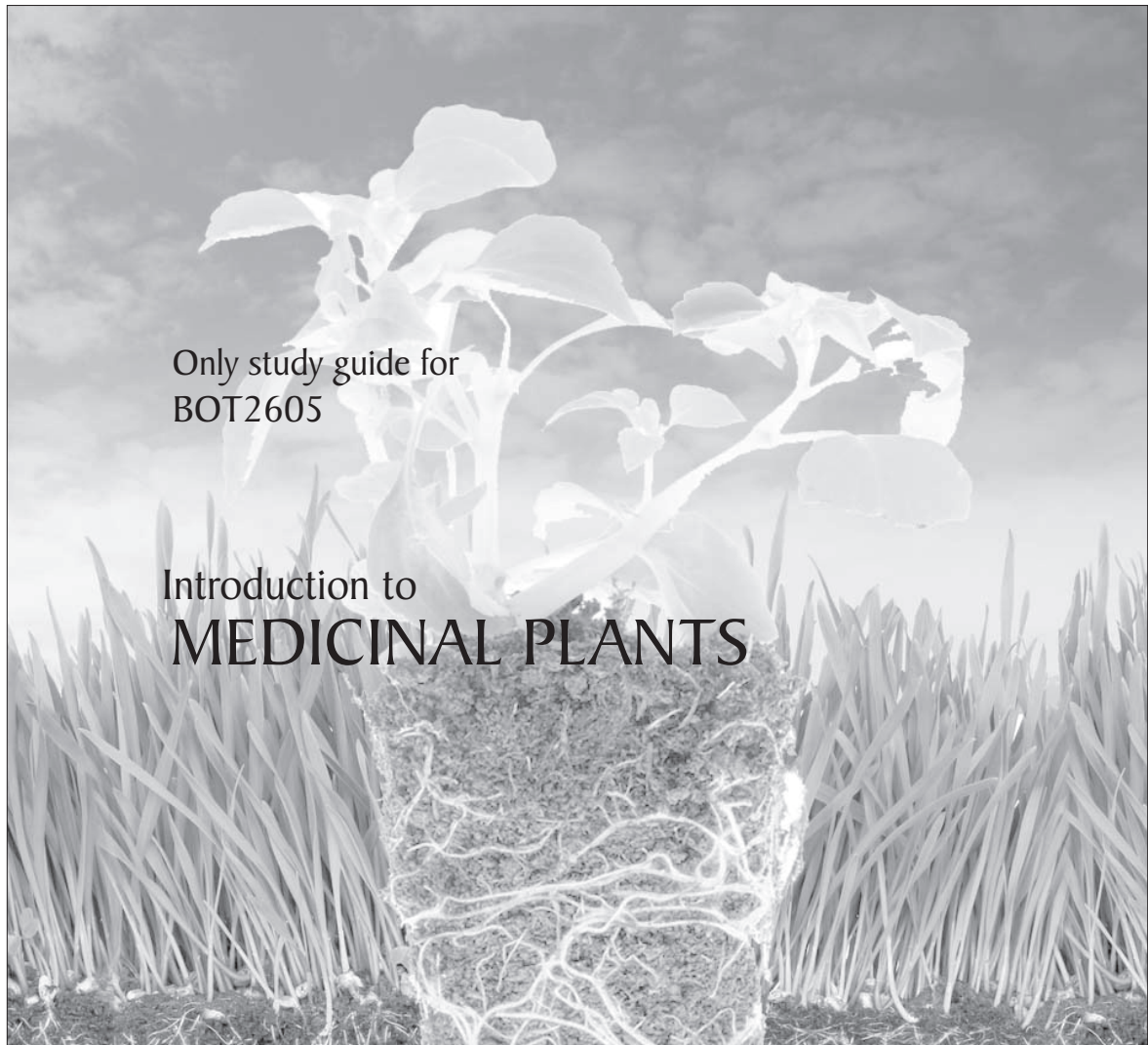




Only study guide for
BOT2605

Introduction to
MEDICINAL PLANTS

Author: Dr Monde A. Nyila

Department of Life and Consumer Sciences

University of South Africa, Florida

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ORIENTATION

Dear Learner

We welcome you to the exciting world of Introduction of Medicinal Plants. The BOT2605 module introduces you to the use of plants as medicine and their traditional uses as plant medicines. It is a great pleasure and honour to introduce you to this stimulating and dynamic field of this study of medicinal plant use. This is a very important module in the undergraduate B.Sc. degree programme. You should use the study guide in conjunction with the tutorial letters (especially TL 101), prescribed textbook, recommended books and articles.

We hope that you will find this module interesting and stimulating. To ensure that you master this field of study we urge and encourage you to read this orientation in detail. Should you have any problems and queries about academic matters, please feel free to contact us.

1. PURPOSE OF THIS LEARNING GUIDE

The purpose of this module is to:

- ◆ Provide students with knowledge of medicinal plants.
- ◆ Equip students with skills to be able to work in medicinal plant laboratories.
- ◆ Equip students with skills to do conservation work and preserve our biodiversity.

2. LINK TO OTHER COURSES/MODULES

This is not a stand-alone module – it forms an integral part of the B.Sc. degree course with various options.

3. LEARNING OUTCOMES

Unisa's approach to teaching and learning is outcomes-based education. In line with this, the module is based on outcomes-based learning. The learning outcomes are linked to assessment criteria, learning activities, assignments, practicals and examination.

3.1 Learning outcomes for BOT2605

After working through this learning guide, you should be able to:

Specific outcome 1

Describe the history of herbal medicines from ancient times till the present day in support of understanding how humans have depended on plants for medicinal use since very early on in human history.

Specific outcome 2

Describe the economically important plant families in South Africa so that students will be able to assess the economic, social and cultural value of our indigenous plants.

