The Importance of Nuclear Magnetic Resonance in Elucidating the Chemical Structures of Active Components found in Medicinal Plants Indigenous to Namibia

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Abstract

Namibia has a vast plant biodiversity which, supported by strong Indigenous Knowledge Systems, could lead to the development of active drugs from one or more of the indigenous plants. This notification paper examines how Namibia is hampered from taking control of and developing its own natural product resources due to a lack of Nuclear Magnetic Resonance (NMR) technology.

Keywords: Namibia, medicinal plants, natural products, NMR, isolation and structural elucidation.

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1 Introduction

Namibia is well known for its vast mineral wealth and is a world leader when it comes to exporting copper, gold, uranium and zinc. Mineral prospecting is actively encouraged and Namibia benefits greatly from the revenue that is generated from this natural resource.

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While mineral prospecting is high on the Namibian agenda there are other natural resources that are potential sources of national income that are largely unexplored. Namibia has a vast plant biodiversity, which is largely untapped. This fact, complimented by well-established Indigenous Knowledge Systems (Cheikhyoussef et al. 2011; Winschiers-Theophilus et al. 2010) puts Namibia in an ideal position to explore and invest in drug discovery from natural resources - known as bio-prospecting.

Discovering lead compounds from natural sources that could possibly be developed into medical products for worldwide public use has the potential to generate billions of dollars in revenue for Namibia. Such work simultaneously aids Namibia's progress towards Vision 2030 (Office of the President, 2004), as well as facilitating development of the nation's nascent pharmaceutical industry, as prioritised by the National Medicine Policy objective; "To stimulate the local pharmaceutical industry to manufacture essential medicines as well as complementary medicines" (Ministry of Health and Social Services, 2012).

2 Findings

Namibia has over 4,334 different plant taxa. Although some of these plants are used as herbal medicines, there is limited knowledge about their efficacy and safety. This is probably due to the fact that screening of plants for pharmacological activity and characterisation of their active chemical compounds is expensive (Chinsembu et al., 2011). A number of studies into the medicinal properties of Namibian plants have already been undertaken and have demonstrated good pharmacological activity (Cheikhyoussef et al., 2011) on a variety of bioassays including HIV/AIDS (Chinsembu et al., 2010) and antiplasmodial activity (Nafuka, 2014). These findings imply that it would be beneficial for Namibia to take this exploration forward and determine what compounds are responsible for the bioactivity in these plants.

Once the chemical structure of the compound is known as well as how it interacts with its receptor, the molecule can be improved by looking at Structure Activity Relationships (SAR's). This valuable information can be used to synthesize various other molecules based on the lead compound's pharmacophore. These newly synthesized compounds would then undergo further rigorous testing and monitoring before being produced in large amounts for pharmaceutical manufacturing (if safety and efficacy during all stages of in vitro and in vivo laboratory tests, as well as that of the clinical trials was maintained). Being able to synthesise the active compound in the laboratory is important to avoid possible plant extinction scenarios. However this process cannot be initiated until the chemical structure of the bioactive compound is known.

Knowing the chemical structures of various Namibian natural products with potential bioactivity is an essential step in the development of possible lead compounds. Structural elucidation of new compounds can be performed with sufficient accuracy using Nuclear Magnetic Resonance (NMR) technology.

At present, Namibia does not have NMR technology. Without this sophisticated and expensive piece of equipment, Namibia cannot take charge of its own, potentially rich and rewarding, indigenous natural product heritage. One might argue that the necessary NMR tests could be sent to a laboratory outside Namibia. However, this may result in Namibia having to share the intellectual property (IP) rights with external contributors. Furthermore, structural elucidation requires considerable NMR time and experimentation; as such it is necessary for the researchers and equipment to be in the same location. In addition, Namibian export permits required for this process would also make it a very timeous process. Plans by the National Commission on Research Science and Technology (NCRST) to obtain an NMR are exciting, however, the NCRST is yet to build the science park which will house the NMR, therefore this important equipment may not be available in the near future.

Without NMR technology in Namibia, the country's medicinal and organic chemistry research will continue to be scientifically disadvantaged. In addition many of the natural product chemistry articles published in the ISTJN may lack real scientific depth and understanding.

3 Conclusion

Namibia's Vision 2030 is for "A prosperous and industrialised Namibia, developed by her human resources, enjoying peace, harmony and political stability". The pursuit of bioprospecting will assist Namibia in reaching this goal. The University of Namibia, as the leading medicinal and organic chemistry research organisation in the country, should take leadership on this issue and take concrete steps to ensure that Namibia has the capacity to embrace and understand the chemistry of its potentially rich biodiversity. Without NMR technology available in Namibia the country's vast plant biodiversity will remain largely unexplored.

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