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***Bioprospecting and Strategies
for Industrial Exploitation
of Medicinal and Aromatic Plants***

Workshop
22-27 September 1997
Enugu, Nigeria



2000



INTERNATIONAL CENTRE
FOR SCIENCE AND HIGH TECHNOLOGY

Bioprospecting and Strategies for Industrial Exploitation of Medicinal and Aromatic Plants

Workshop
22–27 September 1997
Enugu, Nigeria

Scientific editors
Karan Vasisht and Enrico Feoli

Sponsored by

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1

Introduction

The Bioprospecting and Strategies for Industrial Exploitation of Medicinal and Aromatic Plants Workshop focused on the possibility and viability of exploiting forests in non-destructive ways. The purpose of such exploitation is to tap renewable resources that have specific application to the production of "new drugs", as anti-cancer and anti-infection agents. Any discussion about the industrial exploitation of forests for medicinal purposes must address three central issues: firstly, how to enhance the public's general awareness that environmental conservation is essential, feasible and does not compromise economic benefits; secondly, that an (administrative) structure be introduced which ensures that indigenous communities are equitably compensated, based on the kind and quantity of material being extracted, as well as its market value; thirdly, that indigenous knowledge and wisdom be recognized, acknowledged, recorded and compensated and that a system be introduced which facilitates those vital steps.

The recent interest in bioprospecting and industrial exploitation of renewable resources rests on two important issues: the potential contribution to the health of people globally and the enhanced value of forest resources, which in turn promotes a greater incentive to protect and nurture forests in the short and long term.

In order to provide practical solutions to the issues outlined, the International Centre for Science and High Technology (ICS), an institution within the legal framework of the United Nations Industrial Development Organization (UNIDO), collaborated with the Bio-resources Development and Conservation Programme to conduct the international training workshop at Enugu, Nigeria, from 22 to 27 September 1997.

A. Objectives of the workshop

The efficient management and sustainable use of genetic resources have become essential to the socio-economic growth of developing countries. Such genetic resources have been valuable sources of food, building materials and medicines for rural communities. The depletion of plant genetic resources threatens the way of life of a large segment of the human population. It is now widely accepted that careful use of resources can alleviate poverty, enhance quality of life, improve food security and meet energy needs. In general terms, it has become crucial for countries to safeguard resources that meet the basic needs of their people without compromising the well-being of future generations and the integrity of the environment. Industrial utilization of medicinal and aromatic plants is a viable way of increasing the value of forests. The sustainable exploitation of the biodiversity resource not only guarantees improved health of local populations, it also contributes to economic development.

Workshop participants sought to define strategies for industrial utilization of medicinal plants with the following objectives:

- To train mid-level scientists, as well as private sector managers and institutions with backgrounds in biology, chemistry or pharmacognosy, on key elements in establishing a bioprospecting programme. The training programme revises the practical issues for the commercialization of biological resources and details the related technologies for the industrial exploitation of medicinal and aromatic plants;

- To identify potential focal points for the UNIDO–ICS network of biodiversity prospecting for industrial promotion and business development;
- To review, assess and collect state-of-the-art information on projects, methodologies, applied technologies and economic factors for the development of biodiversity prospecting programmes and initiatives.

B. Background

Industrial utilization of biological diversity has been recognized as a feasible way of adding value to forest resources. For developing countries, it has become crucial to formulate mechanisms for safeguarding a resource that meets the basic needs of people without compromising the well-being of future generations and the integrity of the environment.

As developing countries adopt a free market system and political pluralism, the interaction between economic needs and the necessity of environmental conservation becomes even more demanding, complex and urgent. The recognition and acceptance of this interaction was the focus of the United Nations Conference on Environment and Development that produced the Convention on Biological Diversity, adopted by the General Assembly in its resolution 53/190 of 15 December 1998. The Convention, which has been ratified by 166 nations, provides a framework for the exchange of genetic materials and the equitable distribution of the benefits arising from the commercialization of biodiversity.

With each year that passes since the United Nations Conference on Environment and Development, also known as the Earth Summit, that took place in Rio de Janeiro from 3 to 14 June 1992, it becomes more obvious that a huge gap exists between policy-level debates and the practical implementation of the tenets of the Convention on Biological Diversity. Scientists and scholars in developing countries, who are expected to provide the necessary link between concepts and practice, are often not privy to discussions concerning bioprospecting. Indeed, in most cases, they lack the necessary information or data that would enable them to provide serious advice to their Governments.

It is now widely accepted that the drug discovery programmes based on natural products offer one of the most economically viable approaches to increasing the net worth of forests. Tropical forests hold the greatest promise in the search for new drug molecules due to their high degree of biological diversity. A recent survey of the number and source of anti-cancer and anti-infective agents developed as new drugs for the period 1989 to 1995 showed that over 60 per cent of the approved drugs and pre-new drug application candidates are of natural origin. A commercial evaluation of the best selling pharmaceutical agents showed that nearly half of the drugs in that category were either natural products or their derivatives. An earlier analysis of data of the National Prescription Audit of the United States of America, from 1959 to 1973 reported that over 25 per cent of prescription drugs were derived from plant products. Of particular interest is the fact that 119 compounds of significant clinical importance are derived from 90 plant species and that 77 per cent of these are from plants used in traditional medicine. Traditional medicinal agents possess observable pharmacological activity, contain compounds with very impressive biological activity and a good pharmacokinetics profile. However, it does not necessarily follow that such materials can be easily transformed into therapeutic agents. The decision to develop a given compound to a commercial dosage form does not depend only on logical scientific criteria. Typically, the decision is based rather on corporate strategic interests and other commercial aspects, which may not be related to the scientific and medical merit of the discovered active molecule. Scientists, institutions and Governments of develop-

ing countries interested in entering into a biodiversity commercial business or collaboration with the private sector should have some insight into the factors determining the selection of a medicinal agent for development into a drug.

Issues identified as crucial for sustainable commercialization of biological diversity include:

- ❑ How to deal with policy considerations at the interface between ownership and access of genetic materials while simultaneously addressing the dynamic relationship between valuation and equitable distribution of benefits that result from the commercialization of genetic resources; and how investigators should compensate indigenous communities for their contribution to the development of genetic resources as marketable consumer goods. While establishing such benefit-sharing schemes, it is essential to ensure that the traditional systems and cultures are not disrupted by the wholesale importation of concepts and methods from outside, no matter how seemingly benevolent or well-intentioned. Local knowledge should be used for local self-reliance through equitable distribution of benefits and should result in an overall development of the area;
- ❑ The establishment of a commercial arrangement best suited to the complexities of multi-ethnic nations with large populations of indigenous communities and even for the special needs of individual countries. In other words, whether developing countries should provide access to their genetic materials through research agreements that provide for fixed one-time cash payments (as in the sale of automobiles), or whether they should enter into strategic alliances with private and commercial organizations for mutually beneficial programmes. The level of value added at the source nation before genetic materials are exported should also be determined;
- ❑ The establishment of adequate and sustainable technological platforms in countries rich in biodiversity that allow their genetic resources to be enhanced through material processing and product development.

The above issues are the subject of ongoing debate in industrialized countries and at international seminars. Although this has produced a plethora of interesting and highly informative literature, not a great deal of progress has been made in assisting developing countries to articulate workable policy models on bioprospecting. Examples of ongoing bioprospecting projects include the natural products programme of the United States National Cancer Institute; the ethnobotanical-based drug development programme of Shaman Pharmaceuticals, also of the United States; the International Co-operative Biodiversity Groups (ICBG) projects; the Instituto Nacional de Biodiversidad (INBio, Costa Rica) bioprospecting programme; and the development projects of the Bio-resources Development and Conservation Programme (BDCP). The projects are now available and offer improved programmes specifically designed to meet the needs of particular countries.

2

The workshop

A. Deliberations

The workshop began with a review of the global perspective on bioprospecting. The role of ICS, an agency within UNIDO, was discussed. There was a particular focus on the development and application of science and technology, and the industrialization of bioprospecting for pharmaceutical and other related industries. The discussion considered how industrial exploitation of medicinal and aromatic plants was integrally related to a country's development and environmental policies, and that the sustainable industrial production was dependent on the availability of raw materials. It was therefore agreed that bioprospecting was a necessary activity in formulating a national plan for industrial exploitation of these plants. Bioprospecting was seen not only as a screening activity for genera, species and ecosystems, but also as an activity that evaluated the sustainable industrial exploitation of these resources. The role of agrotechniques for domestication and propagation, and of biotechnology for assisting in the production of raw materials and products, needed to be examined carefully and taken into consideration. National policies for the development of rural areas required review in light of the fact that medicinal and aromatic plants were not only of great importance in the health systems of these areas, but also that they had potential for international trade.

Three key issues were discussed:

- ❑ In-country research and development through cooperative agreements that involved capacity-building, collaborations, partnerships and strategic business alliances;
- ❑ Acquisition or transfer of appropriate technology for material processing and product development;
- ❑ International bioprospecting arrangements.

Unfortunately, while bioprospecting per se had been addressed to some extent, little or nothing had been done with the other two issues. With regard to bioprospecting, it was noted that three key points requiring attention included the sustainable sources of raw material, material processing and benefit-sharing agreements.

Subsequent discussions addressed other issues, such as intellectual property rights, ownership and commercialization of medicinal and aromatic plant products and their processing. It was emphasized that laws were dynamic and not static. It was recommended that biodiversity legislation not be too restrictive in attempting to cover and anticipate all possible and imaginable future scenarios. Particular emphasis was placed on laws relating to intellectual property rights and patents. A review of existing legislation revealed that most African countries did not have appropriate laws to cater to the provisions of the Convention on Biodiversity, including bioprospecting. It was pointed out that individual countries needed to be encouraged to take legislative measures, thereby creating an environment that would enable the sustainable utilization of their biodiversity, such as strengthening intellectual property rights laws. The harmonization of such laws across Africa was necessary for a common regional position on the management of biological and ecological resources of Africa. It was noted with

concern that most laws in Africa tended to be punitive. In order to encourage community participation in this endeavour, it was important that laws be formulated after a transparent and participatory discussion with all stakeholders. Incentives needed to be provided to all stakeholders.