Specific outcome 3

Describe the techniques used in medicinal plant analyses in support of understanding the various methods and techniques for screening medicinal plants for their bioactive compound.

Specific outcome 4

Discuss the contemporary issues that are involved in the use of herbal medicines (*muthi*) in South Africa so that students are well informed about this growing trade.

Specific outcome 5

Discuss the *pros* and *cons* of bio-prospecting in South Africa in order to promote the value of medicinal plants in the African Renaissance.

Specific outcome 6

Discuss the sustainable use of medicinal plants.

The assessment criteria for the learning outcomes are included below.

Assessment criteria for BOT2605

1. ASSESSMENT CRITERIA

Specific outcome 1

Describe the history of herbal medicines from ancient times till the present.

Assessment criteria

- 1.1 Valuable medicines in the new world.
- 1.2 Discuss two theories that account for the variety of chemicals found in plants.
- 1.3 Compare the terms primary and secondary metabolism.
- 1.4 List several characteristics of primary metabolites.
- 1.5 List several characteristics of secondary metabolites.
- 1.6 Provide examples of secondary metabolites in the field of:
 - ❖ narcotics and hallucinogens
 - ❖ medicine
 - ❖ poison
 - ❖ stimulants
 - ❖ perfume and spices

Specific outcome 2

Describe the economically important plant families in South Africa so that students will be in a position to assess the economic, social and cultural value of our indigenous plants.

Assessment criteria

- 1.1 Prepare a list of some of the indigenous plant families that are used for medicinal purposes.
- 1.2 Describe the general botanical and microscopic characters of medicinal plants and their specific chemical constituents.
- 1.3 Briefly describe the various biogenetic pathways of secondary metabolite formation and their classification.

Specific outcome 3

Describe the techniques used in medicinal plant analyses in support of understanding the various methods and techniques for screening medicinal plants for their bioactive compound.

Assessment criteria

- 1.1 Describe the sources of information of medicinal plants.
- 1.2 What is meant by the term phytochemical screening?
- 1.3 Describe the methods used in screening plants for bioactive constituents.
- 1.4 Describe some of the specific extraction procedures used to isolate bioactive plant products.
- 1.5 Describe the role of chromatography and spectroscopic techniques for the characterization and identification of isolated plant products.
- 1.6 Discuss the role of fermentation, tissue culture and recombinant DNA technology in the production of clinically useful medicines.

Specific outcome 4

Discuss the contemporary issues that are involved in the use of herbal medicines (*muthi*) in South Africa so that students are well informed about this growing trade.

Assessment criteria

- 1.1 Discuss the demand-and-supply curves of herbal medicines in South Africa.
- 1.2 Discuss the role of quality control and safety in the herbal medicine industry.
- 1.3 Describe the issues related to marketing of indigenous medicinal plants/ products.
- 1.4 Discuss the statement 'the use of herbal medicines can lead to loss of biodiversity'.

Specific outcome 5

Discuss the *pros* and *cons* of bio-prospecting in South Africa in order to promote the value of medicinal plants in the African Renaissance.

Assessment criteria

- 1.1 Outline the various stages involved in the development of a new bioactive product.
- 1.2 Discuss the roles that TRIPS (Trade-Related Aspects of Intellectual Property Rights) and the CBD (Convention on Biological Diversity) play in protecting the inventions and genetic resources, respectively, of a nation.
- 1.3 Discuss the role of indigenous knowledge in traditional medicine development.

Specific outcome 6

Discuss the sustainable use of medicinal plants.

Assessment criteria

Write an essay on the sustainable use of medicinal plants or propose strategies that could be used to protect our indigenous medicinal plant species from overexploitation.

4. FRAMEWORK OF BOT2605

Table 1 Framework of BOT2605

Topic 1: The history of herbal and traditional medicine	Topic 2: Collection and storage of medicinal plants	Topic 3: Economically important plant families in South African medicinal plants	Topic 4: Common South African medicinal plants
Study unit 1.1: Historical background	Study unit 2.1: Collection methods		
Study unit 1.2: Why study medicinal plants	Study unit 2.2: Storage of medicinal plants		
Topic 5: Techniques used in medicinal plant analyses	Topic 6: Bio-prospecting in South Africa	Topic 7: Sustainable use of medicinal plants	

COMMUNICATION WITH THE DEPARTMENT AND THE UNIVERSITY

All communication with the university should from now on be done through the **UNISA Contact Centre** at the following numbers and email address **only**:

RSA: 0861 670 411

International: +27 11 670 9000

Fax number: 012 429 4150/+27 12 429 4150

Email address: study-info@unisa.ac.za

For academic queries please contact the lecturers of the module.

For academic problems relating to the contents of tutorial letters, assignments, study guide and textbooks write to:

Dr. Monde A. Nyila Pr. Sci. Nat. (Microbiological Science)

Department of Life and Consumer Sciences

School of Agriculture and Life Sciences

UNISA Florida Campus

Office no B219

c/o Christian de Wet and Pioneer Avenue

Private Bag X6

Florida

1710

Gauteng

South Africa

Telephone +27 11 471 2294

Fax: +27 11 471 2796

Email: nyilama@unisa.ac.za

Send your completed assignments to:

The Registrar (Academic)

Assignments

University of South Africa

PO Box 392

UNISA 0003

STUDY MATERIAL

WRITTEN EXAMINATION AND ADMISSION TO THE EXAMINATIONS

Written examination: It consists of one 3-hour paper written in January/February. In order to pass the written examination you need to obtain a minimum of 50% and for a distinction you require 75%.

The assignments are compulsory.

Year mark: Both Assignment 01 and Assignment 02 contribute equally (50% each) towards the year mark of 100%.

