South African Journal of Botany 97 (2015) 154–158

Contents lists available at ScienceDirect

South African Journal of Botany

journal homepage: www.elsevier.com/locate/sajb

Grewia bicolor seed oil: Putative pharmaceutical, cosmetic and industrial uses

Trevor T. Nyakudya [a,*], Nosiephi Nosenga [d], Eliton Chivandi [b], Kennedy H. Erlwanger [b], Mazuru Gundidza [c], Energy Gundidza [g], Michael L. Magwa [e], Perkin Muredzi [f]

[a] Department of Human Anatomy and Physiology, Faculty of Health Sciences, University of Johannesburg, Doornfontein, 2028 Johannesburg, South Africa
[b] School of Physiology, Faculty of Health Sciences, University of the Witwatersrand, Parktown, 2193 Johannesburg, South Africa
[c] Department of Pharmaceutical Technology, Harare Institute of Technology, P.O. Box BE 277, Ganges Road, Belvedere, Harare, Zimbabwe
[d] Department of Pharmacy and Pharmacology, Faculty of Health Sciences, University of the Witwatersrand, Parktown, 2193 Johannesburg, South Africa
[e] Botany Department, University of Fort Hare, Private Bag x1314, Alice, Eastern Cape 5700, South Africa
[f] School of Industrial Sciences and Technology, Harare Institute of Technology, Ganges Rd, Box BE 272, Belvedere, Harare, Zimbabwe
[g] Department of Production Engineering, School of Engineering Sciences and Technology, Chinhoyi University of Technology, P. Bag 7724, Chinhoyi, Zimbabwe

ARTICLE INFO

Article history:
Received 22 June 2014
Received in revised form 3 December 2014
Accepted 12 January 2015
Available online 4 February 2015

Edited by AM Viljoen

Keywords:
Grewia bicolor
Fatty acid profile
Physicochemical characteristic
Ethnomedicine

ABSTRACT

The physicochemical characterisation, seed oil content and fatty acid profile of oil extracts from *Grewia bicolor* seeds collected in Zimbabwe were performed using standard extraction and chromatographic techniques. The main objective was to determine the potential domestic and industrial usefulness of the *G. bicolor* seeds. The *G. bicolor* seeds yielded 4.80% of brownish-orange oil that had an acceptable odour. The seed oil consisted of saturated (20.20%), monounsaturated (25.10%) and polyunsaturated (54.41%) fatty acids. Palmitic acid (11.46%), stearic acid (5.77%), oleic acid (19.33%) and linoleic acid (54.41%) were the main fatty acids in *G. bicolor* seed oil. The oil had a high acid value (0.53 mg KOH/g), iodine value (39.21 g I_2/100 g oil) and saponification value (130.43 mg KOH/g) compared to published data on other nutritionally and ethnomedicinally important plant seed oils.
We conclude that the *G. bicolor* seeds are low oil yielding, whose oil could be used as a potential source of palmitic, stearic, oleic and linoleic acids and may potentially be utilized as an industrial ingredient in the manufacture of soaps, pharmaceutical products, and cosmetics. Further studies are required to explore the possibility of using this seed oil in industry.

1. Introduction

Grewia bicolor, commonly known as white raisin or false brandy bush, is an indigenous African tree which belongs to the *Tiliaceae* family (Hutchings et al., 1996; Brink, 2007). The *Grewia* genus has over 250 species that are widely distributed throughout the savannahs of the sudano-sahel ecozone, Eastern and Southern Africa (Baumer, 1983; Brink, 2007). The tree is drought resistant and grows in low to medium altitudes, rocky mountain slopes and low lying depressions (Le Houérou, 1980). It has also been recorded from coastal Benin and Togo and occurs in Yemen, Saudi Arabia and India (Le Houérou, 1980).