Reports and projects from different countries were presented and discussed, including reports from Cameroon, Ethiopia, Gambia, Ghana, Guinea, Kenya, Madagascar, Mali, Nigeria, South Africa, Uganda and the United States. It was apparent that each of those countries needed to encourage the involvement of universities and research institutions. This would ensure that the necessary knowledge required for the conservation and sustainable utilization of biodiversity was available. Standardization of phytomedicines was necessary for quality, process and dosage control in order to comply with existing laws. The relevance of producing official herbal monographs and compendia, such as those in the *United States Pharmacopoeia*, were highlighted. The workshop concluded with a visit to the BDCP Centre for Medicinal and Aromatic Plants at Nsukka, a resource centre established with support from Shaman Pharmaceuticals and the International Co-operative Biodiversity Groups programme. It had facilities for processing and documenting medicinal and aromatic plants. The services provided by the Centre included bioassays, production of extracts and maintenance of an extract library, analytical and quality assurance support to local biopharmaceutical and cosmetic industries, reference herbarium, library and training programmes on various aspects of biodiversity conservation and sustainable use of natural resources.

B. Recommendations

Following the deliberations and discussions of the workshop, nine recommendations were made that:

- ❑ The service coverage of UNIDO–ICS be expanded to include proactive capacity-building and technology transfer in the field of industrial utilization of medicinal and aromatic plants.
- ❑ African countries, as a matter of urgency, enact and apply appropriate and adequate legislation conducive to conservation and sustainable utilization of biodiversity, and that enforcement of these laws be a priority.
- ❑ The role of the Scientific, Technical and Research Commission of the Organization of African Unity be strengthened with the express aim of formulating a harmonized and enforceable African position on conservation and sustainable utilization of biodiversity. (The workshop recognized the important role of the Scientific, Technical and Research Commission of the Organization of African Unity.)
- ❑ African countries take urgent action to ensure adequate capability and capacity of human resources. A particular effort needs to be made towards increasing public awareness on the importance of medicinal plants, and their conservation, as well as initiating public enlightenment programmes within the local population to recognize intellectual property rights issues. This was especially relevant to direct users such as traditional medical practitioners, scientists, institutions, national agencies and industries. Concise national patent information policies needed to be formulated.
- ❑ Various aspects of other bioprospecting models, including benefit sharing and commercial utilization, be studied during the process of developing national policies on conservation and sustainable utilization of biodiversity.
- ❑ Multilateral institutions, such as UNIDO, the Global Environment Facility and the Scientific, Technical and Research Commission of the Organization

of African Unity, find mechanisms to rectify the lack of facilities for carrying out standardization and toxicological evaluation of medicinal and aromatic plants in Africa.

- ❑ Medicinal plant products and preparations in various formulations, already available on the market and in general use, be standardized in the shortest possible time.
- ❑ The Scientific, Technical and Research Commission of the Organization of African Unity reactivate the publication and dissemination of *Research on African Medicinal Plants* and revise the *African Pharmacopoeia* as soon as possible. (It was recognized that the information exchange within Africa in the field of African medicinal and aromatic plants is extremely limited.)
- ❑ The BDCP be assisted in extending its intermediary role to other African countries not yet covered and, if possible, to other developing countries in Latin America and Asia. (It was noted that the efforts of the BDCP in training and capacity-building in many African countries were greatly appreciated.)

3

Summary of presentations and reports

A. Introduction to the UNIDO–ICS Programme

Speaker: Professor Enrico Feoli

Professor Enrico Feoli presented a paper entitled “Overview of UNIDO–ICS Activities and Programmes” in which the mandate of the ICS was discussed, in particular, the transfer of know-how and technology from developed to developing countries. Professor Feoli observed that the transfer was justified by the perception that a competitive industrial and technological capability could not be built without adequate scientific knowledge and access to new and advanced technologies. The session outlined the role of ICS in promoting science-based technologies and enhancing industrial development through the establishment of networks.

The list of target beneficiaries of ICS included scientists, researchers and technologists in research and development (R&D) institutions, science-based industry clusters and/or industries with their own R&D facilities. ICS sought close cooperation with the industrial sector, either through direct interaction or through the provision of eco-services by national and regional R&D institutions. To this end, institutional strengthening and capacity-building of selected national R&D institutions was adopted by ICS as a cost-effective approach to make available the required scientific, technical and managerial services to local industries.

The current ICS work programme focused on specific areas including the environment, chemistry, high technology and new materials. In selecting specific subprogrammes and their related activities, special consideration was given to the scientific and technological needs of developing countries.

ICS operated within UNIDO, an arm of the United Nations. The focus of UNIDO activities was to identify and evaluate sound technologies suitable for accomplishing its goals. ICS had established the following mechanisms of operation: different forms of training; serving as a clearing house of information; and cooperation among institutions.

The areas of ICS activity comprised: earth, environmental and marine sciences; pure and applied chemistry; and high technology and new materials. The theme of the current workshop fell under the area of earth, environmental and marine sciences. It was noted, however, that all three areas worked together to achieve meaningful results.

ICS training activities began in 1988. The activities have created a network of people willing to work together towards a common goal.

Discussions during the workshop gave rise to the question of dissemination of information regarding the ICS training programmes. (The idea of a newsletter was discussed, but was not the favoured option.) The network, already beginning to form at the workshop, was agreed to be an effective means of disseminating the relevant information.

B. Sessions

1. *Overview of global prospecting projects*

Chairman: Professor Enrico Feoli
Rapporteurs: Dr. Deborah Kioy and Dr. Simon Efangé

Topic: *Overview of global bioprospecting*
Speaker: Professor Maurice Iwu

Professor Iwu introduced his topic with the remark that more than an estimated 40 per cent of the world's economy was directly dependent on the utilization of biodiversity. The information had been drawn from a Convention on Biological Diversity report.* The maintenance of biological diversity had a direct impact on global climatic stability, food and fresh-water security and human health. The depletion of plant genetic resources, therefore, threatened the way of life of a large segment of the human population and might result in environmental degradation with possible catastrophic consequences. It was becoming more widely accepted that careful use of such resources led to poverty alleviation, improvement in quality of life and food security and meeting energy needs. For individual countries, it had become crucial to safeguard the resources that provided the basic needs to their people without compromising the well-being of future generations and the integrity of the environment. It was hoped that strategies would be identified and developed that encouraged channelling of economic benefits of biodiversity to the people in greatest need.

One of the methods advocated for adding value to biodiversity was the development of pharmaceuticals, cosmetics and related products from natural resources. The search for a genetic material with the desired biological activity for development into a marketable good had come to be referred to as biodiversity prospecting or "bioprospecting". Although the term used to apply to the quest for genetic materials for biochemical investigation, it had come to refer specifically to commercial activities involving companies in industrialized countries and institutions in developing nations.

The point was made that bioprospecting was a very controversial subject and there was little agreement on any aspect of the process among key players. Much of the controversy had to do with issues of ownership of plant genetic materials and access to legislation concerning material and intellectual property. In the fore was the problem of assessing the value of a genetic resource and agreeing on what constituted a fair deal. A major decision made in establishing a bioprospecting project was the definition or identification of the overall objective of the programme. A realistic assessment of the anticipated benefits and results needed to be put forward and a plan developed for the equitable distribution of income generated from biotrade. Such an assessment had become the single most important prerequisite for bioprospecting. A frequent but misguided assumption existed that every relationship between developed and developing countries was inevitably exploitative. Owing to such an assumption, unfounded and false perceptions about bioprospecting in general had arisen.

Parties that benefited from genetic sharing needed, firstly, to address the needs of source countries for cheap, high-quality products and reduce the dependence on imported pharmaceuticals. Secondly, technological development and capacity-building needed to be promoted. Following from this, physical and intellectual contributions of individuals and communities that had protected, processed and developed the biological resource needed to be rewarded. Finally, incentives for conservation needed to be provided.

*From the *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992* (United Nations publication, Sales No. E.93.1.8 and corrigenda), vol. I: *Resolutions adopted by the Conference*, resolution I, annex II.

Ideally, the goals of conservation needed to identify: the development objectives to be achieved; the social and economic forces leading to the loss of biodiversity; ways of reducing or even reversing the current rate of biodiversity loss; and the priorities within biological conservation.

Professor Iwu identified three major vehicles for the sustainable use of biological resources: firstly, domestic R&D; secondly, product development through partnership arrangements such as cooperative research agreements and strategic business alliances; and thirdly, bioprospecting that involved direct trade of genetic resources from developing countries to industrialized nations. While the latter point had received a great deal of attention, the first two had been largely disregarded. The term bioprospecting has become synonymous with every aspect of exploration of natural resources for the industrial production of marketable goods, regardless of whether the activity was in domestic R&D or in joint collaboration. Key issues in bioprospecting included access regulation, sustainable sourcing, material processing and benefit sharing. While these issues were clearly recognized by the Convention on Biological Diversity, successful implementation of the principles articulated during the conference required creativity on the part of stakeholders. An over-simplified approach to issues such as profit-sharing, which ignored the distinction between the discovery and the ensuing technology, potentially caused impediments to progress. Recognition of this distinction was particularly important for less developed nations that might have had the infrastructure for discovery, but were ill-equipped to develop the associated technologies.

Bioprospecting was affected by both internal factors (such as availability of material, capacity assessment and material environment) and external factors (such as Convention on Biological Diversity compliance, external markets and partnerships). Examples of bioprospecting projects included the United States National Cancer Institute programme; the Shaman Pharmaceutical drug development projects; the ICBG projects in Latin America, Asia and Africa; the bioprospecting project initiated by the IOCD-BDCP in South Africa, based at the Council for Scientific and Industrial Research, Pretoria, South Africa; and the much-publicized biodiversity initiative by INBio in Costa Rica. Each endeavour was unique in many ways and it was not possible for some of them, such as the INBio model, to be simulated in other countries.

There were numerous BDCP activities in the region including examples such as training programmes aimed at building relevant capacities in several aspects of bioprospecting, ethnobotanical inventories established in many parts of Africa and the Centre for Medicinal and Aromatic Plants established at Nsukka, Nigeria. At the Centre, extractions and bioassays were performed, analytical and quality assurance support was provided to the biopharmaceutical and cosmetic industries, reference data of plant extracts were maintained and training was provided. In addition, the Fund for the recently established Integrated Rural Development and Traditional Medicine was set up and the acquisition and maintenance of permanent conservation plots in Nigeria and Cameroon took place. Such plots were being used to create a database for tracking changes in biodiversity, economic value and status of domestic plants facing extinction, such as *Prunus africana*. An interactive database of African medicinal plants was linked to other databases on the continent. This assisted institutions and organizations in Africa to establish bioprospecting projects and business developments based on the sustainable use of natural products; it also assisted collaborating partners for the African ICBG with projects in Nigeria and Cameroon.

