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International Journal of Current Research
Vol. 9, Issue, 12, pp.63014-63018, December, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

REVIEW ARTICLE

MEDICINAL POTENTIALITIES OF *DACRYODES EDULIS* (G. DON) HJ.LAM. LITERATURE REVIEW

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ARTICLE INFO

Article History:
Received 19th September, 2017
Received in revised form
11th October, 2017
Accepted 07th November, 2017
Published online 31st December, 2017

Key words:

Dacryodes edulis, Traditional use,
Phytochemical,
Pharmacological potentialities.

ABSTRACT

Medicinal plants are an important source in the development of therapeutic strategies. *Dacryodes edulis* (G. Don) HJ. Lam (Burseraceae), a plant used for its alicamentary, medicinal properties and potential food, is one of this therapeutic arsenal. Phytochemical studies have revealed the presence of various chemical components that justify the diversity of medicinal indications attributed to this plant. The fruits of *D.edulis* are rich in fats, vitamins, protein and antioxidants. *D.edulis* present also antimicrobial, larvicidal, immunostimulating, anti-inflammatory, antioxidant, and hypoglycemic potentiality. Psychopharmacological studies have demonstrated a psychotropic profile of antidepressants and anxiolytics of essential oil of the pulp of the fruit. This review providesdetails on chemical profile, medicinal potentials and pharmacological activities of this plant, that constitute a support for the development of new drugs.

Citation: Miguel, L. M., Mokondjimobe, E., Okiemy-Andissa, N., Diatewa, M., Moukassa, D., Longo-Mbenza, B. and Abena, A. A. 2017. "Medicinal potentialities of *Dacryodes edulis* (G. Don) HJ.LAM. Literature review", *International Journal of Current Research*, 9, (12), 63014-63018.

INTRODUCTION

Dacryodes edulis is a species of the family of Burseraceae. This is a fruit tree grown in africancountries in equatorial areas, damp tropical or in altitude. The name "safoutier" given to this plant derives from vernacular name "NSAFOU" in Kikongo (Democratic Republic of Congo). The plant is known in english under the names "Bush butter tree" and "Native pear". Several species of *Dacryodes* have uses in traditional medicine. The bark, leaves and resin of *D.edulis* are used to treat infections, fever, pain, malaria and skin diseases (Ndah *et al*., 2013). The fruits of *D.edulis* are rich in lipids, vitamins, proteinsand antioxidants (Okwu 2008; Ajibesin 2011). Different parts of *D.edulis* present also antibiotic, immunostimulating, anti-inflammatory, antioxidant, hypoglycemic and hypolipemicpotentials (Johns 2001; Agbor *et al* 2007; Koudou *et al*. 2008). *D.edulis* help to prevent humans the consequences of lipid peroxidation associated with cancer or atherosclerosis. *D.edulis* decrease in rats, the level of HDL (Leudeu *et al*., 2006).

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It'sa source of hepatoprotective drugs production (Orhue, 2015). The species also presents potentiality in the cosmetics and pharmaceuticals manufacture (Raponda Walkers and Sillans 1961). Indeed, the essential oil (EO) of *D.edulis* has significant antibacterial and antifungal properties (Kudu 2008; Obame *et al.*, 2008). Furthermore, studies on the chemical composition of *D.edulis* revealed that fruit contains about 50% fat, 10% protein, 27% fiber and 10% sugar solids; some varieties with up to 70% essential oil content (Kapseu *et al*., 1988; Silou *et al*., 2000 Kinkela, 2004; Kinkela, 2006). The present work presents a review of ethnobotanical aspects, phytochemical, food and pharmacological potentiality of *D.edulis.*

Synonyms

Several botanists, at different times, were interested in this plant and given it different names that are now as synonymous (Kengue, 1990): *Pachylobus edulisG. Don* (1832); *canariumedule Hook.* (1839); *C. anariunz nzubafo Ficalho* (1881); *Canatiumsaphu Engl.* (1893); *Pachylobussaphu Engl.* (1896); *Soreindeiadeliciosa* A. Chev. ex. Hutch & *Dalz.* (1928); *Dacryodes edulis* HJ. Lam (1932).

Taxonomic classification

Reign : *Plantae*
Division : *Magnoliophyta*
Class : *Magnoliopsida*
Sub-class : *Rosidae*
Order : *Sapindales*
Family : *Burseraceae*
Kind : *Dacryodes*
Species : *edulis*

Geographical Distribution

D.edulis (G. Don) HJ Lam is an evergreen tree native to Southeast of Nigeria, southwest of Cameroon and Congo. It is one of the rare species of african origin, actually cultivated by the indigenous people of Central Africa, the Gulf of Guinea and the Congo Basin. Its current range due to culture extends from Central Africa to Uganda in the east and south to Angola (Kengue, 1990; Awono 2008; Okwu, 2008).

