

Opportunities and challenges in the commercialisation of medicinal plants used in village chicken health management



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Dates:

Received: 10 June 2022

Accepted: 13 Oct. 2022

Published: 08 Mar. 2023

How to cite this article:

Chidembo, R., Ndlovu, W., Mwale, M., Obadire, O. & Francis, J., 2023, 'Opportunities and challenges in the commercialisation of medicinal plants used in village chicken health management', *Journal of Medicinal Plants for Economic Development* 7(1), a175. <https://doi.org/10.4102/jomped.v7i1.175>

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Background: Medicinal plants (MPs) are widely accepted and used in most rural communities in sub-Saharan Africa and beyond to treat and control village chicken (VC) diseases and parasites. They are readily available, accessible and cheap. Moreover, they are nature friendly and have adapted to the local environment, making them easy to produce. Over and above, their use has health benefits for consumers. Little is known about the opportunities and challenges faced when commercialising these MPs.

Aim: It is imperative to unpack the opportunities and challenges that are encountered while commercialising MPs used for treating VC diseases and controlling parasites. Despite these multiple benefits, the commercialisation of these plants seems to be under researched. In South Africa, different rural communities use various MPs in their locality. For instance, most rural families in South Africa are using *Aloe ferox*, *Helichrysum petiolare*, *Tagetes minuta*, *Lippia javanica*, *Agave sisalana*, *Gunnera perpensa* and *Milletia grandis*. Conspicuously, not much is known about the efforts made to commercialise these products.

Method: Through a systematic review of the literature, this paper unpacks the trends, opportunities and challenges faced in commercialising MPs used to treat VC disease and control parasites.

Results: Results have revealed that globally MPs for VC management are not widely recognised, despite their wide usage by local communities. If properly harnessed, they have the potential to strengthen local economic development through income generation. However, currently, little is derived from the sale of these products because of the presence of middlemen. Their commercialisation efforts are hampered by the lack of organised support systems and networks, lack of regularisation strategies and clear criteria for supporting quality, protection and presumed efficiency.

Conclusion: By commercialising MPs, local farmers can exploit MPs beyond the village chickens to broiler and layer chickens, thus offering alternative chicken health and affordable medicinal options for the farmers.

Contribution: The study contributes to understanding the available opportunities and challenges in commercialising MPs used for village chicken health management. It further demonstrates that MPs for village health can be used to transform the livelihoods of the custodians of these plants.

Keywords: commercialisation; indigenous knowledge systems; medicinal plants; parasites; smallholder farmers; village chicken diseases; village chicken production.

Introduction

Treatment of chicken diseases and controlling parasites with medicinal plants (MPs) is as old as humankind. With the current global efforts to reduce the carbon footprint caused by antibiotic use (Ekunseitan et al. 2016), the use of MPs has gained recognition. About 9.1% of poultry smallholder farmers rely on MPs to treat village chicken diseases (VCDs) and control chicken parasites (Oluwafemi, Olawale & Alagbe 2020) as they are comparatively cheaper, accessible and effective. They are less toxic, free of unwanted residues and offer a wide range of benefits such as improved animal performance and high nutritional content (Oluwafemi et al. 2020). They are also used as growth promoters in animal diets (Falcao et al. 2007). Among these reasons, MPs' footprint is increasingly prioritised and recognised in phytopharmaceuticals and nutraceuticals (Raiz et al. 2021). Despite these attributes and global recognition as an alternative to village chicken (VC)

health management options, medicinal products in rural communities are yet to be fully exploited commercially. This article assesses MPs' commercialisation and trading trends, opportunities and challenges, taking cognisance of gathering methods, conservation, production, environmental protection, intellectual property rights (IPRs) and market regulations.

Village chicken diseases and parasites negatively impact growth, productivity and meat quality. In sub-Saharan Africa, including South Africa, MPs are used to treat VCs against several diseases and parasites (Ndlovu et al. 2021). Unlike conventional medicines such as antibiotics, MPs pose fewer threats to the health of the birds and consumers. Moreover, there are no known 'drug-resistance' instances when administered. The MPs form a significant component of the environmentally friendly agricultural practices currently promoted, such as organic and sustainable agriculture, to protect the environment. Smallholder farmers in South Africa use a variety of MPs like sorghum (*Sorghum bicolor*) and aloe species such as *Aloe spicata*, *Aloe ferox* and *Aloe vera* to treat a wide range of VCDs (Jalal et al. 2019; Ndlovu et al. 2021; Seidavi et al. 2021). The perceived ability of indigenous MPs to treat poultry ailments with less, and at times without, side effects than conventional medicines indicates the potential for their commercialisation and the level of preference by local poultry farmers.