BDCP maintained a web site and an electronic newsletter. Bioprospecting needed to focus on resource conservation, material processing and commercialization of the products. The principal elements of a successful biodiversity project included a sustainable source of genetic materials; a technology platform (that provided the capability and capacity assessment); good business development; and an equitable distribution of benefits.

Professor Iwu was asked to comment on the variations in the composition of plant extracts and the difficulties associated with the adoption of suitable reference standards of plant extracts as envisaged in the proposed extract library at the Centre for Medicinal and Aromatic Plants. Professor Iwu acknowledged the problem and stated that initially the reference extracts would be characterized by chromatographic fingerprinting to accommodate the aforementioned variability. Subsequent efforts would be made to characterize extracts obtained under a variety of conditions. When asked if conservation was regarded by indigenous populations as a threat to their well-being, Professor Iwu replied that these populations were receptive to efforts that provided additional sources of income. Finally, in response to a question on capacity assessment, he emphasized that there was no single institution in any of the African countries that had the critical mass of scientists required for the successful implementation of ventures in biodiversity and bioprospecting. He concluded that collaboration among scientists and other stakeholders was essential for the success of the bioprospecting enterprise.

On the operational framework of BDCP, Professor Iwu explained that the BDCP was a non-governmental international organization established in 1991 by a resolution at the inaugural meeting of the Steering Committee at the University of Nigeria, Nsukka. The international programme had been, however, formally established at the 1992 Earth Summit, at an African forum on biodiversity conservation. A network of scientists, industrialists and policy experts had been interested in the issues of providing a link between conservation of tropical forests and economic development. The main mandate of BDCP was to encourage the understanding and appreciation of tropical ecosystems (such as forests, coastal marines, woodlands, savannahs and drylands) as biological resources potentially used as instruments of sustainable development; to link the well-being of tropical ecosystems with the health of human inhabitants through the development of plant-based medicines for the treatment of tropical diseases; to assist indigenous communities, private institutions and individuals in tropical countries to enter into a biodiversity prospecting business (local, national and international) that guaranteed them good returns for their knowledge and labour and also protected forest resources; to seek international support for critically underfunded, community-based biodiversity conservation projects; and to promote study and research in the area of biological diversity and conservation.

In order to implement efficiently its mandate, BDCP was organized into different activities. Information had been collected on the use of African plants with special reference to indigenous food crops, industrial crops and medicinal and aromatic plants. The selected ecologically sensitive zones were monitored for biodiversity loss, and conservation of tropical African forests was encouraged by undertaking basic research on various land use options for the sustainable utilization of tropical forests. Such activities stimulated public awareness and concern about the vanishing resource base of tropical agriculture. BDCP also gave support to the activities of organizations and groups that were working on those issues and fostered cooperation and communication among them. Such activities initiated and encouraged efforts by local communities for sustainable exploitation of biodiversity resources for economic development. They encouraged the establishment of small-scale agro-industry and marketing enterprises that sought to empower the poor and the powerless.

Professor Iwu's discussion turned to BDCP, which relied entirely on grants and specific project funding to carry out its activities. BDCP had been conceptualized as a non-profit, non-governmental institution and the programme was designed to generate its own funds independent of direct assistance from Governments. It was envisaged that most of its activities would be financed eventually from royalties and trust funds.

2. Policy and legal frameworks for bioprospecting

Chairman: Dr. Robert Mshana

Topic: *Intellectual property protection, ownership and commercialization of medicinal and aromatic plant products and processes*

Speaker: Dr. Lucas Sese

Dr. Sese's paper highlighted the importance of laws within countries for intellectual property rights in an era of augmented international trade. It outlined the history of the development of laws and pointed out that every law was created in response to a crisis. The present crisis for international trade was the protection of indigenous knowledge. It was hoped that some form of international property rights law would soon be developed to solve the issues associated with indigenous knowledge and herbal remedies.

The discussion turned to property rights, and the three categories it comprised, namely, movable property, immovable property and intellectual property. Intellectual property is the ownership of ideas and control over the tangible or virtual representation of those ideas. One form of protection under intellectual property rights is the patent. Patent laws protected inventions that had been proven to be absolutely novel and indicated possible industrial application. The applicant of the patent is given exclusive rights on the condition that technological information was disclosed to the State in the form of a patent document.

Dr. Sese presented a situation analysis of the issues of biological resources of developed versus developing countries. The availability of intellectual property rights in developed countries for the protection of biological resources had resulted in the biotechnology era. In contrast, developing countries had been weak in intellectual property rights but rich in biological resources and indigenous knowledge. There was therefore an urgent need to develop an appropriate intellectual property rights regime to protect both resources and knowledge.

Topic: *Need for sustained utilization, development and commercialization of medicinal and aromatic plant products and processes*

Speaker: Mr. James Pearce-Biney

Mr. Pearce-Biney addressed the concern that African traditional medicines had not been developed to western pharmaceutical standards. This factor placed traditional medicines at a distinct advantage as a market commodity. Traditional medicines came from Africa in crude form and were refined into finished products in developed countries for marketing at high prices. The crude forms of the medicines played an important role in primary health-care systems in Africa and were used by communities because they were cheap, effective and easily available to the rural population.

Efforts to improve and control the use of those traditional medicines had been frustrated by the way they continued to be used. The practitioners often operated in isolation and were secretive. In order to improve and preserve traditional medicines, training programmes needed to be undertaken in several aspects concerning conservation measures, cultivation of plant species, collection methods, preparation of medicines into appropriate dosage forms, quality control, packaging of medicines and advertising.

In an attempt to control the use of traditional medicines, the Government of Ghana had enacted some laws dealing with the registration of herbal and homeopathic drugs. Government awareness was necessary in order to educate traditional practitioners for registration.

Topic: *Herbal medicine practice in Uganda*
Speaker: Mr. Godwin Sentongo

Mr. Godwin Sentongo, a traditional doctor from Uganda, gave a short account of his part-time practice. In his practice, plant materials were used, including leaves, stems, roots, barks and flowers. The extracts were sometimes formulated into tablets, creams and solutions and natural preservatives were normally added. Mr. Sentongo started to practise seriously in 1985. He claimed to have treated colour blindness, eye defects, cancer, HIV/AIDS, skin diseases, diarrhoea, diabetes and ulcers.

Mr. Sentongo raised the issue of availability of raw materials and the need for conservation of particular, useful plants that were being destroyed at alarming rates. He stressed how important it was that various stakeholders, including scientists, industrialists and traditional healers, collaborate in order to maximize the benefits from Africa's immense genetic and cultural resources.

3. Implementation of the United Nations Convention on Biological Diversity (panel discussion)

Topic: *Policy framework for bioprospecting and intellectual property rights*
Speaker: Mr. Edwin Barnes

Mr. Barnes outlined some of the problems associated with formulating and implementing biodiversity policies within the framework of material sovereignty. Since many of the developing nations faced similar problems and since a given genetic resource could often be found in more than one country, the adoption of common regional policies for biodiversity was a viable solution. Due to the low level of participation by African nations at international conventions devoted to biodiversity, the Organization of African Unity needed to be empowered to articulate the collective view of African nations, since the deliberations often supported various aspects of economic development in the continent.

Dr. Lucas Sese suggested that the concept of intellectual property, as originally formulated, was ill-equipped to handle African biological resource issues, as it did not explicitly recognize community interest. Modern laws needed to be passed to address the issues related to bio-resource utilization. Differences between the two international conventions on trade needed to be reconciled and African States needed to adopt laws to protect both intellectual property and plant-breeders' rights.

Dr. Nnadozie cited that lack of political will and a positive attitude were two major factors responsible for the failure of African nations to formulate coherent policies on biodiversity. Empowerment of non-governmental organizations might greatly augment the implementation of the Convention on Biological Diversity. Access to bio-resources would be aided by the adoption of a common policy on biodiversity by African nations. The likelihood of its adoption would be greatly enhanced if such a policy framework were flexible enough to accommodate conditions unique to each nation. African nations needed to be willing to make concessions to obtain assistance for developing their biological resources.

At the same time, industrialized nations needed to be encouraged to channel resources back to the sources of the biological "mine" in order to compensate the keepers of the knowledge and to ensure sustainability.

While non-governmental organizations might greatly help in formulating policy at the international level, they did not replace legitimate national Governments in negotiating treaties or conventions. Though African Governments, as a whole, had been slow in articulating national policies on biodiversity, some of them had acted quickly when threatened with loss of a specific resource.

4. *Computerized information systems and bioprospecting*

Chairman: Professor Iwe P. Akubue

Rapporteurs: Dr. Kent Nnadozie and Dr. Medhin Zewdu

Topic: *Resource systems in the use of medicinal and aromatic plants*

Speaker: Professor Enrico Feoli

Professor Feoli opened the session by describing the two types of database systems, namely, resource and exploitation. Resource databases included information on soil, vegetation and atmosphere. Exploitation databases included details on clinical tests, chemical and biological screening as well as marketing information. Key elements in promoting the industrial use of medicinal plants were the interaction of people with resources and intellectual property rights, and laws that regulate their use. Databases were a key factor in the use of medicinal plants. It was better to form small databases, e.g. taxonomical data of a plant with synonyms or vernacular names and link these databases together to form a network. The database of Pretoria was cited as an example that had been developed by the National Botanical Institute. Professor Feoli considered the database too large and cumbersome to be of practical use. Whenever a pharmaceutical industry was interested in developing a drug from plants, it needed to have a close relationship with the healers who had the knowledge and it needed to operate within a system where all could benefit.

Professor Feoli was asked how ownership rights of indigenous knowledge were to be protected if information were in a database. He replied that information in a database was widely accessible, so there was no way to protect intellectual property rights for that particular information. When asked whether an arrangement might be made pertaining to the different types of databases, Professor Feoli answered that it was possible to link one database with another and that the task was simplified by having at least one or two similar data fields.

Asked to clarify what was meant by plant trial, Professor Feoli responded that this referred to bioassay of isolates or even crude extracts, where an isolate was a pure compound separated from the crude extract and constituents were compounds present in the extract.