Botanical description

The safoutier reaches an average height of 18-40 m in the forest. Domestic species do not exceed 12 m (Kengue 1990; Ajibesin, 2011). It is generally branched, with a dense and deep crown. The bark is rough and gives off a whitish resin. The leaves are composed, grouped in pairs (5-8 pairs of leaflets). The fruits are drupes ellipsoidal rather variablesize, 4-12 x 3-6 cm. The exocarp is thin, pink, becoming bleu dark purple at maturity (Kengue, 1990; Awono, 2008).

Traditional use

Several medicinal indications are attributed to *D.edulis.* In Gabon, the bark is used for wound healing (Walker and Silans, 1961). In the Democratic Republic of Congo, the decoction of the bark is used in the treatment of leprosy. In the Republic of Congo, Teke use decoction of the bark in gargles and mouthwashes against various diseases of the oral cavity (mouth ulcers, gingivitis, tonsillitis); leaves eaten raw with almond cola are deemed anti-emetic while the bark powder added with grains of paradise is anti-diarrhea. The Kôta advocate the use in local applications and friction of oleateofsafoutier bark base and palm oil against the general aches and pains with fever; this preparation would also be antipsoric.

This treatment extended to urticaria and other cutaneous affections is identical in the Sangha. Kongo mainly used sheets against otitis (ear instillations juice) and febrile aches with cephalgy (steam baths decoction). In the region of Mossendjo-Mayoko, a region of Congo, bark of *D. edulis*are used as anti-diarrhea, but they are also consumed with the oil, salt and grains of paradise as anemic, anti-haemorrhagic (hemoptysis, tuberculosis). In these indications, Mbosi add the use of decoction of the root bark, in drink, in the treatment of leprosy. The leaves of *D. edulis*, in decoction water with the leaves of *Lantana camara*, *Cymbopogoncitratus* and *Persea american,* would care for malaria (Diafouka, 1997). In Cameroon, the sheets used in local application, treat snake bites (Jiofack *et al*., 2010). In Nigeria, the resin from the bark treat parasitic skin diseases (Ajibesen, 2011) and malaria (Dike, 2012; Betti, 2013). Table I summarizes the main traditional indications of *D.edulis.*

Chemistry of *D.edulis*

The chemical composition of exudate extracted from the stem of *D. edulis* was the subject of several studies and is currently known (Kapseu*et al*, 1996; Koudou *et al*, 2008; Okwu and Nnamdi, 2008, Ajayi and Adesanwo2009; Hanson 2009). This study revealed the presence of several bioactive compounds like saponins (2.08 $mg.100g^{-1}$), alkaloids (0.28 $mg.100g^{-1}$) tannins (0.47 - 0.72 $mg.100g^{-1}$), flavonoids (0.26 - 0.39 $mg.100g^{-1}$), and phenolic compounds (0.01 - 0.05 $mg.100g^{-1}$). The majority of mineral compounds found in this exudate were magnesium (0.22 $mg.100g^{-1}$) and Phosphorus (0.20 $mg.100\ g^{-1}$). Hydrosoluble vitamins such as ascorbic acid, niacin, riboflavin and thiamine were also detected (Okwu and Nnamdi, 2008). Ucciani and B (1963), Umoro Umoti *et al*, (1987) have shown that the oil of the pulp content various degrees of oil from 33 to 65% depending on the origin and degree of ripeness of the fruit, and that the oil contains all fatty acids found in vegetable oils: palmitic acid (36.5%), oleic acid (33.9%), linoleic acid (24.0%), stearic acid (5.5%). Umoro Umoti *et al*. (1987) analyzed the other constituents of the pulp and produced the results below: oil (31.9%), protein (25.9%), ash (10.8%), fiber (17.9 %), Energy (444.7 Kcal per 100 g). chemical composition of the pulp of *D. edulis* is presented in Table II. Twenty-four compounds were identified, comprising 98.5% of the essential oil. Sabinene (21.77%), terpinene -4-ol (19.79%), α-pinene (17.47%) and p-cymene (11.29%) are the major compounds (Table III).