The *G. bicolor* tree is multi-stemmed with dark grey bark and can reach up to 14 m high. The leaves are elliptic-oblong to lanceolate, 1.5–7 cm long × 1–3.2 cm broad, typically bicolored; with a dull green upper surface while the lower surface is silvery white that have a finely toothed margin (Orwa et al., 2009). The edible *G. bicolor* fruits are reddish brown in colour, spherical or bi-lobed drupe and 6–7 mm in diameter (Brink, 2007; Orwa et al., 2009). Although astringent, the sweet, mealy fruit pulp is often eaten fresh or sun dried as candy for consumption at a later stage (Orwa et al., 2009). Some indigenous communities extract juice from the fresh fruit berries for drinking, adding to porridge, fermenting into beer or distillation into liquor (Baumer, 1983). A mixture of the fruit is sometimes used to coat leather containers containing butter or clay pots containing milk to enhance the flavour and organoleptic characteristics of the butter or milk (Orwa et al., 2009). In some communities in Burkina Faso, the bark is used to make 'dolo' which is used to clarify sorghum wort and reduce the bitterness in traditional sorghum beer (Sawadogo-Lingani et al., 2007; Orwa et al., 2009). The mucilaginous leaves of *G. bicolor* are used as a binding agent in sauces (Orwa et al., 2009).

The roots, bark and leaves of the *G. bicolor* tree have a wide range of applications in African traditional ethnomedicine. Extracts and preparations from various *Grewia* plant parts exhibited various biological effects such as anti-oxidant, hepatoprotective, anti-inflammatory, anti-emetic, anti-malarial, analgesic and anti-pyretic activities (Ullah et al., 2012). The presence of triterpenes and alkaloids (6-hydroxyharman) in petroleum ether extracts of the bark and roots makes *G. bicolor* a potent

* Corresponding author at: Department of Human Anatomy and Physiology, Faculty of Health Sciences, University of Johannesburg, Cnr Beit and Siemert Streets, Doornfontein, 2028 Johannesburg, South Africa. Tel.: +27 11 559 6802; fax: +27 11 559 6558.
E-mail address: trevorn@uj.ac.za (T.T. Nyakudya).

http://dx.doi.org/10.1016/j.sajb.2015.01.004
0254-6299/

tranquiliser (Baumer, 1983; Jaspers et al., 1986; Arora, 2011; Augustino et al., 2011). The bark and other plant parts of the tree also contain farnesol, which has a sedative effect that antagonises the stimulatory effect of caffeine and enhances the effects of barbiturates (Brink, 2007; Augustino et al., 2011).

The root methanol extract of *Grewia optiva* and *Grewia mollis*, possesses anti-bacterial activity against Gram-positive and Gram-negative bacteria such as *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli* and *Pseudomonas seruginosa* (Arora, 2011; Shagal et al., 2012). The anti-bacterial properties of the root extracts of related species support the use of *G. bicolor* root decoctions in the treatment of abscesses, pustulous skin lesions, syphilis and gonorrhoea (Arora, 2011). Roots are also used as a remedy for chest complaints, to relieve pain in the intercostal area and to enhance female fertility. *G. bicolor* leaf extracts are used traditionally as a diuretic, a laxative, for intestinal inflammation, and a remedy for colds (Ullah et al., 2012), among other uses. The bark decoctions are used as a vermifuge while the leaf extracts are used as an arbotifacient by traditional healers (Orwa et al., 2009). The use of *G. bicolor* leaf extracts as an arbotifacient can be attributed to its ability to induce strong contractions of the isolated rat uterus (Mohamed et al., 1990; Brink, 2007). Root decoctions have been given to women and sometimes in veterinary ethnomedicine to cattle to aid in the expulsion of the placenta after birth (Jaspers et al., 1986; Brink, 2007). The wood of *G. bicolor* possesses anti-helminthic properties while the bark is used to treat inflammation of the intestines (Orwa et al., 2009).

Other than its ethnomedicinal properties, *G. bicolor* is a veritable multipurpose tree, yielding a range of useful products, and it therefore seems a good candidate for community forestry projects. The trees and shrubs are used as a source of timber and firewood in some parts of Africa such as Senegal and Tanzania (Hines and Eckman, 1993). However due to the small size of the tree or shrub, its timber is unlikely to become sawn wood (Brink, 2007) thus can only be used for construction and making of utensils. The bark fibre can be used for making string, rope or cordage (Hines and Eckman, 1993; Mbuya, 1994) while the ashes of the leaves are utilized as a substitute for soap for washing clothes (Orwa et al., 2009). The tree is also used as an ornamental, a shade tree and as bee forage (Orwa et al., 2009).