Topic: *Policy initiatives on bioprospecting in Ghana—Ministry of Environment, Science and Technology*

Speaker: Mr. Edwin Barnes

Mr. Barnes described the objectives and activities of the Ministry of Environment, Science and Technology, where policy formulation on the Convention on Biological Diversity was the major activity. The office dealt with developments of legislative policies and data management issues. Under the Global Environment Facility, a bioprospecting study concerning the management of biological resources of the country was being carried out. The national biodiversity policy covered various activities involving conservation and sustainable use of resources. It was recommended that a biodiversity unit be created as a focal point to facilitate activities and to strengthen and give support to identified research units or regulatory bodies. Mr. Barnes highlighted the point that Ghana was one of the two African countries involved in the United Nations Environment Programme project to study biological resources. In this regard, five local institutions were networked, each with its own database. Mr. Barnes outlined other biodiversity projects currently being implemented in Ghana. The country had formulated a policy regarding biodiversity and was establishing a unit for management but not for control of bioprospecting. Participation of the private sector in bioprospecting was emphasized, as was the need for a biological inventory and the establishment of a resource database. He elaborated on the usefulness of a database and cited the example

of the PRECIS information database of the National Herbarium in Pretoria, South Africa and the CISMAT being developed by BDCP. However, a major disadvantage was that this exposes information, thereby compromising intellectual property rights.

The creation of the biodiversity unit was discussed. Mr. Barnes described in more detail how it would be structured; for example, that its function was as a coordinating unit or committee made up of members from different institutions. It was solely a management unit, not a control agency, and was represented by one person as a secretariat officer. The issuance of permits and related activities had been separated and were handled by different agencies.

The discussion turned to how academic institutions helped entrepreneurs in promoting bioprospecting activities. Mr. Barnes was asked to comment on this and replied that the role of academic institutions was to identify and confirm plant species upon request. Training programmes were also provided with the available human and material resources. In this way, the relationship between the private and public sector was becoming strong.

5. Sustainable sourcing of medicinal and aromatic plants

Chairman: Dr. Bwogi Kanyerezi

Topic: Ex situ conservation of indigenous African plant biodiversity

Speaker: Professor Alfred Oteng-Yeboah

Professor Oteng-Yeboah opened his discussion with an explanation as to why he preferred domestication over conservation of plants. The former involved the regeneration of plant species in environments or sites other than those in which the plant had always been growing. The justification was that wild plants were being lost owing to the uses to which the land was now subjected. Uncontrolled fires and unsustainable harvesting practices, for example, threatened plants. The objective of domestication was to regenerate a species at different sites in order to prevent its extinction. A list of criteria was provided demonstrating how a species was selected for domestication. It included rare and threatened species, keystone species in major ecosystems, endemic floristic elements of phytochoria and highly significant species in medicines and food.

In strategies to fulfil the objective of domestication, the role of botanic gardens and nurseries, ethnobotanical surveys, distribution maps, ecological data and pilot studies was emphasized. Examples of plants for domestication that were in high demand for use in medicines included *Calophyllum lanigerum* (calanolide A), *Homolanthus nutans* (prostratin) with anti-HIV activity and a species of *Podophyllum* and *Taxus* with anti-cancer constituents.

The discussion that followed focused on the role of biotechnology in biodiversity, where biotechnology was recommended as one method in domestication. It was also possible to use tissue culture as a multiplication and genetic transfer method in *ex situ* conservation. However, the technology was not available in most developing countries. Additional comments were made on the need for the cultivation of plants for various purposes, especially of rare and endangered species.

Topic: Bioprospecting and the conservation of biological resources

Speaker: Dr. Nat Quansah

Dr. Quansah described bioprospecting as the search for wild species and their products, with actual and potential usefulness to humans, where the products were commercial or non-commercial. He described the conservation concept as the management of human use of the biosphere so that potentially it yielded the greatest sustainable use or benefit to present and future generations. He noted that recent moves in the osten-

sible interest of preservation had actually brought about a total embargo, i.e. access to natural resources was now denied to local communities that had always conserved the available resources. Bioprospecting was an inventory of economic ventures that depended on biological resources and conservation and was the management of available resources. Bioprospecting had to be carried out within the limits of the principles of conservation. Workable strategies were defined as taking something away and putting something back in order to maintain a balance.

General comments included the observations that the key question needed to be "how much" and that this was usually the missing element in most bioprospecting ventures.

In reply to a question concerning farmers' perspectives of conservation and bioprospecting in Madagascar, Dr. Quansah replied that while prospecting was taking place, a relationship of trust was being built with the people. Upon request from the local community, a clinic was built in which the traditional healer and the doctor worked side by side. The patient was diagnosed first by the healer and, in cases where the patient was not able to get help from the healer, the doctor intervened. Since providing those services was part of the biodiversity venture, the community had an incentive to continue conserving resources.

General comments included a remark that research at post-graduate level was very useful in the field of sustainable uses of plants. If, for example, the root part was used by the healer, the plant might become extinct. Academicians needed to contribute by helping to determine whether the constituents were also found in other parts of the plant. It was then easier to convince the healer that other parts of the plant could be substituted in critical cases.

Topic: *Information on the pharmaceutical service and regulatory conditions in Gambia*

Speaker: Mr. Momodou Cham

Mr. Cham gave an overview of the situation in his country, regarding pharmaceutical industry regulations and drug control activities. He stated that, until the mid-1970s, the country had good forest cover but, as a consequence of increased tourism, it had now been diminished. There was an attempt to regenerate the vegetation. Regarding medicinal plants, there was no clear-cut policy and few modern herbalists existed in the country. The role of a regulatory body was also mentioned for the control of efficacy, safety and quality both for locally manufactured and imported pharmaceuticals. The drug control laboratory within the institution had a very limited capacity to provide analytical services. Future plans included formulating a team to work towards a better use of traditional medicines. It was mostly done now by individual arrangement and there were constraints such as unavailability of botanists.

In reply to a question about training in pharmacognosy, Mr. Cham said there was no university in Gambia and that people were trained overseas.

During the discussion, an observation was made that professionals had to work against the odds with regard to formulating laws for the protection of forests. The regulatory body in Gambia used to be consulted by the customs office for quality assurance and for issuing certificates for imported items. Now the herbalists were importing materials that in turn had created a lot of cross-border movement of herbs, highlighting the issue of international cooperation.

Topic: *BDCP programme in Guinea*

Speaker: Dr. Foula Barry

Dr. Barry described to the audience how the BDCP was established in Guinea. It was started in 1994 with the help of Professor Iwu. The goals of the programme were to produce low-cost medicine, to develop an inventory of medicinal plants and to provide

assistance to rural communities in making better use of the available flora. Data collection of potential medicinal plants was conducted with scientists from Shaman Pharmaceuticals. No difficulties had arisen concerning the issue of intellectual property rights and the reciprocity programme of Shaman Pharmaceuticals in Guinea. The main interest was to encourage and assist traditional healers' groups. BDCP-Guinea started in-field compensation from 1996 to the National Association of Traditional Healers. The healers provided information about plants to look for and where to find them.

In response to a question concerning how companies keep the agreements, Dr. Barry replied that both partners had to respect norms. When this happened, there were no problems. The company had a set of criteria for sharing benefits, but more important was the emphasis on the need to build social links and engender trust among local populations which went beyond mere financial returns.

Topic: *Ethnobotanical collection and tracking methods for medicinal plant research*

Speaker: Ms. Julie Chinnock

Ms. Chinnock described the systematic process involved in carrying out bioprospecting activities and highlighted her personal experiences in botanical collections in Guinea, as part of the programme by Shaman Pharmaceuticals for the expansion of ethnobotanical and ethnomedical drug discovery in the tropics. The programme involved a combination of traditional and modern scientific knowledge and procedures used in local and global health-care systems. The importance of in-country scientists in the entire set-up was recognized. Appropriate procedures such as obtaining necessary permits had to be undertaken before carrying out the venture. In addition, it was essential to be practically prepared by making use of the appropriate tools and equipment for the collection, identification, cataloguing, preservation and storage of plant samples. One of the primary steps that needed to be taken before commencing any fieldwork was for duplication to be prevented. This involved assessing what work had been done in order to concentrate efforts and direct resources towards new candidates for collection and testing.

When questioned as to whether there were alternative local materials for constructing presses for plant specimens, Ms. Chinnock said there were many options and that the important thing was to arrive at the desired conditions and results.

In the general discussion, a comment was made that Shaman Pharmaceuticals was a company that had gone into the practical activities of bioprospecting and that much could be learned from it. In terms of initial agreements, especially at the national level, to regulate their activities with reference to intellectual property rights issues, the observation was made that, although no national laws currently existed covering biodiversity activities, Shaman Pharmaceuticals and the BDCP tried to work within the existing laws to make sure that rights were not being contravened.

Ms. Chinnock added that, apart from obtaining permits at national, regional and local levels, it was possible to enter into elaborate agreements for regulating activities as well as stipulating other conditions such as scope and compensation issues.

6 and 7. *Tools of the trade*

Chairman: Dr. Robert Boroffice

Topic: *Herbal medicine: HIV therapy in Uganda*

Speaker: Dr. Bwogi Kanyerezi

Dr. Kanyerezi gave a survey of some of the cases handled by him involving the treatment of HIV patients with herbal preparations. According to Dr. Kanyerezi, he had been approached by herbalists who claimed they had remedies for the HIV infection.

His approach, in order to maintain the confidence of herbalists, was not to investigate the type or source of their herbs, but to find out if their claims were authentic. After collecting the substances presented to him, he subjected them to a series of tests before administration. These tests included determining whether they had antiviral activity, toxicity and therapeutic indices suitable for clinical use. Based on his research, Dr. Kanyerezi reported that no single drug was used since the patient developed immunity to it within a few months. Therefore, a cocktail of four or five different types was usually used to maintain effectiveness.

Once the substance was established as a potential drug, Dr. Kanyerezi went on to conduct clinical trials over a long period with varying results ranging from excellent to poor. In one of the six cases presented, one patient was found to be HIV-negative after the course of treatment even up to one year afterwards, while one died during the course of treatment. Other cases were in between, based on their "CD₄" count. Dr. Kanyerezi was asked to say whether he had found the cure for AIDS. He refused to make a categorical claim, stating that it was possible that a lot of other factors had contributed to curing a single patient and that trials are still continuing.

Topic: *Returning benefits from ethnobotanical drug discovery to native communities*

Speaker: Dr. Katy Moran

Dr. Moran presented a paper based on a case study and practical experiences in bioprospecting with particular reference to compensation issues. She gave a brief background of the Healing Forest Conservancy, a charitable organization established by Shaman Pharmaceuticals, that channelled benefits back to local communities where bioprospecting activities had been carried out, as well as to the Government.