Food use

Beyond its indications in traditional medicine, the most widespread use of *D.edulis* remains the consumption of fruit (safou) after softening in hot water, hot ashes or even grilled. Softened fruits are eaten with tubers, plantain or corn (Noumi, 2006; Conrad Omonhinmin, 2012). The fruits of *D.edulis* are consumed and marketed in urban markets in central africa and in african markets in Europe (Awono, 2002; Awono, 2008). The whole fruit can exhibit lipid contents of up to 72.6, 44 to 27.3% for pulp and seeds (Achinewhu *et al*, 1995; Ajiwe, *et al*, 1997; Ajiwe and Obika, 2000). The fruits of *D.edulis* are very rich in protein and fat that can be used in the food industry for the production of edible oils and biscuits (Umorou *et al*., 1987; Larousille 1994; Noumi, 2006). Eating biscuits obtained with the powder of *D.edulis* dried pulps are very nutritious and may help reduce cardiovascular risk (Ndindeng, 2012). The role of vegetable oils rich in antioxidants, in the control of chronic hyperglycemic, dyslipidemia, hypertension or type 2 diabetes and complications has been the subject of several studies (Hartnett *et al*., 2000; Stump anda.l 2006; Wong *et al*. 2006; Da Silva 2010; Aldebasi *et al*., 2011). It is established that a diet rich in antioxidants may reduce the risk of cardiovascular disease and certain complications of diabetes such as retinopathy (Mvitu-Muaka, 2010). A study in the Democratic Republic of Congo showed that high dietary intake of vitamin C and other antioxidants *Gnetumafricanum* and *D.edulis,* helps prevent diabetic retinopathy (Mvitu-Muaka, 2010). This study has shown the role of dietary antioxidants in disease prevention because of cardiovascular and metabolic syndromes (Mvitu-Muaka, 2010, Mvitu-Muaka, 2012).

Antioxidantactivity

Several studies have shown theantioxidant activity of *D. edulis*. The leaves ofthe plantshowed a significant antioxidant effect with different methods (Agbor *et al.*, 2005; Nguefack,

Table 1. Traditional uses of *D.edulis*

Organs	Preparation	Traditional Indications	References
Barks	Decoction	Mouth ulcers, gingivitis, tonsils, diarrhea, generalized pain, fever aches, headache, typhoid fever, hives, vomiting.	Bouquet 1969; Raponda -Walkers 1961
Leaves	Crudeextract	Ear infections, febrile aches, yellow fever, malaria.	Noumi 2006; Dike, 2012; Betti, 2013
Roots	Decoction	Hemorrhagic anemia, leprosy, ulcerous wounds, helminthiasis, skin diseases, elephantiasis, diarrhea.	Bouquet, 1969; Noumi 2006; Raponda -Walkers 1961; Okwu and Nnamdi 2008

Table 2. Chemical composition of the pulpof *D.edulis* (Umoro Umoti *et al*., 1987; Kinkela *et al.*, 2004)

Variable	Average	SD	Maximum	Minimum
Humidity (%)	60.07	5.21	73.71	46.01
Lipids (%)	56.76	5.58	70.17	40.82
Ashes	3.35	0.69	5.55	1.93
carbohydrates	30.91	9.69	49.53	20.05
protein	10.45	1.92	13.76	07.33
Palmitic acid (C16: 0)	44.11	3.44	53.34	32.67
Stearic Acid (C18: 0)	3.29	0.96	6.65	1.67
Oleic acid (C18: 1)	30.38	4.91	49.78	16.84
Linoleic acid (C18: 2)	20.43	4.41	32.02	9.07
Linolenicacid (C18: 3)	0.82	0.36	3.36	nd

Table 3. Physicochemical composition of safoupulp (Kinkela *et al*., 2004; Obame, 2008)

Compounds	Percentage
αthujene	1.56
α-pinene	17.47
camphene	0.24
sabinene	21.77
β-pinene	4.27
menth-3-ene	0.37
α-phellandrene	0.22
δ-3-carene	0.23
αterpinene	1.22
para cymene	11.29
limonene	5.72
b-phellandrene	0.99
1,8-cineol	0.68
g-terpinene	5.84
cis hydrate sabinene	1.08
terpinolene	1.08
trans hydrate sabinene	0.4
cis para menth-2-en-1-ol	0.4
trans paramenth-2-en-1-ol	0.37
terpinene-4-ol	19.79
para cymene-8-ol	0.13
a-terpineol	3.01
trans piperitol	0.2
piperitone	0.22

2009; Onocha *et al.*, 2011). These antioxidant effects were attributed to the presence of flavonoids in the plant. The essential oil of the resin of *D. edulis* also has significant antioxidant effect with anIC 50 of68.5 ± 2.9mg / ml. This effect could be due to the presence of chemical compounds such asmonoterpenssabinene, terpinene-4-ol, α-pinene, p-cymene, γ-terpinène, limonene, β-pinene and α-terpineol (Obame, 2008; Ajibesin, 2011). These results suggest that *D. edulis* could struggle damage caused by lipid peroxidation (Ajibesin, 2011, Tee *et al*., 2016). The antioxidant properties of *D. edulis* were confirmed by measurement of biochemical markersof oxidative stress (glutathione peroxidase, superoxidedismutase and selenium) in rats. The results show a slight increase of these markers in rats fed with supplemented nutrition with oil of *D.edulis* (Leudeu *et al.*, 2006).

