

# Ethnopharmacological use of potassium permanganate in South African traditional medicine

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**Background.** Potassium permanganate (KMnO<sub>4</sub>), which is widely available, is often used by traditional health practitioners (THPs) in South Africa (SA) without taking its potentially harmful properties into account. The crystalline KMnO<sub>4</sub> salt is sold at traditional medicine markets and shops throughout SA. However, to date, traditional uses of KMnO<sub>4</sub> remain undocumented.

**Objective.** To describe KMnO<sub>4</sub> use by THPs in KwaZulu-Natal, SA.

**Methods.** This sub-study is part of a larger study investigating substances used in SA traditional medicine that are collectively known as *imikhando* in isiZulu – literally translated as ‘ore’. THPs (N=201) were interviewed in the local language (isiZulu) by trained interviewers. Information on the reasons for using/not using KMnO<sub>4</sub>, the source of information on its use and modes of administration were collected.

**Results.** KMnO<sub>4</sub> was used as a constituent of traditional medicine by 158 (79%) THPs. Their knowledge of KMnO<sub>4</sub> use was acquired predominantly from fellow THPs (n=134; 85%). Reasons for use included skin rash or wounds (n=99, 63%) and to treat aches, pains and swelling (n=74; 47%). The main modes of administration were in the bath (n=94; 60%), orally (n=67; 42%) and in herbal compresses (n=66; 42%). The principal reason of the 43 THPs for not administering KMnO<sub>4</sub> was not knowing how to use it (n=29; 71%).

**Conclusions.** This study has identified traditional medicine users at risk of manganese toxicity owing to commonly used sociocultural practices. In particular, reports of oral ingestion and use in enemas are cause for concern. This public health issue needs regulatory measures and education programmes to enlighten the population against possible harm caused by KMnO<sub>4</sub> exposure.

*S Afr Med J* 2018;108(3):187-189. DOI:10.7196/SAMJ.2018.v108i3.12606

Potassium permanganate (KMnO<sub>4</sub>) is an industrially significant manganese (Mn) compound of economic importance.<sup>[1]</sup> At room temperature, it exists as a fragrance-free, dark purple crystalline substance with a metallic sheen. It is readily water soluble, and aqueous solutions are pink to violet in colour, depending on the strength.<sup>[2]</sup> KMnO<sub>4</sub> is a powerful oxidising agent and is commonly used medicinally as a topical antiseptic agent.<sup>[3,4]</sup> Nonetheless, over-the-counter availability of KMnO<sub>4</sub> may contribute to its potentially harmful properties being overlooked. For example, ingestion of KMnO<sub>4</sub> may result in widespread systemic toxicity that can cause major morbidity and even mortality.<sup>[5]</sup>

In South Africa (SA), KMnO<sub>4</sub> poisoning in both adults and children has been reported for decades.<sup>[6-9]</sup> A recent study revealed 46 childhood poisonings by KMnO<sub>4</sub> at a single hospital over a 5-year period (2003 - 2008), eight of which included severe corrosive injuries.<sup>[8]</sup> Mn, in the form of KMnO<sub>4</sub>, is one of the main metals implicated in traditional medicine poisonings in SA.<sup>[10]</sup> The crystalline KMnO<sub>4</sub> salt is easily obtainable at traditional medicine markets and shops throughout SA.<sup>[11]</sup> However, to date, traditional uses of KMnO<sub>4</sub> have not been described; therefore, possible risks due to KMnO<sub>4</sub>-associated sociocultural practices remain unknown. The aim of this study was to document ethnopharmacological uses of KMnO<sub>4</sub> in SA traditional medicine.

## Methods

This sub-study on KMnO<sub>4</sub> is part of a cross-sectional, descriptive study investigating metal and mineral substances used in SA traditional medicine, which are collectively known as *imikhando* in

isiZulu; this is literally translated as ‘ore’. The results of our study on KMnO<sub>4</sub>, locally known as ‘double buys’ or *umanyazini*, are reported in this article. The sampling method was detailed previously.<sup>[12]</sup> In brief, traditional health practitioners (THPs) were recruited from KwaZulu-Natal, SA. A total of 201 THPs were interviewed by trained interviewers and a structured questionnaire was administered in the local language, isiZulu. Data collected via the questionnaire were captured on an Excel spreadsheet, then exported to Stata version 14 (StataCorp., USA) for analysis. For certain questions related to KMnO<sub>4</sub> use, multiple responses were allowed. Reasons for administering KMnO<sub>4</sub>, as well as routes of administration, were only included if they were independently reported by ≥5 THPs. The participants signed an informed consent form prior to the start of the interview. The study was approved by the Biomedical Research Ethics Committee (BREC) of the University of KwaZulu-Natal (ref. no. BREC BF185/010).