Article 8, subparagraph (j) of the Convention on Biological Diversity was the basis for the initiative. The article compelled corporations to channel back benefits to the local communities. This had led the Healing Forest Conservancy to establish its own goals of community compensation, which included the promotion of sustainable development, generation of local employment, provision of resources to survey, demarcation and deeding of historic territories to indigenous groups and development of local markets for non-timber forest products, such as medicinal plants, and strengthening indigenous institutions.

Consequently, certain long-term compensation principles were established; there were two processes for compensation: one for the Government for the use of biotic resources and the other for indigenous groups, for the use of cultural resources. All those involved shared equally, that is, a percentage of Shaman Pharmaceuticals profits was distributed to all indigenous committees and countries with which it had worked, regardless of where the actual plant sample or traditional knowledge originated. The process benefited community groups as a whole and not individuals. Long-term compensation persisted as long as Shaman Pharmaceuticals showed a profit. There was a deliberate effort not to give too much too soon, since it was better to give small amounts over a long period of time than to give a large single amount. The latter had the potential either to overwhelm local communities' ability to manage it or create other problems.

Based on such principles, the Healing Forest Conservancy created a mechanism to deliver long-term funding to programmes in a consistent manner, offering flexibility in responding to local needs and using locally elected boards to manage funds. The mechanism was the establishment of trust funds whose boards were selected democratically for a specified term and had fiscal responsibility for funds. The boards did not implement projects but they did decide which ones to fund. A pilot trust fund was already being established in Nigeria in collaboration with the BDCP, to which an initial sum of \$40,000 was to be provided.

During the question and answer session, an observation was made that the advantages of this sort of mechanism were twofold: firstly, it diffused the risk of each of the indigenous groups in negotiating and getting benefits; and secondly, it provided a credible vehicle for recycling benefits.

Topic: *Medicinal plants for industrial exploitation*

Speaker: Dr. Deborah Kioy

Dr. Kioy presented the situation in Kenya, where medicinal plants were used extensively in traditional medicines and where most of the conventional pharmaceuticals originated from plants. She gave an overview of exploitation strategies and the interrelationships inherent and necessary for the successful commercial exploitation of medicinal plants. The activities of her department were restricted by economic limitations, particularly in terms of travelling to establish direct contact with practitioners. There was also a shortage of necessary equipment for thorough analysis and tests. Nevertheless, they had been able to do extensive work with traditional medical practitioners and they had also established a herbal garden. It was observed during the discussion that whatever methods and approaches were adopted, it was of paramount importance to observe good clinical practices in order to ensure consistency and reinforce credibility.

Topic: *The state of bioprospecting in Mali*

Speaker: Dr. Flabou Bougoudogo

Dr. Bougoudogo presented a paper on behalf of Professor Arona Keita. The paper highlighted the work done by Professor Keita in making several commercial herbal preparations, despite limited resources. He had collaborated extensively with local herbalists and had many aromatic plants currently under study. He used the outcome-based approach, working closely with clinicians.

8. *Process technology for the production of phytomedicines*

Chairperson: Dr. Lisa Messerole

Summary of the major topics discussed

There was an increasing interest of industries from the United States, western Europe and other developed countries in the biodiversity of some developing countries. The trend was likely to continue for at least the next three years, potentially meaning major economic benefits for developing countries. However, for the owners of these resources to benefit, certain laws and regulations had to be developed.

Botanicals were not regarded as medicines in the United States, but as dietary supplements. It was critical that the quality and safety of botanicals met United States standards. Botanical monographs were being developed by the *United States Pharmacopoeia*, but public standards were only meaningful if enforced. Good cultivation practices and good harvesting practices were critical for quality assurance of botanicals. The next important step was the formulation of the material into a suitable dosage form. Further research into phytomedicines meant the possible discovery of new medicines, thus returning major benefits. It was important that the role of the traditional healer not be over- or underemphasized in the whole exercise.

Topic: *Key legal and ethno-ecological components of a bioprospecting agenda*
Speaker: Dr. David Stephenson

Various definitions of ethnobotany, bioprospecting and intellectual property rights were proposed. Their legal and ethno-ecological ramifications were emphasized. Dr. Stephenson traced the origin of the term bioprospecting to biodiversity and prospecting. He suggested that careful thought be given at the outset, not only to how a bioprospecting project was to be carried out, but also to how that activity was to be communicated to local populations, Governments and scientists.

There were indications of increasing interest on the part of industries in the biodiversity of developing countries. The trend was likely to continue and these countries stood to benefit considerably from such a situation. The cultural differences and the fact that indigenous people were dependent on biodiversity needed to be understood. Dr. Stephenson cited excerpts from the Declaration of Belem,* which acknowledged that native people were directly responsible for 99 per cent of the world's genetic resources. There was an important link between biodiversity and cultural diversity. The risk was that wealth and values were lost when scientific and industrial objectives took priority.

Local communities had a right to control their resources and receive compensation for the use of their resources and knowledge. To bioprospect, it was important to be aware of the legal aspects of intellectual property rights, licensing agreements, various multilateral conventions, e.g. the Convention on Biological Diversity, natural laws and ethical guidelines. Several concepts, such as the Declaration of Belem, had been developed in the last 10 years. Biotechnology was in a rapid phase of development. All countries needed to be poised to participate. It was important that parties to the bioprospecting ventures came to an agreement on sharing resources, such as the guidelines governing financial gain and proper compensation to stakeholders.

Legal and ethnobotanical frameworks needed to be developed. Intellectual property rights was a western legal term: it connoted the private property of one person. Traditional resource rights was a term that went beyond intellectual property rights and was more relevant to the context under discussion.

Additional comments were offered by several participants. One observed that it was important to get involved in the national laws as citizens of the country. Another voiced the opinion that members of developing countries were being instructed by the western world and told what to do about legal issues. It seemed the contracting party was the United States and decisions were being made by the west. According to another participant, the big problem was who would receive the compensation.

This led to further comments from the audience and included the point that ratifying a convention was not the same as implementing it and that national legislation needed to be enacted in order to incorporate the convention.

One participant contributed the comment that the definition of indigenous people was not relevant to Africa; that no African group had been identified as not being indigenous and, therefore, that the beneficiaries were the local people or Government.

The discussion continued and the further point was made that firm legal structures needed to be implemented for conventions, treaties, law contracts, agreements and ethical guidelines. Finally, the session concluded with a comment about the importance of article 8, subparagraph (j), of the Convention on Biological Diversity, although it could be overwritten by other laws. Local people were parties to the agreement.

*The Declaration of Belem was adopted at the First International Congress of Ethnobiology in 1988. The International Society of Ethnobiology urged certain actions, acknowledging that native peoples have been stewards of 99 per cent of the world's genetic resources; their economic, agricultural and health conditions are dependent on these resources; and there is an inextricable link between cultural and biological diversity.

Topic: *Role of botanical products in the health-care system and scientific issues in the development and establishment of public standards for botanicals*
 Speaker: Dr. V. Srinivasan

Dr. Srinivasan's introductory remarks gave the wide ranging relevance of the topic, in particular the point that herbal preparations had a place in the health-care systems of both developed and developing countries and that the preparations needed to be standardized. The botanical product market in the United States was growing annually at a rate of more than 12 per cent. In the United States, herbal products were sold as dietary supplements and were not regarded as medicines. More than one third of all Americans used alternative medicine daily in routine health care. About 85 per cent of Africans used traditional medicine due to the inaccessibility of western treatment methods.

The issue of quality, safety and efficacy of botanicals was discussed. Federal agencies were aware of issues related to herbal medicines. The example cited was the collaboration plan of the Office of Alternative Medicines, National Institute of Mental Health and the Office of Dietary Supplements to fund research to determine the potential benefits and risks of *Hypericum perforatum* for the treatment of depression. Following the *United States Pharmacopoeia* convention that was held in March 1995, a separate subcommittee on natural products was formed to deal with issues related to botanicals. The subcommittee soon prioritized 21 botanicals according to evidence of beneficial pharmacological action as well as a history of use in traditional medicine (see table below).

Plant drugs of interest to the *United States Pharmacopoeia*

<i>Botanical</i>	<i>Reported action</i>
Ginger (<i>Zingiber officinale</i> Roscoe)	Anti-emetic
Valerian (<i>Valeriana officinalis</i> L.)	Tranquillizer
Garlic (<i>Allium sativum</i> L.)	Antibacterial, cholesterol lowering
Asian ginseng (<i>Panax ginseng</i> C. A. Meyer)	Adaptogen
Ginkgo (<i>Ginkgo biloba</i> L.)	Vasoactive, platelet aggregation inhibitor
Feverfew (<i>Tanacetum parthenium</i> L.)	Migraine prophylactic
St. John's Wort (<i>Hypericum perforatum</i> L.)	Antidepressant
Saw palmetto berries (<i>Serenoa repens</i> (Bartr) (Small))	In prostatic hyperplasia
American ginseng (<i>Panax quinquefolius</i> L.)	Adaptogen
Echinacea (<i>Echinacea angustifolia</i> DC)	Immunostimulant
Matricaria flower (<i>Chamomilla recutita</i> (L.) Rauschert)	Anti-inflammatory
Hawthorn (<i>Crataegus laevigata</i> (Poir.) DC)	Cardiotonic
Golden seal root (<i>Hydrastis canadensis</i> L.)	Anti-inflammatory
Milk thistle (<i>Silybum marianum</i> (L.) Gaertn.)	Hepatoprotective
Cranberry (<i>Vaccinium macrocarpon</i> Ait.)	Antibacterial
Nettle root (<i>Urtica dioica</i> L.)	Diuretic
Ephedra (<i>Ephedra sinica</i> Stapf.)	Central nervous system stimulant (bronchial asthma)
Kava kava (<i>Piper methysticum</i> L.)	Muscle relaxant, tranquillizer
Siberian ginseng (<i>Eleutherococcus senticosus</i> (Rupr. et Maxim.) Harms)	Adaptogen
Liquorice (<i>Glycyrrhiza glabra</i> L.)	Expectorant, anti-inflammatory
Angelica (<i>Angelica archangelica</i> L.)	Spasmolytic

Other considerations in prioritizing the list of medicinal plants for developing herbal monographs included the extent of use, safety attributes, interest of regulatory agencies and the chances of success to develop typical monographs in accordance with requirements of the *United States Pharmacopoeia*.