Moreover, experiences from other sectors, such as phytopharmaceuticals and nutraceuticals show that if commercialised, the MPs can offer alternative affordable organic medicine for poultry farmers and create opportunities for local entrepreneurs (Nwafor, Nwafor & Manduna 2021). Globally, the international trade of MPs has increased (Hamilton 2013), exceeding the market value of US\$107 billion annually (Karik & Tunçtürk 2019). In addition, the World Bank projects medicinal plant trade to grow to US\$5 trillion by 2050 (Bucher et al. 2020). Inarguably, MPs are in high demand (Khan et al. 2011; Pyakurel, Sharma & Smith-Hall 2018; Williams 2003), as evidenced by current trends of increased volumes and unit prices of MPs.

Two decades ago in South Africa, MPs for humans and animals were worth R27 million (Dold & Cooks 2002); the industry grew by R2.9 bn per annum (Mander et al. 2007). This constitutes about 5.6% of the national budget in South Africa. Despite this national trend, indigenous MP trade benefits among rural communities remain low. Surprisingly, literature on the commercialisation of MPs for poultry production is scanty. In South Africa, MP commercialisation and trading are joint in rural and urban areas (Nadawonde et al. 2007); however, they are a part of the 'hidden economy'. Ndawonde (2020) asserted that this industry has a lucrative and high financial benefit for businesses. Riaz et al. (2021) added that MP trading significantly contributes to the gross domestic product (GDP) for most developing nations, especially those with abundant biodiversity. Thus, commercialising MPs in South Africa for VCDs and parasites control has enormous potential to grow local rural economies

and create employment (Gunjan et al. 2015). For this reason, the study is premised on opportunities and challenges for commercialising MPs for the treatment of VCDs and control of parasites in the Vhembe district of Limpopo province, South Africa.

The inspiration to author this article emanated from the experiences of the authors' research activities in selected villages of Vhembe District, South Africa, between 2017 and 2019. They observed that rural households keeping indigenous VCs used MPs to treat various chicken diseases and control parasites. Cognisant that most of the families were headed by the elderly and unemployed, without stable sources of income, it dawned on the researchers that there is a need to explore the available opportunities and their associated challenges. This article builds on the previous work of Ndlovu et al. (2021).

Research methods and design

A systematic review of peer-reviewed journal articles was followed to identify, select, assess and synthesise the articles on opportunities or challenges of commercialisation of MPs in general. 'Commercialisation of medicinal plants' was the main topic to initiate database searches. Other words such as 'Medicinal Plants', 'Poultry Production', 'Village Chicken' and 'Village Chicken Diseases' in South Africa were also used. Google Scholar, Science Direct, Ebscohost and Connected Papers were used to search for journal articles. A total of 198 articles were retrieved from the database searches. Most articles were discarded either because they were not focused on MPs for animal diseases or because they did not focus on the opportunities and challenges of commercialising MPs. Overall, as indicated in Table 1, 27 journal articles and one policy document were found to be relevant for the scope of the study. Central to this review are the opportunities and challenges to commercialising MPs by the harvesters or the smallholder VC farmers. Particular attention was on trading, gathering methods, conservation, production, environmental protection, IPR and market regulation.

Results and discussion

Global trends of the commercialisation of medicinal plants

Medicinal plant value stood at US\$84.5 bn in 2019 and is expected to rise to approximately US\$411.2 bn in the next 5 years (Polaris Market Research 2020). The increased human need for MP products is attributed to this growth. Despite this lucrative value, MPs are continuously threatened by the changing climate (Ghorbanpour et al. 2017). Environmental issues such as loss of biodiversity, air, water, soil, forest destruction and land degradation pose an existential threat to the MPs (Kurnaz & Kurnaz 2021). Indirectly, these threats affect MPs' commercialisation efforts. Climate change affects the access and cultivation of MPs and the chemical composition in the plants as well (Applequist et al. 2020). Medicinal plants commercialisation is further derailed throughout the globe by the proliferation of alien invasive

TABLE 1: Review framework and indicators.