## Results

Of the 201 THPs interviewed, most were female (n=142; 71%), 62% had practice experience of >5 years, and 30/190 (16%) had no (formal) schooling (Table 1). About three-quarters of the respondents (n=158; 79%) reported using KMnO<sub>4</sub> as a constituent of SA traditional medicine. Gender, education and years of practice were not significantly associated with KMnO<sub>4</sub> use (Table 1).

The THPs who used KMnO<sub>4</sub> acquired the knowledge for usage from three different sources, i.e. fellow THPs, being self-taught or their ancestors (n=134, 85%; n=12, 8%; and n=11, 7%, respectively) (results not tabulated, 1 missing response).

**Table 1. Demographic characteristics of study participants, stratified by KMnO<sub>4</sub> use**

Characteristics	Total (N=201)	KMnO <sub>4</sub> users (n=158)	Non-KMnO <sub>4</sub> users (n=43)	p-value
Gender, n (%)				0.073
Female	142 (70.6)	116 (73.4)	26 (60.5)	
Male	59 (29.4)	42 (26.6)	17 (39.5)	
Years of practice (in 5-year intervals), n (%) <sup>*</sup>				0.166
≤5	75 (38.1)	57 (36.8)	18 (41.9)	
5.1 - 10	40 (20.3)	31 (20.7)	9 (20.9)	
10.1 - 20	47 (23.9)	34 (21.9)	13 (30.2)	
>20	35 (17.8)	32 (20.7)	3 (7.0)	
Education, n (%) <sup>†</sup>				0.926
None	30 (15.8)	25 (17.0)	5 (11.9)	
Lower primary	41 (21.6)	32 (21.6)	9 (21.4)	
Higher primary	29 (15.3)	23 (15.5)	6 (14.3)	
Attended high school	69 (36.3)	53 (35.8)	16 (38.1)	
Completed high school	16 (8.4)	11 (7.4)	5 (11.9)	
Tertiary	5 (2.6)	4 (2.7)	1 (2.4)	

\*Four responses missing.

†Eleven responses missing.

The 43 THPs provided six reasons for not administering KMnO<sub>4</sub>, including: (i) not knowing how to use it (n= 29; 71%); (ii) it being unsafe (n=6; 15%); (iii) not believing in it (n=3; 7%); (iv) according to their ancestors they should not use it (n=1; 2%); (v) only using African medicine (n=1; 2%); and (vi) only using traditional medicine dug from the ground, e.g. plants (n=1; 2%) (Table 2).

Table 3 presents, in descending frequency, the 11 principal reasons provided by the 158 THPs for administering KMnO<sub>4</sub>. The main responses included use for skin rash or wounds (n=99; 63%), aches, pains and swelling (n=74; 47%) and gastrointestinal disorders (n=33; 21%).

Eight modes of KMnO<sub>4</sub> administration were reported, with the main methods being use in the bath (n=94; 60%), orally (n=67; 42%) and herbal compresses (n=66; 42%) (Table 4). Administration of KMnO<sub>4</sub> by means of an enema was reported by 44 (28%) of THPs.

## Discussion

Our study revealed a larger proportion of female than male THPs using KMnO<sub>4</sub> in their healing practice (82% and 71%, respectively). The majority of the THPs using KMnO<sub>4</sub> acquired the knowledge for usage from fellow THPs; however, with the diverse modes of administration and reasons for use, it was evident that the information relayed was not standardised and in certain cases may be harmful to traditional medicine users.

Mn is recognised as an essential micronutrient, but the acute toxicity of KMnO<sub>4</sub> is defined by its oxidant/irritant properties and by the toxicity of Mn.<sup>[13]</sup> The symptoms of KMnO<sub>4</sub> poisoning depend on the route of exposure, which is most commonly ingestion.<sup>[14]</sup> The findings of our study revealed that 42% of the THPs administer KMnO<sub>4</sub> orally. Manifestations of oral intake include nausea and vomiting in mild cases.<sup>[15,16]</sup> Owing to its caustic action, burns and ulceration of the mouth, oesophagus and stomach may occur.<sup>[5,16]</sup> Another common mode of KMnO<sub>4</sub> administration is by means of an enema, as reported by 28% of the THPs. Caustic enemas may have devastating consequences.<sup>[9,17]</sup> Enemas containing caustic substances may be more damaging than ingestion because of the increased tissue contact time in the lower gastrointestinal tract.<sup>[17]</sup> Nonetheless, little is known about treatment and prognosis.<sup>[17]</sup>

Two-thirds of the THPs in our study administered KMnO<sub>4</sub> for healing of wounds and/or skin conditions. This is consistent with the

**Table 2. Traditional health practitioners' reasons for not administering KMnO<sub>4</sub>**

Reason (N=41) <sup>*</sup>	n (%)
Don't know how to use it	29 (70.7)
It is not safe to use	6 (14.6)
Don't believe in it	3 (7.3)
Ancestors say you must not use it	1 (2.4)
Only use African traditional medicine	1 (2.4)
Only use plants	1 (2.4)

\*Two responses missing.