In developing botanical monographs, the availability of reference standards and the pharmacognostic identification were the major limitations. The components of monographs included:

- Latin botanical name
- Description of the botanical
- Identification—pharmacognostic
- “Content of ingredients” rather than “active ingredients”
- Marker substance—positive identification
- Other substances (contamination test)
- Foreign organic matter
- Microbial contamination—bioburden load and aflatoxin content
- Pesticide limit
- Packaging and storage
- Appropriate labelling (expiry date)

In order to make or manufacture good quality standard botanicals, good cultivation and harvesting practices needed to be observed.

In reply to a question about reference substances for botanicals in other countries, Dr. Srinivasan said that the *United States Pharmacopoeia* had developed a number of reference substances,* while other countries had their own pharmacopoeia.

A comment was made that a number of plants from developing countries were not known in the United States and that a useful contribution of the United States would be to train scientists from developing countries in the development of reference substances.

Topic: *Pharmacognostical standards for crude drugs*
Speaker: Professor Tony Elujoba

Professor Elujoba stressed the need for standardization for assurance of quality, safety, efficacy and reproducibility of herbal drugs. He suggested several steps for formulating a monograph:

- Authentic confirmed identity
- Morphology or macroscopy
- Histology/qualitative and quantitative microscopy of fresh drugs
- Structural standardization to define the limit of adulterants
- Analytical standardization to identify and quantify the phytoconstituents
- Physical constants
- Collection and post-harvest care

The pharmacognostic standards were recommended to accommodate data from samples collected from various geographical locations and in different seasons. This needed to be accomplished to an extent that was practicable and reasonable in order to take into account the natural variations. There were sometimes problems and confusion in ensuring the correct identity of the species. Activities relating to standardization, toxicity studies, consolidation of scientific findings, formulation and production research and registration guidelines needed to be increased.

*Reference substance here refers to pure compound, isolated and identified from a plant. In most successful cases, it is responsible for biological activity of the plant.

In the discussion, disagreement was expressed about the often-repeated allegation of misidentification of species by healers. It was possible for healers to identify species through their own science; species have their own properties even if they were not identified in a laboratory.

The point was also made that different parts of the plant might be used for different therapeutic uses.

A traditional healer commented that God had given traditional healers the knowledge and ability to heal, that the inner spirit was the science and that it was possible to use different parts and species and still elicit the desired response.

Topic: *Process technology for production of phytopharma medicines*
Speakers: Professor R. Nasipuri and Dr. D. Kunle

The speakers pointed out that the World Health Organization definition of herbal medicines did not include isolated compounds. The process technology for production of phytomedicines involved two steps: extraction and drying. In extraction, the particle size of the drug, solvent and method of extraction affected the extraction process. In the second step, it was possible to dry the extracts at atmospheric pressure, under vacuum or through the method of freeze-drying. Product formulation was a critical step. It needed to involve pre-formulation studies, selection of desired dosage form and adjuvants.

Topic: *Ethnobotany and economic evaluation of plant species in Bafut, Sabga and Oku (North-West Province of Cameroon)*
Speaker: Dr. Clare Wirmum

Dr. Wirmum's introduction provided insights into demographic, administrative and geographic arrangements in the North-West Province of Cameroon. The three regions were Bafut, Sabga and Oku. Bafut had vegetation from savannah to forest. The forests served as a useful source of food. Sabga was known for the group of tribal people, Fulani, and for ethnoveterinary products. Oku had forest regions of cultural and religious value. It was also an area of unique biodiversity.

The projects undertaken involved the villagers and the local administrators in activities including data collection, educating the youth of the area and distributing information according to their villages. Overall, more women than men were involved in the projects.

9. *Pharmacological and clinical considerations*

Chairman: Professor Alfred Oteng-Yeboah

Topic: *Pharmacological and clinical issues related to commercialization of phytomedicines*
Speaker: Professor P. Akubue

Professor Akubue gave a detailed account of the pharmacological studies necessary for the commercialization of herbal drugs. The studies ranged from preliminary to detailed and were carried out on either isolated tissues or cells, or in whole animals. Most studies ended at this stage. However, in order to commercialize a product, toxicological studies had to be conducted before the product was able to be cleared for clinical trials. Finally, the substance underwent clinical phase I, phase II, phase III and phase IV studies before entering the commercial market. For every thousand substances tested, only one reached clinical trials, and one in one hundred clinical trials reached phase IV.

The whole process took between 7 and 10 years at an estimated cost of over \$10 million.

What was to be done for herbal drugs was the question raised by Professor Akubue. He advised monitoring the clinical pharmacology and toxic side effects of the herbal products in use. Formulation studies were necessary if products were to be commercially successful.

During the discussion, the comment was made that regulating the use of plants for simple ailments did not necessarily pose a major problem. Regulatory organizations became more concerned when a phytomedicine was suggested as a remedy for a more complicated health problem.

Topic: *Phytomedicine research in central and eastern Nigeria*

Speaker: Dr. F. Okwuasaba

Dr. Okwuasaba emphasized the difficulty in gaining access to traditional knowledge, as the healers were often secretive. It was suggested that the role of traditional healers in the primary health-care system be acknowledged and recognized by the Government and that healers should be encouraged to become informed about and to develop their faith in modern systems of drug development and research. The benefits of a multidisciplinary approach to research at university level was highlighted, involving clinician, healer and phytochemist. Areas of research interest included fertility, contraception, anti-asthmatic and antifungal drugs.

Topic: *National Agency for Science and Engineering Infrastructure (NASENI)*

Speaker: Dr. R. Boroffice

A general discussion took place during this session. Various comments were made, including the following: people knew what was good for them and their efforts were being reinforced by the National Agency for Science and Engineering Infrastructure; the Government of Nigeria was encouraged to take the lead in supporting the formulation of phytomedicines that had been found to be useful in the country; the Government (through NASENI) had already put something in process: efforts were now focused on developing what had been started.

10. *Technology management*

Chairman: Dr. Piergiorgio Stipa

Rapporteurs: Ms. Patricia Johnson and Dr. Nat Quansah

The programme was divided into three main parts: Technology management I; Technology management II; and Case study "Le Cabas". Each part involved a key presentation followed by discussions, questions and comments.

Dr. Stipa's introduction showed the existing relationship between ICS and UNIDO and the different arms of their networking systems, mentioned earlier in the proceedings. He highlighted the technology management unit, its objectives and the model strategy. Professor Iwu was mentioned as the connecting link in Nigeria.

The main strategies of the workshop were to identify the market requirements and trends in the natural product industries in Africa (discussed further by Dr. Gericke below) and to develop strategic business alliances and international cooperation (to be taken up by Professor Iwu).

Topic: *Technology management I*
Speaker: Dr. Nigel Gericke

Dr. Gericke divided the topic into the following elements: mission, focus, business plan, regulatory environment, virtual organization, joint ventures and raw materials. The mission was to make safe, effective phytomedicines for our individual countries; thus the focus was on phytomedicines and not on cosmetics, nutraceuticals, etc. With the focus and budget in mind, developing a business plan was possible. The regulatory environment in the country needed to be understood. It was essential that the virtual organizations were linked, for example, universities and market sources needed to be linked with other institutions. Joint ventures addressed a large market and thus overseas partnership was required. Accessing the global market had the advantage of increased technology transfer and provided capital. Raw materials needed to be available in sufficient quantities and cultivation needed to be undertaken wherever necessary. The two case studies used were Rwanda and South Africa.

Rwanda used to have a well-developed phytomedicine programme, including cultivating plants and producing its own ethanol. Sadly, the programme had been devastated by war.

In South Africa, the annual sale of medicinal plants was about \$12 million, made from about 500 species. There were between 20 and 50 species on the endangered list. Traditional medicine was a complete unit, every aspect of which was not necessarily scientifically understood. The phytomedicine production and market in South Africa was described. Four of Dr. Gericke's own products were shown and products of Healers' Choice, the brand name of Dr. Gericke's products, were used as a home remedy for various ailments.

Dr. Gericke's discussion was followed by a question-and-answer session. The first question concerned traditional medicine and cooperation between South Africa and other countries or institutions. Dr. Gericke replied that cooperation was informal, though some external groups were already approaching South Africa with funds. Therefore, linkage was based on personal contacts.

When asked how traditional culture was protected and properly compensated by such a marketing model, Dr. Gericke replied that the book, *Medicinal Plants of South Africa*, had been written to increase public awareness of the country's rich reserves. There was also a great deal of collaboration among traditional healers, scientists and companies. A trust fund had been set up, into which some of the profits from the sale of phytomedicines went.

The comment was made that the presentation went directly to the point and aim of the workshop on industrial development and production. The importance of finding a point of focus among different alternatives was emphasized. This required the analysis of the market, especially the local market, and careful analysis of the resource system from which raw materials were to be provided. The intervention of investors was facilitated by a clear and careful plan involving the required technology.

The discussion turned to what information needed to be included on product labels in order to satisfy regulatory authorities in a foreign country and what the role was of the regulatory authorities in South Africa in terms of registration. Dr. Gericke mentioned there was a consumer information leaflet accompanying each phytomedicine. The leaflet was in the vernacular language and included a warning that the phytomedicine must not be administered to pregnant women, children under 12 years and lactating mothers. It also included information about storage conditions, constituents and dosage. Dr. Gericke added that the regulatory environment was a nightmare in South Africa as there were no established procedures.

The comment was made that there were many groups of traditional healers or herbal practitioners, such as herbalists, spiritualists and mystics, and that regulatory mechanisms in South Africa concerning phytomedicines appeared to be progressing.

This led to a query about regulatory mechanisms applying to practitioners and whether there were any rules applying preparations or packaging of herbal preparations, for example. In response, Dr. Gericke said there were about 200 different groups of traditional healers and they were working together to form a national association. Until that was done, very little influenced their practice.

The speaker was then asked to clarify his usage of the marketing term “world class” when referring to his own extracts and also to elaborate on what was meant by that measure and standard. Dr. Gericke explained the standards used were mainly those used in Germany, which owned 50 per cent of the world's market of extracts. However, specific standards were used for the standardization of phytomedicine preparations including his company's brand (Healers' Choice mentioned above).

Since affordability was a key factor favouring use of phytomedicines, the speaker was asked to comment on methods used for cost-consciousness in product development and packaging. He replied that the products of Healers' Choice were cheaper than most phytomedicines or drugs on the market, though a detailed market survey had not been done.

