

Professor Berhanu Abegaz

A Tribute



This special issue of ARKIVOC is dedicated to Professor Berhanu Abegaz to celebrate his 60th birthday and to acknowledge his contributions to the chemistry of natural products and to the development of chemistry on the African content.

Dr. Abegaz was born in Ethiopia on April 12, 1947. He completed his secondary education at Woizero Siheen Comprehensive Secondary School, Wollo, Dessie in 1963 and then entered Haile Selassie I University, Addis Ababa, Ethiopia. After receiving his B.Sc. in Chemistry in 1968 he was awarded an AFGRAD Scholarship and joined the Graduate Program in Chemistry at the University of Vermont, USA, where he studied under the mentorship of Professor A. Paul Krapcho. He was awarded a Ph.D. in 1973 for his dissertation entitled “Photochemistry of Polymethylene-ketene Dimers and Polyspirocyclobutanones.”

Dr. Abegaz joined the Department of Chemistry of Addis Ababa University in 1973 as Lecturer. From 1973-1994 he progressed to the rank of Associate Professor III. In 1994 he was appointed Professor in the Department of Chemistry at the University of Botswana, a position he currently occupies. Since 1973 he has also been a Rockefeller Fellow and Visiting Research Associate, University of Ibadan (Nigeria), a Visiting Assistant Professor of Chemistry, Boston University (USA), and a Senior Fulbright Research Scholar, Florida State University (USA).

After graduate school Dr. Abegaz turned his research attention to the chemistry of natural products. This work has led to approximately 125 publications and numerous invited lectures at major universities and international meetings. He has made substantial contributions to three areas of natural product research.

The first area involves the isolation and characterization of novel secondary metabolites from plants traded in markets in Africa. Phenyl anthraquinones (PAQs) and isofuranaonaphthoquinones (IFNQ), for example, are relatively new classes of secondary metabolites. Although the first PAQs were isolated from the *Kniphofia* species, the Abegaz Group found that *Bulbine* species are a far richer source of PAQs and INFQs. Many of these compounds in both classes were

isolated in their laboratories, with the sodium sulfate derivatives of the PAQs emerging as the most polar and structurally challenging members of the group. Collaborative studies have shown that PAQs are a new class of anti-plasmodial substances. (See references 1, 7, 8, 25)

To date, 140 homoisoflavonoids are known. About 40 of these were characterized by the Abegaz Group from various species of the Hyacinthaceae. Most recently, they discovered an isoquinoline alkaloid with a new carbon skeleton that they believe is formed by a new biosynthetic pathway. (See references 6, 15)

Another class of structurally novel secondary metabolites are isoflavonoids lacking the biosynthetically important 4'-oxygenation. Only about 20 isoflavonoids are known having oxygenation in ring B, but not at the 4'-position. More than 50% have been isolated in the Abegaz laboratories. (See references 30, 31)

In a second area of research the Abegaz Group discovered several natural products with anti-plasmodial, anti-proliferative, anti-helminthic, anti-typanosomal, anti-oxidant, insect feeding deterrent, and some with the potential to reverse the resistance of plasmodium falciparum to the anti-malarial drug chloroquine. The anti-plasmodials discovered by Abegaz in collaboration with others include the sesquiterpene dimers which have anti-plasmodial activity against chloroquine (CQ) resistant parasites. These compounds are as active as, or even slightly more active than CQ. Other promising anti-plasmodial metabolites include the PAQs, especially knipholone anthrone, some catechin timers, bi-flavonoids, and chalcones. (See reference 12)

Essential oils, food, and beverages constitute the third research area of interest to the Abegaz Group. Their work with Nigist Asfaw of the Ethiopian Spice Extraction company has led to the successful marketing of essential oils from indigenous species such as ginger and cardamom. They also studied the toxic principles of legume pea (*Lathyrus sativus*) a plant with potential benefit to developing countries with low-rainfall farmlands. They were able to show that the plant toxin, β -N-oxalyl-L- α , β -diaminopropionic acid, can be isomerized to a 60/40 equilibrium mixture with the non-toxic α -isomer, a finding which paved the way for a better understanding of the mechanism of the thermal isomerization process. (See references 27, 29) They also identified the bitter principle of the Ethiopian hop plant Besho (*Rhamnus prinoides*). This compound, named Geshoidii, is a non-toxic substance found in copious amounts in the stem and leaves of *R. prinoides* and has potential as a bittering agent.

Research in the Abegaz Laboratory has also provided an excellent environment for educating young African research students. The first Ph.D. degrees in any subject awarded from Addis Ababa University and the University of Botswana were Ph.D. degrees in chemistry awarded in 1989 and 1999 respectively to students mentored by Dr. Abegaz. A number of Chemistry Departments at other African universities have followed his example and are now also awarding Ph.D. degrees.

In addition to his contributions to the science of natural products, the scientific enterprise in Ethiopia and throughout Africa has benefited from Dr. Abegaz's efforts and enthusiasm. He was one of the forty founders of the Chemical Society of Ethiopia in 1983 and served as the Society's first president from 1983-1987. He was also founding editor of the Bulletin of the Chemical

Society of Ethiopia from 1987-1994. This has become one of the leading journals in Africa and is covered by the major abstracting and indexing and databases in the world. During the decade from 1982-1992 he was Chair of the Natural Sciences Department of the Ethiopian Science and Technology Commission and worked to foster research in the natural sciences. He also served as Director of Research at Addis Ababa University from 1992-1994.