Example: You obtained 70% for Assignment 01 and 50% for Assignment 02. Your year

$$\begin{aligned}\text{mark is } & 70 \times 50\% + 50 \times 50\% \\ & = 35 + 25 \\ & = 60\end{aligned}$$

Your year mark will be 60%

ACTION VERBS

The action verbs clarification that is given below attempts to assist you to understand what is expected of you.

Name: Give a statement only.

Define: Give the essential characteristics of the term.

Tabulate: Compare in a table (tabular form).

Criticise: Give the good and the bad characteristics after scrutinizing the statement.

Differentiate: How can you distinguish between structures, objects or terms?

Substantiate: Give reasons for the statement.

Analyse: Find and give the essence or parts of the concerned matter.

Explain: Make known in detail by using a description, examples or illustrations.

Describe: To give the characteristics of something in a logical and structured way.

Discuss: Examine by argument. Look at different angles of a statement.

Identify: Give essential characteristics of the structure or a term.

Compare: Give the similarities and the differences between structures. This is usually done in a table.

Give a line diagram: Give a labelled outline of the different parts of an object. It is not necessary to give a detailed drawing.

Make a drawing: Give a labelled drawing that shows the different parts of the object.

Give a diagrammatic representation: Give a scheme of the different steps or phases of a process.

HOW TO USE THIS STUDY GUIDE

The aim of this study guide is to guide you through specific chapters in your prescribed textbook to attain the desired outcomes. Each study unit is based on a number of chapters in the textbook. Each chapter is divided into concepts. The concepts are designed to support your learning process and to guide you to achieve the learning outcomes. Strictly follow the sequence of events and complete all learning activities. Study the learning outcomes in the study guide. These outcomes define the link between the intentions and learning results. In other words: learning outcomes are statements of what is expected of you after studying this section. Our advice is that you should take these outcomes seriously and that you apply them at the point of departure, during all activities, and that you use them as a check list at the point of completion. Relevant and applicable sections from the textbook *Medicinal plants of South Africa* by Van Wyk et al (2009) are applied in the learning activities. Make use of these to support your learning process. Reflect on your learning process and the achievement of the outcomes.

Tutorial letter 101 will instruct/inform you which assignments you must submit for evaluation by the lecturer.

USE OF ICONS



Learning outcomes. The learning outcome icon indicates which aspects of the study material or particular topic you have to master.



Activity. The activity icon refers to activities that you must complete in order to develop a deeper understanding of the learning material (the study units that you have completed).

STUDY MATERIAL

In addition to this study guide the following sources are essential.

1. The prescribed textbook:

Van Wyk, BE, Van Oudtshoorn, B & Gericke, N. 2009. *Medicinal plants of South Africa*. 2nd edition. Pretoria: Briza Publications. ISBN 978-1-875093-37-3

2. Recommended reading:

2.1 Van Wyk, B & Gericke, N. 2000. *People's plants*. 1st edition. Pretoria: Briza Publications. ISBN 1875093 19 2

2.2 Articles that will be made available from the library.

TOPIC 1

THE HISTORY OF HERBAL AND TRADITIONAL MEDICINE

STUDY UNIT 1.1

HISTORICAL BACKGROUND

Learning outcome

Describe the history of herbal medicines from ancient times till the present day in support of understanding how people have relied on plants as a source of medicines since very early on in human history.

Key questions

By the end of this study unit you should be able to explain the fundamentals of the discipline of medicinal plants. You will know that you have achieved this if you can:

- ◆ Define medicinal plants.
- ◆ Give the background on the medicinal use of plants.
- ◆ Explain the importance of medicinal plants.
- ◆ Analyse the different parts of plants used in traditional medicine.
- ◆ Demonstrate an understanding of traditional uses of plants in the context of the indigenous knowledge system.



INTRODUCTION

Where do most of the medicines primarily come from? Are you aware that plants are the primary source of most of the medicines in the world?

The use of plants as medicine is older than recorded history. For centuries people on all continents have been using infusions of plant extracts for various ailments. Civilisations of the ancient Chinese, Indians, and North Africans furnished written proof of man's resourcefulness in utilising plants for the treatment of a wide variety of ailments.

In ancient Egypt, garlic was used as part of early diet and it was fed to people involved in heavy labour such as building of the pyramids. Garlic was also used for the treatment of abnormal growths such as abscesses. In ancient Greece, garlic was fed to the soldiers to give them courage during war and was also given to the athletes before they competed in the Olympic Games. Garlic was also used to protect the skin against poisons and toxins. Hippocrates, widely regarded as the father of medicine, advocated the use of garlic for various ailments. In ancient Rome, Japan and China, garlic was used for digestion, respiratory ailments, arthritis, convulsions, animal bites, to alleviate depression and for male potency.

STUDY UNIT 1.2

WHY STUDY MEDICINAL PLANTS

South Africa is rich in plants with over 30 000 species of higher plants. About 3 000 species of plants are used as traditional remedies for ailments in Southern Africa. Up to 60% of the South African population consult one or more of an estimated 200 000 traditional healers in preference to or in addition to consulting Western medical doctors (Van Wyk et al. 2009). South Africa has made a substantial contribution to the world's medicines derived from plants, just to name a few: buchu (*Agothosma betulina*) is used as a urinary antiseptic and possesses diuretic properties; the Cape aloe (*Aloe ferox*) is used for the treatment of eczema, arthritis, conjunctivitis, hypertension, stress and as a laxative; and devil's claw (*Harpagophytum procumbens*) is used for the treatment of rheumatism and arthritis (Van Wyk et al. 2009).