When asked whether there were some traditional healers who produced their own preparations and sold them in the market or shops and, if so, whether the regulatory authorities allowed such sales and, further, why there was an objection to marketing his products, Dr. Gericke answered that the regulatory authorities did not bother traditional herbalists working in small villages. However, if herbalists became too successful, the regulatory authorities clamped down on them.

This led to a further query about whether a programme existed that allowed for the introduction of quality and consistency into the operations of traditional healers or practitioners in South Africa. Dr. Gericke explained that because there was a lot of discord among healers in South Africa, no one got involved with them. He described the capital market in South Africa as not well developed and certainly not like the United States. The capital base for a phytomedical industry was not required to be big and, if one started small, a joint venture would not be needed.

Two questions were raised regarding phytomedicinal products, with reference to the traditional method of a decoction or infusion to produce a tincture. Dr. Gericke was asked firstly how he knew the difference in their therapeutic activity and how he estimated shelf-life. Secondly, he was asked about his strategy for introducing new phytomedicinal products into the market. Dr. Gericke replied that all the constituents of the four different products of Healers' Choice had been used as tinctures for 4,000 years, so one was actually going from the known to the unknown and checking the therapeutic effects, but that stability tests and shelf-life did constitute a problem. The main strategy for introducing the new product was first reconfirming the plants used by traditional healers from different parts of the country and then undertaking research on the plants.

The discussion turned again to comparing regulations governing the use of phytomedicine and conventional drugs. According to Dr. Gericke, as long as a plant had had a long traditional and safe use, it was considered a phytomedicine. Only a few countries insisted on clinical trials. In contrast, toxicity studies and clinical trials were necessary for conventional drugs.

The final question referred to brand names for phytomedicines and whether they were allowed to be registered in South Africa as trade names, to which Dr. Gericke replied that some were and others were not, but that registering them simply as phytomedicines was always possible.

A concluding observation was offered by Professor Iwu, that the regulatory environment was thoroughly documented in the proceedings of the last workshop on phytomedicines. The existing situation in South Africa was not like anywhere else in the world, because multi-purpose shops had the African-Indian influence of selling herbs as well as phytomedicines.

Topic: *Technology management II*
Speaker: Professor Maurice Iwu

Professor Iwu began his presentation by showing a transparency of a pie chart divided into quadrants. The quadrants contained the following: sourcing issue (biodiversity, culture, collection and ethnobotany); technological platform (extraction, production and storage facilities); project management (sole effort, network alliance and subcontracts) and commercial development (marketing concerns and intellectual property rights).

A strategic business alliance between two bodies depended on whether there was a network or some form of cooperation in place. Professor Iwu analysed the basic elements of the strategy using the BDCP herbal product plan as an example and outlined the major questions (who, what and how), including which herbal products interested BDCP. The choices ranged from whole herbs to standardized extracts to phytomedicines or formulations. In terms of who was involved, it was usually a wholly-owned subsidiary. The way in which this was done was by establishing a local base and partnership or by a strategic business alliance. The capability of each party always needed to be determined. In research collaborations, it was better to establish a relationship rather than a deal. The principles of successful partnership included finding a partner, creating a contract and managing the partnership. The latter was one of the greatest obstacles: communication in Africa was a problem; thus managing the partnership was difficult. Professor Iwu said that for each arrangement a focus was essential, whether for phytomedicines or phytonutraceuticals and health foods.

Most African communities seemed to settle for handouts rather than receiving their share of benefits from the bioprospecting trade. It was important that bioprospecting involved the local communities. Both parties needed to work on a partnership that enhanced both groups, rather than settling for selling extracts that only brought in pennies now and denied one from all the benefits in the future.

A question-and-answer session followed the presentation. The first question concerned the possibility of new members being admitted to BDCP, and whether application was through Professor Iwu. He answered that membership was not required for participation in BDCP activities in Nigeria. However, BDCP was a membership organization in Cameroon, which made it appear closed. Participation was mainly by individuals but the benefits were aimed at communities rather than individuals.

Another question raised the issue of synergism between new drug discovery and phytomedicines to which Professor Iwu replied that there was scope for more progress in the area.

A participant made the observation that the concept of traditional medicine and its relationship to modern medicine was complicated and kept secret from the scientist. Since this was happening, the speaker was asked to comment on whether there was any possibility of BDCP opening a school of herbal medicine in any African country to break down such barriers. Professor Iwu explained that BDCP did not have the resource base to handle that. The Organization of African Unity might look into such an establishment.

In response to a query regarding freelance collectors and what was to be done about them since they caused so many problems, especially in benefit sharing, Professor Iwu responded that nothing was able to be done, but that countries needed to work on setting up the right infrastructure in order that potential bioprospecting opportunities were not lost.

Topic: *Case study "Le Cabas" Centre for Research and Production of Phytomedicines and Cosmetics—Yaoundé, Cameroon*
Speaker: Dr. Abondo Ngonu Mballa

Dr. Ngonu Mballa outlined the objectives and perspectives for setting up "Le Cabas". Its main focus was on dermatology, which was of particular relevance and interest to

African women. Using the *African Pharmacopoeia*, Dr. Ngonu Mballa was able to formulate several products and phytocosmetics including scarring oil, medicinal soaps and oils, regenerating soaps and oils and masking creams. It was important that the commercial circuit for such products be functional at both national and international levels.

In response to a question about programmes instituted to ensure the sustainability of the raw material base, Dr. Ngonu Mballa explained that some plants used as food were cultivated, and that there were plans to cultivate plants used as raw materials in phytocosmetics in the future.

When asked whether she had tested her products for side effects, Dr. Ngonu Mballa replied that most of her products were essential oils and, therefore, were safe.

11. Group discussions

Three discussion panels were selected, covering three areas:

- Group A. Policy considerations, access, intellectual property rights and benefit sharing;
- Group B. Conservation and sustainable sourcing;
- Group C. Biotope and phytomedicines—key issues and solutions.

Issues relating to the above areas were discussed and appropriate solutions recommended within the context and theme of the workshop. Group reports were presented to all the participants for comments. Outcomes of the discussion groups were recorded.

Group A. Policy considerations, access, intellectual property rights and benefit sharing

Chairpersons: Dr. Lucas Sese and Dr. David Stephenson

Rapporteur: Dr. Abondo Ngonu Mballa

The panel agreed that:

- National legislation was a key issue for the application of the Convention on Biological Diversity;
- There was a need for wide participation (of scientists, universities, industries and local communities) to address issues of benefit sharing and intellectual property rights;
- It was important to ensure and promote the inventory of endangered species;
- There was a need to regulate and enforce regulations for bioprospecting (Convention on Biological Diversity);
- It was essential that access and ownership of knowledge and resources be controlled;
- There was a need for multilevel harmonization at the national and international levels.

Group B. Conservation and sustainable sourcing

Chairpersons: Dr. Nat Quansah and Dr. Cosmas Obialor

Rapporteur: Mr. Momodou Cham

Many issues important to conservation were raised during the discussion. They included questions regarding what the purpose or goal was, what plant material was sought, where and in what quantities it was found, how it was collected and how collection was to be sustained.

An inventory was deemed necessary of the quantity and distribution of available resources in a country. The information might be provided by traditional healers, institutions (such as universities, colleges, forestry organizations, herbaria, non-governmental organizations), herb traders, farmers and other members of the community. Many questions had to be asked before starting the project. The most important was to know the goal and then focus efforts to achieve the target.

The survival of some plants was threatened due to the present harvesting practices, their increased use in human life, the increased use of land for human activities and bush fires. The panel agreed on the following measures to check the potential threat to plant genetic resources:

- Changing farming practices and introducing new technology;
- Training in harvesting techniques and introducing policies;
- Working to resolve ownership issues in order to encourage sustainability;
- Assessing the environmental impact:
 - Putting into perspective the impact on all vegetation
 - Facilitating an ongoing process
 - Initiating a good environment-planning programme;
- Monitoring effectively the conservation programme;
- Reviewing laws and developing them with the participation of local communities;
- Enforcing conservation laws;
- Making available resources to implement the conservation programme (human and material);
- Domesticating and cultivating selected plants both *in situ* and *ex situ*;
- Taking into account conservation measures at the beginning of a bioprospecting project;
- Taking into account the gender situation and especially the role of women in conservation.

Group C. Biotrade and phytomedicines—key issues and solutions

Chairmen: Dr. Nigel Gericke and Dr. Piergiorgio Stipa

The discussion was restricted to issues relating to plants in local and international trade.

The group decided that an inventory was required of all species being traded, including the cost and quantity of materials involved and the ecological status. The information then needed to be entered into a database. It was recommended that the database be maintained by an independent group because of the interdependent nature of the information. The issues of access and control needed to be addressed and needed funding in order to develop the inventory and database.

A further requirement was identified: a facility, preferably university-based, established for the purpose of identifying plant materials in the trade. Higher quality standards needed to be made applicable at all levels from raw material to finished product as quality assurance was a part of any product development.

The existing markets needed to be identified and quantified, the needs of such markets addressed and, in turn, new markets explored. It was important to identify and address the requirements of all stakeholders.

The panel agreed on the following points:

- ❑ Botanical issues:
 - Creating an inventory and database of all the available information
 - Developing methods of identification of plant materials
 - Developing standards for plant products
 - Taking into consideration methods of testing in the country of origin and the destination country
 - Differentiating indigenous from exotic plants
 - Knowing what species in the trade are threatened, at risk or endangered
 - Differentiating wild-collected and cultivated plants
 - Identifying raw materials;
- ❑ R&D:
 - Identifying sources of funding for research and for species propagation
 - Identifying the sources of funding for the construction of the inventory and database
 - Determining the location, control and access of the inventory and database;
- ❑ Indigenous knowledge:
 - Identifying stakeholders and their needs, including intellectual property rights
 - Identifying the skills and knowledge of the stakeholders
 - Conservation and sourcing, including indigenous knowledge (referring to plants and information)
 - Respecting indigenous knowledge;
- ❑ Marketing and trade aspects:
 - Storing, packaging and transporting of plant materials
 - Differentiating between the intended uses of the product, i.e. food versus medicine and self-care versus prescription drugs
 - Identifying the market needs and future trends
 - Establishing the distribution chain, for management and control, from harvest to consumer
 - Defining the effects of GATT and WTO
 - Regulating the supply to prevent a crash in prices;
- ❑ World environment:
 - Monitoring the effects of the trade on the ecosystem
 - Clarifying the socio-economic impact.

