to have a significant potential in PHC by some NGOs, institutions of the church and others.

Areas covered will include:

- Ethnobotany (the study of local knowledge)
- Ethnopharmacology (the effects of such plants) including observational studies on medicinal plant use
- Extracts as bioactive leads
- Bioactive natural products derived from traditional and local knowledge
- Strategies for research and development of novel plant based, rational phytomedicines
- Use of medicinal plants in primary health care both in Europe and in developing countries

Coursework

In the first semester, there are three major pieces of coursework:

1) Seminar presentation

Each student will give a seminar presentation on the topic of their respective dissertation. The presentation should summarise the key aspects of your dissertation work. Presentations should be between 15 and 20 minutes long, with an additional few minutes for questions from your fellow students and members of the course team.

2) Seminar handout

This is to accompany your presentation and a copy will be handed out to each student on the course. The handout should be a summary of the key aspects of your dissertation work and should be one side of A4 only (font size 12 point); small

diagrams and/or chemical line drawings are permitted. This handout is likely to be a slightly longer version of the abstract of the dissertation.

You should spend a total of around 20 hours on items 1 to 3 above. This would probably be broken down as: preparation of seminar presentation and handout (10 hours each).

3) Quality of botanical material based on the Pharm. Eur.

Various criteria are used to assess the quality of herbal medical products. Using the European Pharmacopoeia (see also Wichtl 2004, as well as the textbook 'Fundamentals of Pharmacognosy and Phytotherapy') you should compare the methods used to assess the quality with respect to the following examples (select one from the list below)

- Content of essential oil in fennel, cumin, anise, and star anise and methods to analyse this
- HPLC and TLC analysis of alkaloids in Datura, henbane and other solanaceous drugs
- Microscopic characteristics of peppermint, sage, and thyme
- Differentiation of sennoside containing botanical drugs (senna, cascara, aloë and others) using TLC methods
- Standardisation of botanical drugs – special prerequisites based on the Eur. Pharmac.

In the second semester, there is one major piece of coursework:

1) Single Chemical Entity Natural Product Monograph Preparation

One natural product drug will be selected and a 5000 word monograph will be produced on its chemistry and pharmaceutical relevance. In the monograph, all relevant aspects of the molecule selected, i.e. its chemistry, biological sources, pharmaceutical analysis, pharmacodynamic and pharmacokinetic aspects, clinical effectiveness and toxicology should be covered. Example of possible compounds are:

- Galanthamine
- Ephedrine
- Taxol
- Tetrahydrocannabinol
- Curcumin

Research Project

A major component of the MSc in Pharmacognosy course is the research project. Projects will be assigned in December and will be supervised by an academic member of staff from the School who has a research interest in natural product science. This will cover a number of diverse topics ranging from isolation of bioactive products, natural product synthesis, analysis of natural products and herbal medicinal product use in the community. The projects will be undertaken in the laboratory of a member of staff between May and August inclusive. Students are expected to develop their own research ideas and experimental series in discussion with their supervisor and complete a comprehensive literature review to supplement their work. This comprehensive literature review will begin at the start of semester 2.

Results will be written up and submitted as a dissertation and presented in an oral presentation at the end of the year in the first week of September.

The King's Kew Square Consortium

Students will automatically become members of the King's-Kew-Square (KKS) consortium. This is a consortium made up of the three major research groups in the UK that conduct natural product research. This will entitle students to attend these regular ½-1 day mini symposia where scientists from the consortium present results of their research.

Assessment

There are four components of assessment:

- Semester I: continuous assessment by three coursework assignments and one 3 hour written examination in late January/early February.
- Semester II Module: continuous assessment by one coursework assignment and one 3hour written examination in April.
- Literature survey to commence in February.
- Written research project report and oral presentation in early September.

The pass mark is 40% in the written examinations and 50% in all other assessments, with an overall mark of 50% required for the award of the MSc. The weighting for each element of assessment is set out in the course regulations and marking scheme. Students who achieve an overall mark of 70% or higher are awarded the MSc with distinction.

Students must obtain a minimum pass mark of 50% in the research project. Students who do not pass an assessment at the first attempt may, at the discretion of examiners, be referred and allowed to re-take the assessment. The pass mark on re-assessment is 40% for examinations and 50% in coursework. The course regulations and marking scheme set out the specific details.

A final oral examination (viva) takes place in August/September. Only selected students are called to viva.

All course materials and assessments are in English. Students may not take an English language dictionary into examinations.

*** Please note, the course information provided above may be subject to change.**

Part II

Course Dates 2008/9

This is a provisional calendar for 2008/9.

Start Date	29 September 2008
Induction	29 September to 3 October 2008
Semester I	
Classes start	6 October 2008
Last day of classes	12 December 2008
<i>Christmas vacation</i>	<i>13 December 2008 to 11 January 2009</i>
Classes resume	12 January 2009
Examination	week of 2-6 February 2009
Semester II	
Classes start	16 February 2009
Last day of classes	27 March 2009
<i>Easter vacation</i>	<i>28 March - 19 April 2009</i>
Examination	mid to late April 2009
Semester III	
Research Project submission & Presentations	late August/early September 2009
Viva examination	September 2009
Graduation ceremony	late September 2009