Why study medicinal plants

The following reasons, adapted from Naranjo (1995), give an overview as to why the study of medicinal plants is important:

1. To preserve knowledge in imminent danger of being lost. The indigenous knowledge system can be passed on from one generation to the next through the study of medicinal plants.
2. The utility of plants in current therapy. Various ailments could be cured.
3. The usefulness of plants in the development of physiopathology
4. The wide use of plants in folk medicine. People from different cultures use plants as medicine.
5. To obtain intermediate chemicals. Active compounds are isolated from crude plant extracts and purified to obtain the required chemicals.



Study task

Study the introductory pages in Van Wyk et al (2009:7–11) and pay special attention to the following:

- ◆ The indigenous ***plant species richness*** in ***South Africa***.
- ◆ The importance of medicinal plants in folk medicine.
- ◆ The role played by traditional healers.
- ◆ The contribution of medicinal plants to the economy of the country.
- ◆ Examples of some important medicinal plants, for example, devil's claw (*Harpagophytum procumbens*), etc.



Activity 1

1. Discuss at least three medicinal plants and their use.
2. How many medicinal plant species are there in Southern Africa?

Feedback

Aloe ferox (Cape aloe), *Agothosma betulina* (buchu), *Harpagophytum procumbens* (devil's claw) are some of the medicinal plants whose extracts are sold in the informal and formal sectors of South African economy. It is estimated that 27 million South Africans use traditional herbal medicine derived from more than 1 020 plant species.

Southern Africa has more than 30 000 species of higher plants. From this diversity of species about 3 000 are medicinal plants.

SUMMARY

Medicinal plants are used to treat a variety of ailments. In South Africa a large section of utilised medicines are still derived from plants and their extracts. Plants

and their extracts are sold both in the informal and the commercial sector of the economy. Traditional medicine is a broad term used to define any non-Western medical practice. Up to 60% of the South African population consult one or more of an estimated 200 000 traditional healers in preference to or in addition to consulting Western medical doctors.

SELF-EVALUATION QUESTIONS

Discuss at least two medicinal plants that play a role in both the informal and formal sectors of our economy.

In this study unit you were introduced to the medical use of plants and in study unit 2 you will learn about the collection and storage of medicinal plants.

SOURCES CONSULTED

- Naranjo, P. 1995. The urgent need for the study of medicinal plants, in *Ethnobotany, evolution of a discipline*, edited by RE Schultes & S von Reis. Portland: Dioscorides Press.
- Phillipson, JD. 2001. Phytochemistry and medicinal plants. *Phytochemistry* 56: 237–243.
- Rivlin, RS. 2001. Recent advances on nutritional effects associated with the use of garlic as a supplement. *Journal of Nutrition* 131: 951S-954S.
- Stafford, GI, Jager, AK & Van Staden, J. 2005. Effect of storage on chemical composition and biological activity of several popular South African medicinal plants. *Journal of Ethnopharmacology* 97: 105–115.
- Taylor, JLS & Van Staden, J. 2001. COX-1 inhibitory activity in extracts from *Eucomis L' Herit* species. *Journal of Ethnopharmacology* 75: 107–115.
- Van Wyk, BE, Van Oudtshoorn, B & Gericke, N. 2009. *Medicinal plants of South Africa*. 2nd edition. Pretoria: Briza Publications.
- Van Wyk, B & Gericke, N. 2000. *People's plants*. 1st edition. Pretoria: Briza Publications.

TOPIC 2

COLLECTION AND STORAGE OF MEDICINAL PLANTS



Learning outcome

Describe the history of herbal medicines from ancient times till present in support of understanding how humans have depended on plants for drugs from a very early age.

Key questions

You will know that you have achieved this if you can:

- ◆ Describe the correct way to collect medicinal plants.
- ◆ Explain the importance of conservation of medicinal plants.
- ◆ Explain the storage of plant parts.

INTRODUCTION

It is very important that you consider some measures when collecting medicinal plants. A number of questions should be considered before you go to the field to collect plants, such as which plant part is to be collected, or should the whole plant be removed. One should carry the necessary equipment for cutting or removing the plant material.

Medicinal plants are under threat of habitat destruction as the result of industrialisation, agricultural and urban settlement development (Van Wyk et al. 2009).

STUDY UNIT 2.1

COLLECTION METHODS

Before the traditional healer or 'inyanga' collects the medicinal plant he or she considers various factors such as locality, the season for collection, type of soil and its moisture content, and time of day. The healers know that these factors influence the potency of their medicines extracted from the medicinal plants. For more information on this read the relevant section in the prescribed textbook.

Which steps would you take if you were to collect a particular medicinal plant for your research activities? Remember that you cannot collect medicinal plants anywhere in the country.

After the plant material has been collected it is taken to the herbarium where the specimen is prepared and the plant is identified scientifically by the taxonomist. The specimen should be kept at the herbarium for future references.

STUDY UNIT 2.2

STORAGE OF MEDICINAL PLANTS

Plant material which is dry should be stored in paper bags, newspapers, tin cans or glass jars. Some plant material may be stored as is or reduced to powder form. One should make sure that the packaging materials do not damage and contaminate the medicine. The packaging materials should ensure that the active compounds remain stable.



Activity 2

1. Explain appropriate ways to consider when harvesting medicinal plants.
2. Summarize the traditional taboos associated with the collection of plants.
3. Discuss the storage of plants after they have been harvested.

Feedback

1. Inappropriate harvesting methods damage the plants. Appropriate ways may include:
 - ◆ Cutting only the part of the plant to be used.
 - ◆ Not damaging the roots, bark, etcetera when pulling or cutting, and not over-harvesting, etcetera (see Van Wyk et al. (2009) page 14) and the article by Zschocke et al (2000)). See also the relevant article given in the list.
2. Proper care should be taken when removing some parts from the plant.

SUMMARY

In this study unit you have learnt the appropriate ways of collecting and storing medicinal plants; the importance of conservation of medicinal plants; and the storage of plant parts.