Toxicity: The toxicity of *D.edulis* has been investigated in rodents. When administered orally, the essential oil of *D.edulis* did not cause any signs of toxicity nor any mortality side until a dose of 15 $ml.kg^{-1}$ in acute administration (Miguel, 2014). However, no data is available on the safety of this oil, or any one of part of this plant, after repeated oral administration or other way, especially on organs.

Effectson biochemical parameters

Literature data indicate that the type of dietary fat influences the level of circulating lipids, with consequences on the risk of cardiovascular disease and atherosclerosis (Leudeu *et al.*, 2006). Thus, ratio LDL/HDL and TC/HDL cholesterol are goods markers of cardiovascular disease risk. Consumption of oil *D.edulis* decreases LDL / HDL and TC / HDL ratio, reducing for 43.91% risk factors (Leudeu *et al.*, 2006).

Analgesic activity

The analgesic activity of the pulp fruit of essential oil of *D. edulis* (HEDE) (1% vol/vol) was investigated in mice after oral administration of HEDE, at the doses of 1, 2.5 and 5 $ml.kg^{-1}$.

The essential oil and morphine (10 $mg.kg^{-1}$) significantly increase the response time of the animals on the hot plate (Miguel *et al.*, 2014). These results justify the indication of this plant in traditional medicine in the treatment of various pains (Bouquet, 1969).

Psychopharmacologicalactivities

Psychopharmacological properties of essential oil (1% vol/vol) fruit pulp of *D.edulis* were investigated in mice afteroral administration, using the assays of the forward psychopharmacological (the spontaneous motor activity, testing of the effect on catalepsy and ptosis induced by haloperidol, the elevated plus-maze test and the forced swimming test). The effect on rectal temperature was also sought. Doses of 2.5 and 5 $ml.kg^{-1}$ increase spontaneous motor activity of the animals, antagonize catalepsy and ptosis induced by haloperidol. The essential oil of fruit of *D.edulis* results decrease significantly the immobility of the animals in the forced swimming test, and appears to have the same action profile as diazepam at a dose of 10 $mg.kg^{-1}$ in the elevated plus-maze test. Only doses of 2.5 and 5 $ml.kg^{-1}$ reduce rectal temperature of the animals. These results show that the essential oil of fruit of*D.edulis,* at the studied doses, has a psychopharmacological profile of antidepressants and anxiolytics (Miguel *et al.*, 2014).

AntimicrobialActivities

The antimicrobial activities of the essential oil of the resin of D.edulis have been studied by several authors. The essential oil of *D.edulis* presented antimicrobial activity against clinical isolates and a reference panel (*Klebsiella pneumoniae, Proteus vulgaris, Proteus mirabilis, Escherichia coli, Staphylococcus aureus, S. pneumoniae, Pseudomonas aerugirosa, Bacillus cereus, Streptococcus pyogenes, Enterococcus faecalis, Listeria innocua, Salmonella enterica, Shigella dysenteriae, Staphylococcus camorum*) by the disc diffusion method and microdilution (Cosentinoandal., 1999; 2003; Obame 2008; Amise *et al*., 2016). The essential oil of the resin of *Dacryodes edulis* also has antifungal activity against *Candida albicans*. The antibacterial activity presented a broadcast diameter greater than 16 mm, to a concentration of 5 µl./disc (Cosentinoandal, 1999; Obame, 2008; Amise *et al*., 2016). The antimicrobial activity of strains isolated clinically pathogens interest pharmaceutical industry in the target to development of new drugs (Okwu, 2009; Amise, 2016, Obame-Engonga *et al.*, 2016). Some studies have shown that essential oils and their constituents have significant potential as antimicrobial agents with application in several industrial and medical fields (Baser, 2000; Koudou *et al.*, 2008).

Larvicidal activities

A study in Gabon showed that the essential oil of *D.edulis* has a larvicidal activity against *Anophelesgambiae* (Obame-Engonga *et al*., 2016). These authors also showed that the combination of essential oils of *Aucoumeaklaineana, Canarium schweinfurthii* and *Dacryodes edulis* presents greater effects, against these parasites, than each oil considered (Obame-Engonga *et al.*, 2016).

Conclusion

The medicinal potential of *D.edulis* were the subject of several studies. This work has showed the different pharmacological properties of different parts of this plant. These properties and psychotropic effects (Miguel, 2014), antimicrobial (Cosentino *et al.,* 1999; Sahin *et al*, 2002; Karaman *et al.*, 2003; Amise *et al*., 2016), antioxidants (Agbor *et al*, 2005; Nguefack, 2009) and larvicides against *Anopheles gambiae* (Obame-Engonga *et al*., 2016) were also identified. Oil of *D.edulis* also reduce the risk of developing cardiovascular disease (Leudeu *et al.*, 2006). The different studies of *D.edulis* are important supports for the development of new drugs.

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