Aspect	Indicators	Sources
Global trends of the commercialisation of MPs	Trade	Astutik et al. 2019; Atanasov et al. 2015; Cameron et al. 2015; Chen et al. 2016; Ghorbanpour et al. 2017; Howes et al. 2020; Kurnaz & Kurnaz 2021; Mustafa et al. 2017; Nugroho et al. 2016; Polaris Market Research 2020; Tanga et al. 2018; Timmermanns 2003; Volenzo & Odiyo 2020
	Gathering methods	
	Harvesting of MPs	
	Conservation	
	Environmental protection	
	Intellectual property rights	
	Market regulation	
Commercialisation challenges	Support systems	Coghlan et al. 2012; Karik & Tunçtürk 2019; Kuniyal et al. 2013; Nadawonde 2007; Purohit & Vyas 2004; Pyakurel et al. 2018; Raiz et al. 2021; Volenzo & Odiyo 2020; Williams 2003; Zhang et al. 2012.
	Knowledge transfer	
	Health and safety regulations	
	Collection and conservation strategies	
	Global supply chain	
	Intellectual property rights and patenting	
	Government support	
Commercialisation opportunities	Knowledge and zeal for the economic benefits of MPs	
	The demand for the MPs' potential for expansion to other poultry species	Agelsen et al. 2017; Guleria et al. 2014; Hickey et al. 2016; Mohapatra et al. 2018; Nielsen et al. 2017; Raiz et al. 2021; Wunder et al. 2014
	The MPs comparative advantage	
	Value addition and beneficiation	

MP, medicinal plants.

Note: Please see the full reference list in Opportunities and challenges in the commercialisation of medicinal plants used in village chicken health management', *Journal of Medicinal Plants for Economic Development* 7(1), a175. <https://doi.org/10.4102/jomped.v7i1.175>

species, pests, changes in habitats and phenological risks that directly affect natural ecosystems' resilience, which are vital sources of the MPs (Kurnaz & Kurnaz 2021). On a global scale, the use of MPs in VC health management is not widely recognised, although indigenous communities and households widely use it, especially in Africa (Jambwa et al. 2022; Khunoana & McGaw 2020; Wodegebriel, Abede & Tamir 2018). Thus, the use of MPs, if adequately explored, has the potential to generate income for the custodians of this knowledge.

The MPs can only be traded or commercialised locally, nationally and internationally if markets are sufficiently valuable or scarce (Cameron et al. 2005). The market is available because they are used by the villagers in the Vhembe District of South Africa (Chitura et al. 2018). Currently, Germany, the USA and Hong Kong are leading in the commercialisation of MPs for livestock, with about 80% of their trade being carried out in about 12 countries (Nugroho et al. 2016; Tanga et al. 2018). Interestingly, among the traded and commercialised MPs, not much is known about the ones for the VC management. Thus, adequately marketed MPs for VCs can tap into these global markets where MPs are appreciated.

In rural communities of South Africa, the harvesters collect most of the MPs from the natural environment with little or no knowledge about environmental sustainability (Chitura et al. 2018). The same trend has been observed in Latin America by Bussmann (2019) who observed that the

gathering methods do not adequately guarantee extraction sustainability and *in situ* preservation. As a result, the harvesters and the custodians derive little from their products. Bussmann (2019) echoed this sentiment by observing that in Latin America, harvesters of the MPs derive little from their work. On an international scale, it is evident that the custodians and harvesters of the MPs lose a lot to the middlemen and wholesale traders (Kurnaz & Kurnaz 2021). In short, there are no formal relationships between the custodians of the MPs and the customers. Thus, it can be inferred that lack of knowledge and information among the local custodians of MPs for VC management exposes them to unsustainable harvesting practices that threatens existence of MPs species, while at the same time creating an avenue for exploitation by the middlemen as reported by Kurnaz and Kurnaz (2021).

For the commercialisation of MPs to be a reality and beneficial to the local communities, production and consumption methods need to be rethought in South Africa. In the face of changing climate and the increasing demand for MPs in village health management, the production and consumption need weighty introspection so that their commercialisation and production help in climatic mitigation and adaption efforts. In other words, for the demand to be met sustainably, there is a need to transition to sustainable bioresource management within the scope of preserving biodiversity and a circular economy (Kurnaz & Kurnaz 2021). Thus, the commercialisation of MPs needs to be cognisant of the commercial and industrial production imperatives, such as extinction threat posed by mass production of MPs. There is a need for the transition to sustainable bioresource management within the scope of preserving biodiversity and a circular economy (Kurnaz & Kurnaz 2021). Similarly, almost 20% of the *Prunus africana* trees were lost in the Kakamega forest in Kenya between 1997 and 2003 due to market liberalisation (Volenzo & Odiyo 2020). Thus, the commercialisation of MPs for VC health management needs to be carried out after fully appreciating the sustainability of the production methods of the MPs in question.