**Table 3. Health conditions identified for treatment with KMnO<sub>4</sub><sup>\*</sup>**

Reason (N=158)	n (%) <sup>†</sup>
Skin rash or wounds	99 (62.7)
Aches, pains and swelling	74 (46.8)
Gastrointestinal: aches and cramps	33 (20.9)
Sexually transmitted diseases	23 (14.6)
Nervous conditions	23 (14.6)
Blood cleaning	14 (8.9)
Kidney and/or bladder	13 (8.2)
Aphrodisiac	7 (4.4)
Impotence	6 (3.8)
Gynaecological	5 (3.2)
HIV	5 (3.2)

\*Multiple responses allowed.

†Reported by ≥5 traditional health practitioners.

customary use of KMnO<sub>4</sub>, i.e. the disinfecting and cleaning of wounds and as a general topical skin antiseptic.<sup>[18]</sup> Nonetheless, despite its long history of use, there is a lack of evidence to support KMnO<sub>4</sub> to aid the management of exuding wounds; therefore, its medicinal indication remains controversial.<sup>[19,20]</sup> It is interesting to note that the study by Balme *et al.*<sup>[8]</sup> on childhood poisoning in SA classified toxic substances according to the intended use of the agent and classified KMnO<sub>4</sub> as an antiseptic agent. Our study provides evidence to consider the classification of KMnO<sub>4</sub> under the agent category of traditional medicine.

**Table 4. Traditional health practitioners' various administration modes for KMnO<sub>4</sub> use\***

Administration mode (N=158)	n (%) <sup>†</sup>
In bath	94 (59.9)
Oral	67 (42.4)
Herbal compress	66 (41.8)
Enema	44 (27.9)
Cutaneous implantations	25 (15.8)
Licking off finger tips	8 (5.1)
Inhalation/facial sauna	7 (4.4)
Licking off hand	6 (3.8)

\*Multiple responses allowed.

<sup>†</sup> Reported by ≥5 traditional health practitioners.

Our study revealed the use of KMnO<sub>4</sub> for a range of sexual issues, including sexually transmitted infections (STIs) (23%), as an aphrodisiac (4%), and for impotence (4%). The oral use of KMnO<sub>4</sub> as an alternative treatment to prevent or cure STIs has previously been reported in SA.<sup>[21,22]</sup> Our study further revealed the use of KMnO<sub>4</sub> for HIV infection; however, the exact specification (e.g. prevention, management) is not given. In China, KMnO<sub>4</sub> is reportedly used by female sex workers to prevent HIV and STIs,<sup>[23]</sup> despite there being no supporting scientific evidence.<sup>[23]</sup>

Although general symptoms of Mn toxicity include nausea, vomiting and gastrointestinal tract disturbances,<sup>[5,18]</sup> there is a need for a comprehensive understanding of Mn risk, the mechanism of toxicity, clinical interventions, as well as primary prevention strategies.<sup>[24]</sup>

## Conclusion

There is a growing body of evidence relating to Mn toxicities from a range of sources, which signifies its public health importance.<sup>[24]</sup> This study has identified traditional medicine users at risk of poisoning owing to sociocultural practices involving KMnO<sub>4</sub>. Healthcare providers may be unaware of the metal salts used in traditional medicine; therefore, circumstances around KMnO<sub>4</sub> poisonings may be inaccurately documented and/or under-reported. To this end, the lack of an SA medicine pharmacopoeia is a public health threat. Furthermore, there is a need for poisoning prevention programmes that are locally relevant and culturally cognisant.

**Acknowledgements.** The authors would like to thank their respective institutions for financial support.

**Author contributions.** RAS initiated the concept and oversaw the study data collection. GMK and CC performed the statistical analyses and interpreted the results. RAS, GMK and CC drafted the manuscript, and

read and approved the final manuscript. The content of this publication is solely the responsibility of the authors and does not necessarily represent the official views of any of the institutions mentioned above.

**Funding.** This project was funded by the South African Medical Research Council (SAMRC), funding provided to the principal investigator from the SAMRC's Career Development Awards Programme. The University of KwaZulu-Natal, Durban, is thanked for additional funding.

**Conflicts of interest.** None.

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Accepted 2 October 2017.