The fresh or dry leaves and fruit are foraged by domestic livestock and game due to their good nutritional value (Kamwihangilo et al., 2001; Terefe et al., 2010). The leaves provide a good source of macro- and micro nutrients with relatively low crude fibre (160–220 g/kg dry matter), good digestibility (70%) and net energy concentration (5.5 to 6.0 MJ/kg dry matter) (Fall, 1991; Osolo et al., 1994). Due to their high nutritional value for livestock and game, *G. bicolor* leaves have been classified as mineral phytocentres for livestock and should be considered for conservation in enclosures.

There is no doubt that *G. bicolor* has a wide range of domestic, nutritional and ethnomedicinal uses. Most studies focussed on the roots, barks, wood or timber and leaves of *G. bicolor* tree (Jaspers et al., 1986; Mohamed et al., 1990; Baumer, 1983; Hines and Eckman, 1993; Kabasa et al., 2004; Sawadogo-Lingani et al., 2007; Orwa et al., 2009; Ullah et al., 2012), but there is limited information on the potential uses of the seeds which are often thrown away after fruit pulp utilization. In order to investigate the possible domestic and industrial usefulness of the *G. bicolor* seeds, our current study was aimed at extracting the oil and determining the oil yield, physical characteristics, fatty acid content and profile of *G. bicolor* seed oil.

2. Materials and methods

2.1. Seed collection, identification and oil yield determination

G. bicolor ripe fruits, from which seeds were obtained, were collected on 25 July 2010 at Musukutwa Kraal, Bikita District, Zimbabwe, 140 km East of Masvingo Town and identified by a botanical taxonomist at the Southern Rhodesia Government Herbarium (Voucher number: 960). The seeds were dried and weighed to determine their dry mass. The dried seeds (see Fig. 1) were crushed using a mortar and pestle before standard procedures were used for the oil extraction (Akubugwo and Ugbogu, 2007). Briefly, the crushed seeds were transferred into a sealable dark bottle and a known volume of hexane (Merck Chemicals, Wadeville, South Africa) was added to cover crushed seeds. The bottle was sealed and shaken continuously for 5 days. The extracted oil sample in hexane was filtered (Whatman No. 1, size 18 mm, Lasec, South Africa, Johannesburg) and the hexane was removed on a rotary evaporator. The yield of the extracted oil (%) was expressed on a dry air basis.

2.2. Fatty acid profiling

A sample of the extracted *G. bicolor* seed oil was sent to the Agricultural Research Council's Irene Analytical Services, Pretoria, South Africa for lipid profiling using gas chromatography as previously described by Christopherson and Glass (1969). Briefly, 1 ml of the oil extract was transmethylated with 2 M methanol-sodium hydroxide. The resulting fatty acid methyl esters were extracted in heptane, filtered and dried under nitrogen. A gas chromatogram (HP6890 GC, Hewlett Packard, Bristol, UK) with a BB-23 capillary column (90 m × 250 μm × 0.25 μm) (Supelco™ 37 Component FAME Mix, Catalog No. 47885-U, Sigma-Aldrich, Johannesburg, SA) and a flame ionisation detector (FID) was used to separate the fatty acids. Detector and injector temperatures were set at 300 °C. A computer installed with CHEMSTATION software (Chemstation, Deutschland GmbH, Augastrasse, Germany) was used to quantify the fatty acids. Nonadecanoic acid was used as an internal standard.

2.3. Determination of iodine value

The iodine value of a substance is the weight of iodine absorbed by 100 parts by weight of the lipid. Iodine value (IV) was determined using the iodine monochloride method previously described (Brisbois et al., 2004). Briefly, 1 g of the oil extract was dissolved in 10 ml carbon tetrachloride (Merck Chemicals, Wadeville, South Africa) in a 100 ml flask. 25 ml of iodine monochloride solution was added to the mixture. The flask was closed with a stopper previously moistened in potassium iodide solution. The mixture was allowed to stand in a dark cupboard for 30 min at room temperature. After 30 min, 20 ml of 10% potassium iodide solution (Merck Chemicals, Wadeville, South Africa) was added

Fig. 1. *Grewia bicolor* seeds.