Abegaz also had the vision to bring African researchers together in a common effort to enhance chemical research on the African continent. To work toward that goal he was one of the founding members of the Natural Products Research Network for Eastern and Central Africa (NAPRECA) which he helped establish in 1984 and has continued to support. He served as its Assistant Secretary/Treasurer until 1996. For his efforts he received the IFS-DANIDA award of 1997. In order to promote cooperation among African scientists, since 1992 Dr. Abegaz also served as the founding Coordinator of the Network for Analytical and Biological Services for Africa (NABSA) and was a member of the International Chemistry Conference in Africa (ICCA) from 1986-1995. These efforts have also been extended through his work with the United Nations University, the University of Uppsala (Sweden), the International Foundation for Science as a senior advisor, the Academy of Sciences for the Developing World, Italy (as an elected member), and the American Association for the Advancement of Science (AAAS).

As a result of these and other contributions, The International Organization for Chemical Sciences in Development (IOCD) presented the Pierre Crabbe Award for 2003 to Berhanu Abegaz, Ermias Dagne, and John Bradley. These three distinguished African Scientists were honored for their contributions to the advancement of Science in developing countries.

Through his scientific presentations at universities and symposia across Africa, through his numerous editorial contributions, and through his work as an external examiner at various African universities, Dr. Abegaz has made a major impact on the development of Chemistry and Chemical education in Africa. African chemistry owes much to this esteemed colleague.

Professor James W. Pavlik
Department of Chemistry and Biochemistry
Worcester Polytechnic Institute
Worcester, MA 01609
jwpavlik@wpi.edu

Selected Publications

1. Mutanyatta, J., Bezabih, M., Abegaz, B. M., Dreyer, M., Brun, R., Kocher, N. and Bringmann, G. The first 6'-O-sulfated phenylanthraquinones: isolation from *Bulbine frutescens*, structural elucidation, enantiomeric purity, and partial synthesis. *Tetrahedron* **2005**, *61*, 8475.

2. Bonaventure T. Ngadjui, Jean Watchueng, Felix Keummedjio, Bathélémy Ngameni, Ingrid K. Simo and Berhanu M. Abegaz. Prenylated chalcones, flavone and other constituents of the twigs of *Dorstenia angusticornis* and *Dorstenia barteri* var. *subtriangularis*. *Phytochemistry* **2005**, *66*, 687.
3. Barthelemy Ngameni, Bonaventure T. Ngadjui, Gabriel N. Folefoc, Jean Watchueng and Berhanu M. Abegaz Diprenylated chalcones and other constituents from the twigs of *Dorstenia barteri* var. *subtriangularis* *Phytochemistry* **2004**, *65*, 427.
4. Berhanu M. Abegaz, Bonaventure T. Ngadjui, Gabriel N. Folefoc, Serge Fotso, Pantaleon Ambassa, Merhatibeb Bezabih, Etienne Dongo, Frode Rise and Dirk Petersen. Prenylated flavonoids, monoterpenoid furanocoumarins and other constituents from the twigs of *Dorstenia elliptica* (moraceae), *Phytochemistry* **2004**, *65*, 221.
5. Ladislaus K. Mdee, Samuel O. Yeboah, and Berhanu M. Abegaz. Rhuschalcones II-VI, Five New Bichalcones from the Root Bark of *Rhus pyroides*, *J. Nat. Prod.* **2003**, *66*(5), 599.
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7. Abegaz, B. Novel Phenylanthraquinones, isofuranonaphthoquinones, homoisoflavonoids and biflavonoids from African plants in the genera *Bulbine*, *Scilla*, *Ledebouria*, and *Rhus*. *Phytochemistry Reviews* **2002**, *1*, 299.
8. B. Abegaz, M-T. Bezabih, T. Msutha, R. Brun, D. Menche, J. Muelbacher and G. Bringmann Gaboroquinones A and B and 4'-O-β-D-glucopyranoside, phenyl anthraquinones from the roots of *Bulbine frutescens*. *J. Nat. Prod.* **2002**, *65*, 1117.
9. B. T. Ngadjui, E. Dongo, B. M. Abegaz, S. Fotso and H. Tanboue. Dinklagins A, B and C: three prenylated flavonoids from the twigs of *Dorstenia dinklagei* *Phytochemistry* **2002**, *61*, 99
10. G. Bringmann, D. Menche, R. Brun, T. Msutha and B. Abegaz.. Bulbine-knipholone, a New Axially Chiral Phenylanthraquinone from *Bulbine abyssinica* (Asphodelaceae): Isolation, Structure elucidation, enantioselective synthesis and antiplasmodial activity. *Eur. J. Org. Chem.* **2002**, 1107.
11. B. M. Abegaz, B. T. Ngadjui, E. dongo, B. Ngameni, N. Nindi and M. T. Bezabih. Chalcones and other constituents of *Dorstenia proropens* and *D. zenkeri*, *Phytochemistry* **2002**, *59*(8), 877.
12. M. Bezabih, B. M. Abegaz, K. Dufall, K Croft, T. Skinner Adams, T. M. E. Davis. Antiplasmodial and anti-oxidant isofuranonaphthoquinones from the roots of *Bulbine capitata* *Planta Medica*, *67*, 297-390.
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22. M. Bezabih and B. M. Abegaz. 4'-Demethylknipholone from aerial parts of *Bulbine capitata*. *Phytchemistry* **1998**, *48*, 1071.
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26. Gizachew Alemayehu and Berhanu M. Abegaz Bianthraquinones from the Seeds of *Senna multiglandulosa*. *Phytochemistry* **1996**, *41*, 3, 919.
27. A. De Bruyn, C. Becu, F. Lambein, Naod Kebede, Berhanu M. Abegaz, Peter Nunn. The Mechanism of the Rearrangement of the Neurotoxin β -ODAP to -ODAP. *Phytochemistry* **1994**, *36*, 85.
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