SELF-EVALUATION QUESTIONS

1. Discuss the storage of dry plant material.
2. You want to use the bark from the plant. Illustrate the steps you may follow to collect the bark.

SOURCES CONSULTED

- Stafford, GI, Jäger, AK & Van Staden, J. 2005. Effect of storage on the chemical composition and biological activity of several popular South African medicinal plants. *Journal of Ethnopharmacology* 97: 107–115.
- Van Wyk, BE, Van Oudtshoorn, B & Gericke, N. 2009. *Medicinal plants of South Africa*. 2nd edition. Pretoria: Briza Publications.
- Zschocke, S, Rabe, T, Taylor, JLS, Jäger, AK & Van Staden, J. 2000. Plant part substitution – a way to conserve endangered medicinal plants? *Journal of Ethnopharmacology* 71: 281–292.

TOPIC 3

ECONOMICALLY IMPORTANT PLANT FAMILIES IN SOUTH AFRICAN MEDICINAL PLANTS



Learning outcome

Describe the economically important plant families in South Africa so that students will be able to assess the economic, social and cultural value of our indigenous plants.

Key questions

You will know that you have achieved this if you can:

- ◆ List some of the indigenous plant families that are used for medicinal purposes.
- ◆ Describe the general botanical and microscopic characters of medicinal plants and their specific chemical constituents.
- ◆ Briefly describe the various biogenetic pathways of secondary metabolite formation and their classification.

INTRODUCTION

As explained before in the introduction in study unit 1.2, more than 30 000 species of higher plants are found in South Africa of which about 3 000 species of plants are used as traditional remedies for ailments. Some of the important families are dealt with below.

Apocynaceae

One plant that is indigenous to South Africa and Namibia that has been shown to have a commercial value is the genus *Hoodia*, in particular the *H. gordonii* species. *Hoodia gordonii* belongs to the Apocynaceae family. *Hoodia* has been used traditionally by the San people of Southern Africa as an appetite suppressant. The species has been commercialised as a weight-loss product and therefore, it has been marketed widely. *Hoodia gordonii* has been marketed as a functional food and products are available in many different dosage forms that include tablets, capsules, powders, sprays, tea, fruit and chocolate bars. Another species of *Hoodia*, *H. pilifera* has also been found to have appetite-

suppressing activity on rats. It is not surprising that a patent has been registered based on *Hoodia* use. The Council for Scientific and Industrial Research (CSIR) patented the active compound responsible for appetite suppression from *H. gordonii* and named it P57. For more information on *Hoodia* please study the prescribed book and the relevant articles.

Asphodelaceae

Another plant family that has been used commercially is Asphodelaceae. Some of the commercially important species from this family are *Aloe arborescens* and *A. ferox*. The *A. ferox* species has been used extensively in different pharmaceutical products such as popular self-care remedies 'Lewensessens' and 'Schweden bitters'. Do you know any product derived from *A. ferox*? Besides commercial use, the two species have been used in traditional medicines for the treatment of various ailments. Can you name those ailments that are treated by the use of the two aloe species that are mentioned in this study unit?

Pedaliaceae

Harpagophytum procumbens belongs to the family Pedaliaceae. The species is better known as the 'devil's claw' in English. Devil's claw has also been used commercially as different pharmaceutical products in the form of tablets, gels, etc. The plant is used to treat rheumatism, arthritis and the management of inflammation. The phytochemical screening indicated that *H. procumbens* contains iridoid glycosides, acetylated glycosides and terpenoids. Which other illnesses are treated with *H. procumbens*?

Fabaceae

Sutherlandia frutescens is known in English as the 'cancer bush'. The species belongs to the family Fabaceae. The species is also one of the commercially important medicinal plants in South Africa. *Sutherlandia frutescens* has been reported to be used in South Africa for the management of pain and inflammation. *Sutherlandia frutescens* has also been reported to have antibacterial activities/properties against *Staphylococcus aureus*, *Enterococcus faecalis* and *Escherichia coli*. For more information on the importance of the family Fabaceae please consult the prescribed book and the relevant articles. There are other species of medicinal importance that belong to this family; can you mention them?



Activity 3

Study Van Wyk et al (2009)

Study at least 10 commercially important species and try to answer the following:

- ◆ To which family do they belong?
- ◆ Their medicinal use.
- ◆ The compounds that are active.
- ◆ The active compounds belonging to which group, eg flavonoids, terpenoids, etcetera.

SELF-EVALUATION QUESTIONS

1. Discuss the medicinal use of *Aspalathus linearis*.
2. Explain in detail the use of *Agothosma betulina* as traditional medicine.
3. Which medicinal plants are used to treat diarrhoea? Discuss at least three.

FEEDBACK

The commercial viability of medicinal plants cannot be underestimated. A lot of research is being conducted in South Africa and most other countries with regard to the medicinal use of plants. Organisations in South Africa such as the CSIR have been involved in bio-prospecting of medicinal plants. An example is the partnership of CSIR with the San people of South Africa with regard to the use of *Hoodia gordonii*. Rooibos tea scientifically known as *Aspalathus linearis* is also another example of a plant that has enormous commercial spinoffs. There are many other important medicinal plants that have not been discussed in this study unit. You are requested to study them in the prescribed book and also to read the relevant articles.

SUMMARY

In this study unit you have learnt about some South African medicinal plants that are of commercial importance as well as their traditional use. These plants are used in traditional medicine for a variety of ailments. The compounds found in these plants play a key role in their biological activity against various illnesses. For example, the leaves of *Artemisia afra* are medicinally used to treat coughs, fever, colds, influenza and blocked nasal passages.