Papers contributed by workshop participants

Topic: *Research and development activities on medicinal and aromatic plants in Ethiopia*

Speaker: Dr. Medhin Zewdu

Dr. Zewdu gave an overview of the R&D activities of medicinal plants in Ethiopia. The national body was the Science and Technology Commission, under whose umbrella four councils existed: Industrial, Health, Agricultural and Energy, Mines and Environment. Each was given a mandate on a specific aspect of the country's development programmes. The institutions involved in R&D were the Chemistry Department of Addis Ababa University, the Essential Oil Research Centre of the Ministry of Industry, the Drug Research Development Unit of the Ministry of Health, the Pharmacy School of Addis Ababa University, the Biodiversity Institute and the Pathobiology Institute. The activities of the Essential Oil Research Centre and the Biodiversity Institute were outlined.

Dr. Zewdu highlighted that traditional medicines were well recognized in the health policy of the country. The Essential Oil Research Centre had developed three essential oils (lemon grass, palmarosa and citriodora) and two spices (capsicum and ginger). Extraction industries were in place. The Biodiversity Institute had been set up in 1976 as the National Plant Genetic Resources Centre/Ethiopia, with the objectives of collection, evaluation and conservation of biodiversity. There had been *ex situ* collections of 56,000 germ plasms and accessions of about 101 species including wheat, barley and maize. The National Plant Genetic Resources Centre/Ethiopia became the Biodiversity Institute when the sustainable use of biological resources was incorporated in its mandate.

Two main programmes were being undertaken by the Global Environment Facility and the Cambridge Business Development Centre for *in situ* conservation of land races. Other activities of the Biodiversity Institute included a nutrient laboratory and research on medicinal plants. The Traditional Healers' Association had links with the Biodiversity Institute, which provided office space, land and other facilities to the Traditional Healers' Association. Joint research programmes were undertaken with other institutions such as the Drug Research Department of the Pharmacy School and the Chemistry Department. The Traditional Healers' Association was not involved in joint research programmes. A programme was being initiated by the Biodiversity Institute with aid from the World Bank for developing a medicinal plant inventory and assessment for the phytomedicine industry in Ethiopia.

The main constraints were the difficulties in gaining access to information, lack of collaboration between research institutions and scientists and poor linkages between scientists and traditional healers. The presentation concluded with three recommendations: a need for transparency, strengthening of linkages among institutions and having multidisciplinary teams as well as a proper database for networking.

Topic: *Remote sensing and its application to bioprospecting in Nigeria*
Speaker: Dr. Aka Kyrian

Dr. Kyrian gave an explanation and introduction of remote sensing. He listed the activities that negatively affect biodiversity, including heavy infrastructural development, bush burning, farming practices, erosion, deforestation, industrial pollution and increasing urbanization. Information-gathering required field surveys. Traditional or earlier methods (typically two-step methods) contained discrepancies. In contrast, remote sensing offered a three-step approach that added ground-truthing to the traditional method. Ground-truthing was performed after images from the traditional method had been obtained. Remote sensing was then used to determine the manner and type of deforestation. It was useful for monitoring vegetation information, such as deforestation, distribution and type and was therefore valuable in management decisions.

Dr. Kyrian, when asked about the cost of remote sensing, replied that the cost was dependent on what was obtained from satellite owners.

The comment was made that if one started remote sensing from scratch then it was very expensive. However, if facilities were already present in a country, remote sensing costs were low. In any case, remote sensing was the cheapest way of obtaining information with a high degree of accuracy.

Another comment offered was that if the general environment was not conducive to acquiring and using facilities such as remote sensing, then it was an impossible task, i.e. this meant that neither funds nor computers were available to acquire images or to effect good resolutions of images.

Topic: *Regulatory bodies in Cameroon*
Speaker: Mr. Andre Tchukangoua

Mr. Tchukangoua mentioned the role of the Ministry of Commerce in the development of the industry and its involvement in the national drug policy. Different directorates looked after different services and the mandates of the pharmaceutical services included phytomedicines. Four phytomedicines had already been developed. Money was paid to national institutes, universities and the Directorate of Environment for the regeneration of forests. Mr. Tchukangoua commented that this was an enabling environment for the development of herbal medicines. However, there was a lack of collaboration among different institutions and researchers, as well as a lack of funds.

12. *Cosmetics and essential oils and biotrade opportunities*

Chairman: Professor Johnson Ekpere

Topic: *Clinical uses for essential oils*
Speaker: Dr. Lisa Messerole

Dr. Messerole gave an overview of disease trends, especially in the United States, with a view to establishing the potential importance of essential oils in the health-care system. Respiratory infections, resistance to antibiotics and the presence of resistant strains, even in infants, were listed among serious problems. Other problems included non-infectious diseases such as leukaemia, chronic pneumonia, asbestos dust poisoning and other occupational hazards. The presentation reviewed the opportunities for essential oils in health care, including agents that promoted healthy intestinal flora, immunomodulators, anti-oxidants and adaptogens. Examples were given of plants rich in essential oils, such as *Mentha piperita*.

The discussion touched on the important properties of essential oils which included having good transdermal absorption and leaving no smear. They were known to act on the respiratory, urinary, nervous, digestive, endocrine, circulatory and immune systems, as well as the skin. Though essential oils were known to have biological activities, such as anti-inflammatory and anti-allergic, they seemed to be most widely used as antimicrobial agents.

A list of therapeutic and useful effects of essential oils was provided:

- Antifungal and antibacterial;
- Anti-allergic (citronella and citral);
- Antispasmodic (peppermint oil);
- Beneficial effects in headache and skin rash;
- Preservative activity.

The discussion moved on to the need for proper identification of plant material and assurance of quality in clinical application in order to avoid unwanted reactions. It was noted that large quantities of plant material were required to extract a small quantity of oil.

Beauty products also contained essential oils. Examples were given, including small quantities for preparations for acne and oils from *Ocimum* and witch hazel, as they possess anti-inflammatory activity.

Safety concerns needed to be taken into consideration. Attention to any side effect of the oil was important as some oils were known to cause allergic reactions, such as phototoxicity.

The main problems in the development of aromatic products included:

- Access to raw material;
- Sustainable harvesting and production;
- Complexity of quality control due to multi-components of these oils;
- Profit potential;
- Availability, affordability and efficacy of these products.

Dr. Messerole's concluding comments were that there was a growing international market within the areas of body care and cosmetics; that the acceptability of herbal products as insect repellents, in aromatherapy and veterinary uses had increased and that some herbal preparations containing essential oils, such as ginger, played an important role in the health economy of the world.

Topic: *Role of medicinal chemistry in the development of natural product drugs*
Speaker: Dr. Simon Efange

Dr. Efange was involved in the synthesis of an antiviral substance, now being developed as a radiosensitive agent in liver cancer. This was happening, however, without the acknowledgement of Dr. Efange's contribution. The Iboga plant (found in Cameroon and Gabon) had a number of uses in traditional practice. Most uses related to neurological activity, e.g. alertness, hallucination and aphrodisiac. Dr. Efange cited two examples related to the use of the plant: a drug addict who experimented with Ibogaine found that it had eliminated his craving for heroin and patented it to the exclusion of either Gabon or Cameroon. Following this, the same individual, along with his collaborators, synthesized a compound with similar properties to Ibogaine (for the reversal of drug addiction), although with a different chemical structure. They also applied for a patent for this, to the exclusion of Gabon and Cameroon.

Based on the two cases cited above, it was emphasized that coordination was crucial in any development strategy if control of bio-resources was to be retained. The services of experts such as lawyers and pharmacists needed to be used in order to help understand the implication of the actions taken in releasing information. When asked what was to be done to prevent being left out by people who had taken extracts or compounds studied here and then modified them into drugs with different chemical structures, Dr. Efange replied that there was little that could be done about it since the drug was different from the one initially discovered. The lesson learned was that it was important to ensure that all possible precautions were taken before information was disclosed on a chemical structure or the process involved.

A general comment was added that care needed to be taken not to keep information or materials away from others for too long. An unwanted result of this was that developments would continue with the exclusion of important contributions of traditional knowledge.

13. Strategies for the conservation of biological resources, biodiversity assessment and monitoring programme

Chairman: Professor Alfred Oteng-Yeboah

Topic: *Economic value assessment of forest species*

Speakers: Professor Maurice Iwu, Mr. Noble Nweze and Dr. Clare Wirnum

The assessment project had been carried out in order to obtain the actual economic value of bio-resources to the local people. Most of the previous assessments had been inadequate since the value that indigenous people had placed on items had not been

taken into consideration. The study was ethnocentric, thus allowing actual values to be determined for resources. To date only rapid appraisal tests had been conducted. Results showed that community forests were very useful for family survival. Major economic species had been identified for other uses.

The study was conducted in Cameroon and Nigeria. Plots were assigned in each location for detailed studies as well as for monitoring the effects of various activities on biodiversity. One interesting observation drawn from the research was that timber cutting, which had always been assumed to destroy biodiversity, did not affect biodiversity if well spaced and in low density.

The speakers concluded the session with the comment that the study had been useful as it put an actual value on the plants and provided a useful exchange of information between communities, which in turn resulted in an enhanced economic valuing of bio-resources. A general comment was offered that this type of study gave people a strong reason for conserving their biodiversity, since they were made more aware of its value to them.

On the issue of bush fires, the observation was made that, generally, natural ones were good because, in some cases, fire was necessary for the flowering of some plants. Another contributor mentioned that American Indians had used it to control their natural habitat.

A final comment was that the study was useful because, based on information provided by indigenous people, extinct or rare plants could be identified and that comparative plots had also been included in the study.

Annex A

List of participants

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Annex B

Profiles of participants

Resource persons

The seven participating resource persons were acknowledged local and international experts with proven competence in relevant fields. They included academicians, researchers and industrial technologists with experience in developing countries and on problems related to biodiversity exploitation. Each was invited to deliver lectures and chair different sessions and discussions.

Participants

The invited participants were mid-level senior scientists, institutional and industrial managers working in public or private institutions and/or companies. Some were professionals with experience in industrial exploitation of biodiversity. Their areas of experience included taxonomy, inventories of uses, analytical chemistry, biotechnology, business development, benefit sharing and intellectual property. (A quarter of the participants were women.)

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