Commercialising the MPs for VC health management has the propensity to threaten the already overburdened environment. Simultaneously, hesitancy in commercialisation directly affects the sustainability of the pharmaceuticals and nutraceuticals sector (Atanasov et al. 2015). Thus, at both the national and global levels, there is a need to strike a balance between the two to ensure the sustainability of natural environments and animal health, cognisant that the changing climate is even complicating the conservation imperative. It is indisputable that commercialisation and industrial production of any active medical compound from biological sources lead to overexploitation of biological species especially if the ecosystem management practices do not factor environmental protection practices in their programming. For instance, *Ferula narthex*, one of the valuable MPs, has approached near extinction in Northern Pakistan as local farmers cut the plant,

unsustainably disturbing its natural cycle (Mustafa et al. 2017). As such, commercialisation efforts of MPs increase the pressure on unsustainable harvesting of MPs.

The Convention on Biological Diversity (CBD), signed in 1993 in Rio de Janeiro, Brazil, assigns the ownership of any commercially valuable indigenous biological diversity to the local communities. Questions have been raised on the practicality of monitoring and enforcing these IPR, especially after considering the financial and time implication of exercising and enjoying these rights (Timmermanns 2003). Importantly, IPRs encapsulated in the CBD only recognise 'individuals who claimed invention rather a collective community based on its tradition' (Munson 2019). This is problematic because it disregards cultural recognition of the MP use in VC ailments and parasites, directly affecting their subsequent commercialisation initiatives. Linked to the IPR on biological diversity is the effect of diminishing plants on the local communities. In Latin America, 14% of the flora are either extinct or threatened with extinction status (Howes et al. 2020). Globally, a quarter of MPs range from vulnerable and critically endangered to extinct in the wild or extinct (Howes et al. 2020). Thus, Kurnaz and Kurnaz (2021) posits that all countries and local communities must holistically implement CBD and IPR to protect the biodiversity and fully reap commercial benefits of the locally available medicinal resources, allowing coproduction and commercialisation of the MPs. This approach has been used successfully in Nepal and India. For instance, awareness and training for producers and buyers of *Cinnamomum tamala* (Indian bay leaf) have resulted in viable and win-win partnerships for the essential oil and spice sector, doubling the producers' income.

Another overarching global issue on the commercialisation of the MPs is market regulation. It is well established that wholesalers in the MPs value chain have more significant margins ranging from 1.5- to 20-fold than collectors (Nugroho et al. 2016). Additionally, bureaucracy along the MPs' value chain is inhibiting in commercialising medicinal products (Astutik et al. 2019). Bureaucracy coupled with red tape jeopardises investments and the subsequent commercialisation of MP. Lack of sufficient global access channels and transaction components that limit the development of the valuable plants has further exposed market regulation challenges. As a result of these and other associated inadequacies, bio-diversity-rich countries and communities cannot develop their capacities for investment attraction (Kurnaz & Kurnaz 2021), which frustrates MPs' commercialisation. Besides the market regulation-related issues, it needs to be flagged out that the commercialisation of MPs, especially those used in VC health management, is threatened by the cost of transporting them to market centres (Kurnaz & Kurnaz, 2021) as it involves large biomass.

Commercialisation challenges of medicinal plants for village chickens health management

It was observed that generally in South Africa, there is a lack of organised support systems and networks in the MPs'

value chain (Ndawonde 2020). A noticeable deficiency is the lack of intermediaries for knowledge transfer from the custodians of the MPs used in VC health management to the industry in the country. This has been explained by the fact that the global supply of MPs is regulated by the developed nations of Asia, Europe and North America (Karik & Tunçtürk 2019). Thus, the commercialisation of MPs in South Africa is complex. In addition, the situation has been worsened by the existence of stringent health and safety requirements (Food and Agricultural Organisation 2004). As such, without a more holistic solution to these impediments, it will remain a nightmare to commercialise MPs that have been used successfully to treat VC ailments and parasites.