SOURCES CONSULTED AND FURTHER READING

- Kundu, JK, Mossanda, KS, Na, H-K & Surh, YJ. 2005. Inhibitory effects of the extracts of *Sutherlandia frutescens* (L.) R.Br. and *Harpagophytum procumbens* DC on phorbol ester-induced COX-2 expression in mouse skin: AP-1 and CREB as potential upstream targets. *Cancer Letters* 218: 21–31.
- Lee, RA & Balick, MJ. 2007. Indigenous use of *Hoodia gordonii* and appetite suppression. *EXPLORE: The Journal of Science and Healing* 3: 404–406.
- Moyer-Henry, K. 2008. Patenting *Neem* and *Hoodia*: Conflicting decisions issued by the Opposition Board of the European Patent Office. *Biotechnology law report* 1 Volume 27.
- Van Heerden, FR, Horak, RM, Maharaj, VJ, Vleggaar, R, Senabe, JV & Gunning, PJ. 2007. An appetite suppressant from *Hoodia* species. *Phytochemistry* 68: 2545–2553.
- Van Heerden, RF. 2008. *Hoodia gordonii*: A natural appetite suppressant. *Journal of Ethnopharmacology* 119: 434–437.
- Van Wyk, BE, Van Oudtshoorn, B & Gericke, N. 2009. *Medicinal plants of South Africa*. 2nd edition. Pretoria: Briza Publications.
- Van Wyk, B & Gericke, N. 2000. *People's plants*. 1st edition. Pretoria: Briza Publications.
- Vermaak, I, Hamman, JH, Viljoen, AM. 2010 (a). High performance thin layer chromatography as a method to authenticate *Hoodia gordonii* raw material and products. *South African Journal of Botany* 76: 119–124.
- Vermaak, I, Hamman, JH, Viljoen, AM. 2010 (b). A rapid spectrometer method for quantification of P57 in *Hoodia gordonii* raw material. *Food Chemistry* 120: 940–944

TOPIC 4

COMMON SOUTH AFRICAN MEDICINAL PLANTS

INTRODUCTION

In the prescribed book (Van Wyk et al (2009) South African medicinal plants such as *Aloe ferox*, *Artemisia afra*, *Eucomis autumnalis*, etcetera, are discussed in detail (the botanical description is also included).



Learning outcome

Discuss the contemporary issues that are involved in the use of herbal medicines (*muthi*) in South Africa so that students are well informed about this growing trade.

Key questions

You will know that you have achieved this if you can:

- ◆ Explain the way the medicinal plants are used for various ailments.
- ◆ Discuss the general information of different medicinal plants, eg *Eucomis autumnalis*.
- ◆ Summarise the background on their use.

INTRODUCTION

There are more than 3 000 species of medicinal plants in South Africa. *Artemisia afra*, *Eucomis autumnalis*, *Aloe ferox*, *Tulbaghia violacea* and *Harpagophytum procumbens* are a few examples of the medicinal plants that are commonly used in South Africa for the treatment of various ailments.

Study task

Study Van Wyk et al (2009) and pay special attention to the following medicinal plants:

- ◆ *Aloe arborescens* and *A. ferox*
- ◆ *Artemisia afra*
- ◆ *Eucomis autumnalis*
- ◆ *Hoodia gordonii*
- ◆ *Mentha longifolia*
- ◆ *Datura stramonium*
- ◆ *Harpagophytum procumbens*
- ◆ *Sutherlandia frutescens*
- ◆ *Pelargonium sidoides*
- ◆ ***Plectranthus ecklonii***
- ◆ *Tulbaghia violacea*
- ◆ and other medicinal plants



Artemisia afra

Artemisia afra belongs to the family Asteraceae. It is known as African wormwood. In Zulu and Xhosa it is known as 'umhlonyane', and 'lengana' in Sotho and Tswana. *Artemisia afra* is a perennial shrub with greyish-green leaves, and yellow flowers. The leaves are medicinally used to treat coughs, fever, colds, influenza and blocked nasal passages. The plant has antimicrobial and anti-oxidative properties. The compounds isolated from *A. afra* which have been reported as having antimicrobial properties are: 1.8-cineole, α -thujone, β -thujone, camphor and borneol. Consult the prescribed book and the articles to discover which bioactive compounds have been previously isolated from *A. afra*.

Datura stramonium

Datura stramonium belongs to the family Solanaceae. The plant is commonly known as the thorn apple. In Zulu it is known as 'iloyi'. It has white or purplish tubular flowers and 4-locular fruit capsules which have brown, kidney-shaped seeds. The leaves of *D. stramonium* are medicinally used to relieve asthma, rheumatism, gout, boils, abscesses, sore throat, tonsillitis and respiratory difficulties. Atropine and scopolamine are the two major compounds isolated from *D. stramonium*. In a previous study (Mdee et al (2009) *D. stramonium* was found to have antifungal activity against several tested fungi such as *Aspergillus niger*, *A. parasiticus*, etcetera.

You should continue to study other medicinal plants. The prescribed textbook and the relevant articles will assist you in this regard.



Activity 4

1. Discuss the medicinal use of *Tulbaghia violacea*.
2. Explain in detail the use of *Artemisia afra* as traditional medicine.
3. Which medicinal plants are used to treat diarrhoea? Discuss at least three.

Feedback

Different plants are used for a variety of ailments and *A. afra* and *E. autumnalis* are just two examples.

SUMMARY

In this study unit you have learnt about some South African medicinal plants and their use as popular and commonly used herbal medicines. These plants are used in traditional medicine to treat a variety of ailments. The literature has demonstrated that the medicinal plants have been found to have bioactivity against various microorganisms. The medicinal plants have also been found to have anti-inflammatory, anti-oxidant, anti-allergic and anti-viral effects. In the following chapter (Topic 5) you will learn more about the compounds from plants that are responsible for these abovementioned activities.

