



A global perspective on research integrity in natural products research and development: Lessons for Uganda

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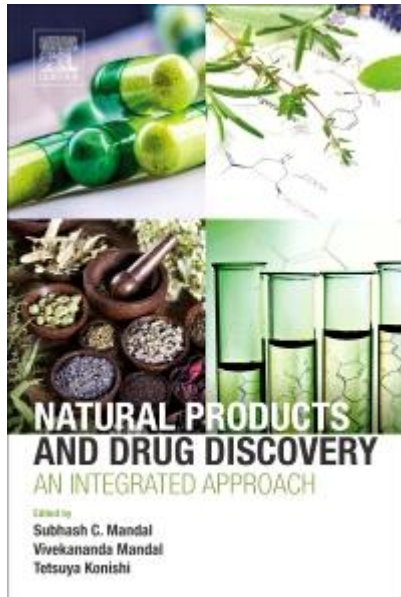
Overview

- What are natural products?
- Evolution of natural product R&D
- Integrity issues in natural products R&D
- Examples of integrity issues in natural products R&D
- Examples of Good Integrity Practices in R&D of natural products
- Lessons for Uganda



What are natural products?

- Natural products are substances produced from various natural sources such as plants, bacteria, fungi, insects, arachnids, marine organisms, and higher-order animals.
- Include botanical products, animal products, probiotics, refined products, and placebos.





Evolution of natural product R&D

Period	Main transition period	Natural product sciences	Natural product technologies
Second industrial revolution	1940-1960	Compound structure elucidation	UV, IR, radioisotopes, chromatography
Third industrial revolution	1980-2010	Compound synthesis, biosynthesis, and biological testing in vivo and in vitro	HPLC, NMR, mass spectrometry, PCR, stable isotopes, X-ray crystallography, data acquisition and analysis
Fourth industrial revolution	2010 to present	<i>In silico</i> assessment, metabolomics, genomics, synthetic biology	Artificial intelligence, machine learning, robotics, 3D printing, blockchain technology

Abbreviations: HPLC, high-performance liquid chromatography; NMR, nuclear magnetic resonance; PCR, polymerase chain reaction; UV, ultraviolet; IR, infrared; 3D, three-dimensional.

Cordell G., 2021 doi.org/10.1177/1934578X211036257

Natural products research is progressively getting integrated scientifically into society



Why natural products have become relevant

- Need for confrontation of increasing life threatening challenges
 - Natural
 - Lifestyle induced
- Desire for functional foods
- Depletion of genetic resources elsewhere making Africa and Asia a hotbed for natural products



Integrity issues in natural products R&D

- Ownership
- Intellectual property management
- Access and benefit sharing
- Partnerships especially with private sector
- Disclosure
- Bio-piracy and misappropriation in bio prospecting processes





Examples of integrity issues in natural products R&D

- Battle Creek Sanitarium, USA, 20th Century
 - Intellectual property
- Dietary Supplement Health and Education Act, USA, 1994
 - Role of politics, marketing claims, subjects safety
- COVIDEX case, Uganda, 2021
 - Intellectual property



Causes to misconduct

- Limited resources
- Agenda for source of research funding
- Hyper-competition in research system
- Publication pressure
- Pressure to solve emerging life threats i.e. COVID 19
- Institutional policy for appointments and promotions
- Limited supervision and mentoring
- Limited knowledge on approval and regulatory frameworks for good bio-prospecting practices



Examples of Good Integrity Practices in R&D of natural products

- Artemisinin in China for anti-malarial drug
 - Bioprospecting*, methodology optimization, IP, Private sector involvement
- Moroccan Argan tree for cosmetic and skin care industries
 - Indigenous custodians benefit sharing, environment management
- Kakadu plum in Northern Australia for source of vitamin C
 - Local community private sector involvement
- A hoodia case in South Africa involving CSIR and the Sans
 - Bioprospecting, indigenous people involvement in R&D, informed consent, benefit sharing



IPs from Natural Products R&D

- Breeder's rights
- Patent
- Licensing
- Trademark
- Copyright
- Regulatory system
- IP Litigation



Lessons for Uganda

- Environmental management for resource sustainability
- Investment in research and meta-research
- Involvement of IK custodians: Access and benefit sharing *
- Multi-disciplinary collaborations
- Intellectual property management and benefits
- Private sector involvement
- Guidelines and committees for research integrity
- Capacity building for research integrity compliance & communication



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Thank you