Some scholars have speculated that there is a lack of regularisation of collection strategies for harvesting of individual species used as MPs and ecosystems (Kuniyal et al. 2013; Raiz et al. 2021). This has been earlier on observed by Nadawonde et al., 2007, who concluded that MPs are harvested without replenishment. Undoubtedly, this approach is not sustainable and threatens the long-term survival of plant species, thereby jeopardising any hopes of ever commercialising this product. There are, however, other explanations that MPs are in high demand, and this is putting a lot of pressure on the harvesters to employ incorrect methods, which have led to the decline of some of the critical species, while others are on the verge of extinction (Williams 2003). Thus, if ever the commercialisation drive of MPs used to control VCDs and parasites is to be rewarding to the custodians of the plants, there is a need to regularise harvesting and come up with new strategies for conservation of individual species, which are used to treat VC and control parasites.

In addition, commercialisation and patenting are often guided by policy discourses that conflict with existing customary rights on access, use and control of medicinal plant resources (Volenzo & Odiyo 2020). For instance, bioprospecting has been met with different outcomes in Africa and other parts of the world (Fashing 2004). Bioprospecting, that is, exploration of the biological properties for commercially valuable genetic and biochemical properties (United Nations Convention on Biological Diversity 2021), includes studies that determine MPs' chemical profile and composition (Street & Prinsloo 2013). Thus, there is a need to synchronise the existing customary rights and patenting and commercialisation strategies to avoid unnecessary hurdles. In addition, this synchronisation should be aware of the impact and role of climate change on these MPs for village health management. As a result of climate change, most traditional plants are failing, so it is imperative to develop climate change interventions geared towards protecting and preserving these plants.

On the same note, it was observed that the harvesters and farmers of MPs for VC health management ailments generally seem unaware of the resource's economic benefit (Purohit & Vyas 2004). This has been identified as one of the impediments

to the commercialisation of the plants for the use of the local communities. Thus, it was recommended to advocate for community awareness and inculcate an entrepreneurship culture among the local rural communities to get the best of their resources and intellectual property. It is worth noting that, where MPs are commercialised, only the harvesters without government and non-government support (Pyakurel et al. 2018) do so. Thus, they largely depend on local resource access and control, harvesting knowledge and low capital requirements (Winkler 2005). Therefore, the custodians of the MPs used for health management are discouraged from expecting much from the government and non-governmental organisations other than themselves.

MPs used for VC health management, like any other herbal and dietary supplement, have been criticised for not providing adequate criteria or empirical evidence to support their quality, protection and presumed efficacy (Coghlan et al. 2012; Zhang et al. 2012). This criticism has adversely affected the formulation of policies that stimulate the commercialisation of the product (Nchu et al. 2020). Unless and until traditional science is recognised and indigenous knowledge is appreciated in the same way as Western Science used to make critical decisions, commercialisation will remain in the pipeline. Thus, it is imperative to deliberate efforts to confirm the efficacy with empirical evidence to convince that traditional science can be equally used to curb current village health ailments and parasites.

Commercialisation opportunities of medicinal plants for village chicken diseases

Several opportunities can be derived from commercialising MPs to treat VCDs. In the context of this study, commercialisation is viewed as all the efforts that seek to promote marketing of MPs for maximising profits. In the words of Richerzhagen (2011), it is the integration of commercial value of the MPs where the market is created for the users and the providers negotiate conditions of exchange. To begin with, as several traditional crops are failing because of climate change, trading and cultivation of MPs offer a viable economic opportunity for profit maximisation (Riaz et al. 2021). In addition, there is a noticeable increase in global recognition of medicinal products (Riaz et al. 2021). This is an opportunity for harvesters and custodians of the MPs used in VC health management. If they capitalise on these global trends and strive to commercialise their products, there is potential for enormous economic benefits. Thus, the commercialisation of the MPs used to treat chicken diseases and control parasites can serve as the cornerstone to the sustainability of civilisations, source of income and trade (Raiz et al. 2021). There is also room for local economic development because of commercialising these MPs.