SOURCES CONSULTED AND FURTHER READING

Mangena, T & Muyina, NYO. 1999. Comparative evaluation of the antimicrobial activities of essential oils of *Artemisia afra*, *Pteronia incana* and *Rosmarinus officinalis* on selected bacteria and yeast strains. *Letters in Microbiology* 28: 291–296.

Mdee, LK, Masoko, P & Eloff, JN. 2009. The activity of extracts of seven common invasive plant species against fungal phytopathogens. *South African Journal of Botany* 75: 375–379.

Van Wyk, BE, Van Oudtshoorn, B & Gericke, N. 2009. *Medicinal plants of South Africa*. 2nd edition. Pretoria: Briza Publications.

Van Wyk, B & Gericke, N. 2000. *People's plants*. 1st edition. Pretoria: Briza Publications.

TOPIC 5

TECHNIQUES USED IN MEDICINAL PLANT ANALYSES

Learning outcome

Describe the techniques used in medicinal plant analyses in support of understanding the various methods and techniques for screening medicinal plants for their bioactive compounds.

Key questions

You will know that you have achieved this if you can:

- ◆ Explain different methods used in the isolation process.
- ◆ Differentiate between thin layer chromatography (TLC) and Sephadex column chromatography.
- ◆ Decide on the best method to use for a given amount of extract.



INTRODUCTION

Various extraction methods and specific isolation processes are used to extract compounds from medicinal plants.

A dried plant material is often ground into powder form before extraction. Sometimes the fresh plant material is homogenised and soaked for a few days before the crude is filtered.

A mortar and pestle is often used for grinding small amounts of plant material. For a large amount a grinder is used (depending on the amount of plant material). Various solvents are used in the extraction process.

METHODS OF IDENTIFICATION OF COMPOUNDS

Thin-layer chromatography (TLC) is used to identify compounds in the crude plant material. In this method the crude extract is spotted on a TLC plate using a micro-pipette and using different solvent systems as eluents in the TLC tank. The results on the TLC plate would give an indication of which solvent system is the best to apply when running the silica gel column chromatography. Sephadex column chromatography is also used for isolation processes, especially when

only a small amount of crude plant extract is available and there are only a few compounds in the fraction to be isolated.

Techniques such as high performance liquid chromatography (HPLC) and gas chromatography (GC) are in use for analysing the compounds. The GC is used to analyse volatile compounds.



Activity 5

1. Explain the process involved in the isolation of compounds from the crude plant extract.
2. Discuss the system used for routine analysis of plant extracts.

Feedback

Thin-layer chromatography is the most used form of chromatography for routine analysis of the crude extracts

SUMMARY

The choice of chromatography procedure to be used depends on the amount of plant material available, and on the target compounds to be isolated. For routine analysis of crude plant material TLC is used. The solvent system to be used on the silica gel column depends on the results of the TLC plates. The TLC plate would give an indication of how many compounds are present and which solvent system would be appropriate. After the pure bioactive compound has been isolated the next step is to determine its structure using the nuclear magnetic resonance (NMR) technique.

SELF-EVALUATION QUESTIONS

1. Differentiate between silica gel chromatography and Sephadex chromatography.
2. Discuss the chromatography procedure to be used for very small quantities of samples (eg 10 mg and less).

SOURCES CONSULTED AND FURTHER READING

Mathabe, MC, Hussein, AA, Nikolova, RV, Basson, AE, Meyer, JJM & Lall, N. 2008. Antibacterial activities and cytotoxicity of terpenoids isolated from *Spirostachys africana*. *Journal of Ethnopharmacology* 116: 194–197.

- Mativandlela, SPN, Lall, N & Meyer, JJM. 2006. Antibacterial, antifungal and antitubercular activity of (the roots of) *Pelargonium reniforme* (CURT) and *Pelargonium sidoides* (DC) (Geraniaceae) root extracts. *South African Journal of Botany* 72: 232–237.
- Nyila, MA, Leonard, CM, Hussein, AA & Lall, N. 2009. Bioactivities of *Plectranthus ecklonii* constituents. *Natural Product Communications* 4: 1177–1180.
- Springfield, EP, Eagles, PFK & Scott, G. 2005. Quality assessment of South African herbal medicines by means of HPLC fingerprinting. *Journal of Ethnopharmacology* 101: 75–83.
- Tshikalange, TE, Meyer, JJM & Hussein, AA. 2005. Antimicrobial activity, toxicity and the isolation of a bioactive compound from plants used to treat sexually transmitted diseases. *Journal of Ethnopharmacology* 96: 515–519.
- Van Der Kooy, F, Meyer, JJM & Lall, N. 2006. Antimycobacterial activity and possible mode of action of newly isolated neodiospyrin and other naphthoquinones from *Euclea natalensis*. *South African Journal of Botany* 72: 349–352.
- Van Wyk, BE, Van Oudtshoorn, B & Gericke, N. 2009. *Medicinal plants of South Africa*. 2nd edition. Pretoria: Briza Publications.

TOPIC 6

BIO-PROSPECTING IN SOUTH AFRICA



Learning outcome

Discuss the *pros* and *cons* of bio-prospecting in South Africa in order to promote the value of medicinal plants in the African Renaissance.

Key questions

You will know that you have achieved this if you can:

- ◆ Explain the various stages involved in the development of a new bio-active product.
- ◆ Discuss the roles that TRIPS (Trade-Related Aspects of Intellectual Property Rights) and the CBD (Convention on Biological Diversity) play in protecting the inventions and genetic resources, respectively, of a nation.
- ◆ Discuss the role of indigenous knowledge in medicine development.

INTRODUCTION

By the middle of the nineteenth century, approximately 80% of medicines were developed from plants. Aspirin, atropia, artimesinin, atropine, taxol, morphine, reserpine, pilocarpine, quinine, digoxin, ephedrine and quinidine are some of the examples of plant-derived medicines that were initially discovered through the study of traditional remedies and folk knowledge of indigenous people. From the opium poppy (*Paper somniferum*), morphine was isolated and it is one of the early substances that entered into conventional medicine as the best painkiller available to humans.

BIO-PROSPECTING

In South Africa one plant species that has been commercially marketed is the *Hoodia gordonii*. As stated in topic 3 of this guide, *Hoodia* has been found to have appetite-suppressant properties. *Hoodia* was long used by the San, indigenous peoples of the Southern African region, as an appetite suppressant. It is not surprising that a patent has been registered based on *Hoodia* use. The Council for Scientific and Industrial Research (CSIR) patented the active compound responsible for appetite suppression from *H. gordonii* and named

it P57. Initially the CSIR (the patent holder) did not give any credit to the San people, the holders of indigenous knowledge about *Hoodia*, who accused CSIR and its partners of bio-piracy. The South African government intervened by offering a cash settlement to the San people for using their indigenous knowledge. The San people from four Southern African countries, namely South Africa, Botswana, Namibia and Angola, were offered payment of at least \$30 000 during clinical trials on *Hoodia*. The CSIR and the San people have reached a mutually acceptable agreement to share benefits in terms of which a 6% share of the royalties received from drug and product sales would go to the San people.

The South African government has taken steps towards the official recognition and institutionalisation of African traditional medicines, and in 2008 the South African government published regulations on bio-prospecting, access and benefit sharing (*Government Gazette* No. 30739, 2008). The purpose of this legislation is to regulate any kind of research and bio-prospecting with regard to the systematic collection, study and investigation of indigenous biological resources. Issues such as indigenous knowledge, benefit-sharing, export, permit, etcetera are explained in detail. As a good citizen you need to bear this in mind when you collect biological resources such as plants. What is your take on this matter? For more information on bio-prospecting study the relevant articles and the National Environmental Management: Biodiversity Act, 2004: Regulations on Bio-Prospecting, Access and Benefit-Sharing (*Government Gazette* No. 30739, 2008).

Activity 6

1. What role can be played by local people who have contributed to bio-prospecting processes such as their indigenous knowledge with respect to a particular plant?
2. Discuss steps to follow when investigating plants for anti-tuberculosis activity or any other bioactivity.



SOURCES CONTACTED AND FURTHER READING

Lee, RA & Balick, MJ. 2007. Indigenous use of *Hoodia gordonii* and appetite suppression. *EXPLORE: The Journal of Science and Healing* 3: 404–406.

Moyer-Henry, K. 2008. Patenting *Neem* and *Hoodia*: Conflicting decisions issued by the Opposition Board of the European Patent Office. *Biotechnology law report* 1 Volume 27.

- Van Heerden, FR, Horak, RM, Maharaj, VJ, Vleggaar, R, Senabe, JV & Gunning, PJ. 2007. An appetite suppressant from *Hoodia* species. *Phytochemistry* 68: 2545–2553.
- Van Heerden, RF. 2008. *Hoodia gordonii*: A natural appetite suppressant. *Journal of Ethnopharmacology* 119: 434–437.
- Van Wyk, BE, Van Oudtshoorn, B & Gericke, N. 2009. *Medicinal plants of South Africa*. 2nd edition. Pretoria: Briza Publications.

TOPIC 7

SUSTAINABLE USE OF MEDICINAL PLANTS

Learning outcome

Discuss the sustainable use of medicinal plants.

Key questions

You will know that you have achieved this if you can:

- ◆ Discuss the sustainable ways which could be applied to conserve medicinal plants.



INTRODUCTION

Medicinal plants, just like any other important resources, should be conserved for future generations. Over-harvesting should be avoided. Environmental education on medicinal plant is essential in inculcating in communities their role in conserving their heritage. Just like people are often told about endangered species, the same should apply to medicinal plants. Once people understand the economic value of the medicinal plants and the value of the trade in raw medicinal plant materials they are bound to use them in a sustainable manner. All role-players in medicinal plants should be involved.

Activity 7

1. What role can be played by local people in conserving the medicinal plants they have harvested?
2. How can the destruction of habitat of medicinal plants caused by housing, industrial development and infrastructure be overcome?
3. As an individual, which contributions can you make in the conservation of medicinal plants?



Feedback

This study unit tests your understanding of environmental challenges faced by medicinal plants and plants in general. The resources we have should be used sustainably and cost-effectively.

You can consult other sources on this matter.

SUMMARY

In this study unit you have learnt that conservation of plants is very important for present and future generations.

SELF-EVALUATION QUESTIONS

Discuss ways to conserve medicinal plants in danger of extinction.

SOURCES CONSULTED AND FURTHER READING

Timmermans, K. 2003. Intellectual property rights and traditional medicine: policy dilemmas at the interface. *Social Science and Medicine* 57: 745–756.

The International Union for Conservation of Nature and Natural Resources (IUCN), Gland, Switzerland, in partnership with The World Health Organization (WHO), Geneva, Switzerland, and WWF – World Wide Fund for Nature, Gland, Switzerland. 1993. *Guidelines on the conservation of medicinal plants*. ISBN 2-8317-0136-8

Van Wyk, BE, Van Oudtshoorn, B & Gericke, N. 2009. *Medicinal plants of South Africa*. 2nd edition. Pretoria: Briza Publications.

Zschocke, S, Rabe, T, Taylor, JLS, Jäger, AK & Van Staden, J. 2000. Plant part substitution – a way to conserve endangered medicinal plants? *Journal of Ethnopharmacology* 71: 281–292.