One of the emerging issues is that MPs for treating VC ailments and controlling parasites are found naturally in the human habitat. For instance, *A. ferox* is used for controlling gastrointestinal parasites, while *Helichrysum petiolare* is burnt into ashes and *Tagetes minuta* leaves drive away parasites in

incubating hens. *Lippia javanica* branches are widely used to get rid of ectoparasites. They are all found naturally in human habitat. Their increased demand globally presents an opportunity for them to be cultivated under field conditions for sale and mass production (Mohapatra et al. 2018). In addition, they are found in tropical Africa. This places the origin on the comparative distributional advantage that unlocks the actual value of the natural products endemic to rural communities of South Africa. However, it must be highlighted that not all South African communities are endowed with knowledge and the abundance of MPs used to treat VCDs and control parasites. In the context of this article, the reported MPs were recorded in selected four villages of Vhembe District in South Africa, namely Tshikambe, Tshidzini, Tshamutshedzi and Tshivhili. Commercialisation and controlled cultivation of these MPs do not affect the cultivation of food crops because they grow naturally in the forest. Cognisant of the current IPR dictates, there is an opportunity to patent all MPs for VC health management that are locally available. As these MPs are locally available and are part of indigenous knowledge systems peculiar to these communities, there is no formal training needed. Instead, all families that are interested in selling these products need to be organised in association with enhancing their bargaining power. Both the formation of associations and patenting of the MPs create a legal route for monetising by protecting their use and exploitation. Through patenting and monetising, communities endowed with MPs can capitalise on this opportunity and get the best out of this product for socio-economic development. Lastly, the processing of MPs for treating chicken diseases is associated with a large quantity of residual biomass (solid, liquid gaseous) that could be used for value addition.

Current studies have revealed that, there are no properly defined market channels for MPs in South Africa (Ndawonde 2020). In addition, the prices are not attractive coupled with no properly defined MPs regulatory framework in the country (Chitura et al. 2018). To succeed in commercialising MPs used to control VCDs and parasites, there is a need for attractive prices, fixed market channels, price assurance by agents and a monopoly of the group of producers in cultivating and selling these products (Riaz et al. 2021). Thus, well-established market channels prompt farmers to grow and commercialise MPs (Guleria et al. 2014). Elsewhere therapeutic plant collection has been identified not only as the employment of last resort but also as an environmentally friendly source of income that can serve as a pathway out of poverty (Angelsen et al. 2014; Hickey et al. 2016; Nielsen et al. 2017; Wunder et al. 2014). Based on these observations, it can be safely argued that MPs such as *A. vera*, *A. ferox* and *A. spicata* for controlling chicken diseases and parasites of VC are associated with several opportunities that can be capitalised on for the socio-economic development of the custodians of these products.

Conclusion

The commercialisation of MPs used for VC health management is marred with challenges and opportunities for socio-economic development. A lack of organised support

systems within the MPs' value chain and intermediaries for knowledge transfers from the custodians to other traders are some challenges thwarting commercialisation efforts for MPs for VC health management. In addition, the regularisation of the collection, processing and harvesting of plants has compromised the country's commercialisation agenda. Interestingly, the incompatibility of cultural rights with patenting and commercialising MPs has complicated the situation. This has been coupled with a lack of knowledge on the commercial value of MPs used in VC health management. Despite the challenges of commercialising MPs, many opportunities are equally presented. For instance, commercialisation allows for the cultivation of these crops on a large scale. Geographically, they are found in the tropics, which offers an opportunity to turn the economic fortunes of these underdeveloped communities. It is, thus, recommended that responsible authorities gazette attractive market prices and fixed markets. In addition, custodians of these products are allowed to monopolise the trade of MPs and products to get the best of their intellectual property. Furthermore, there is a need for targeted awareness, capacity building and training among the custodians of the MPs for VC health management on an array of issues that include conservation, environmental protection and available policies that promote commercialisation of MPs. There is scanty research on the commercialisation of MPs for VC health management; thus, further investigation is recommended to understand this phenomenon clearly.

Acknowledgements

Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

R.C., W.N. and M.M. conceptualised the idea; R.C. searched for literature, synthesised literature and developed the draft manuscript, W.N. and M.M. coordinated and managed the worked, W.N., M.M., J.F. and O.O. reviewed the manuscript and provided mentorship role; R.C. addressed comments raised and finalised the manuscript.

Ethical considerations

Research Ethics Committee of the University of Venda SARDF/15/IRD/10/0502

Funding information

The authors received funding from The University of Venda's Research and Publication Committee (SARDF/15/IRD/10/0502).

Data availability

The data sets generated during this study were obtained from Google Scholar, Ebscohost and Science Direct.

Disclaimer

The views and opinions contained herein are solely of the authors and do not represent the official policy or position of the University of Venda.

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