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Physico-chemical characteristics and biochemical potential of Moringa *oleifera* Lam. (Moringaceae)

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ABSTRACT

Moringa oleifera Lam. (Moringaceae) was evaluated for phytochemicals and physico-chemical parameters.The physico-chemical characteristics(Table1) showed the acidic character of M.oleifera extracts (pH 5.19-6.77) but no variations were found in temperature values. The infusion was the best extraction method with the highest yield values (4.40 to 9.90%).These data could serve for technological processing of the plant. The phytochemical screening of Moringa oleifera extracts was carried out in various solvents and revealed the presence of alkaloids, cardiac glycosides, tannins, saponins, flavonoids and steroids. The flour extracts revealed the presence in high concentration of most of the screened phytochemicals, whereas they were less present in the bark. Alkaloids were present in all the tested plant extracts however saponins were less present in most of these solvent extracts especially in dichloromethane. Ethanolic extracts of M.oleifera showed a greater presence of phytochemicals than the other extracts. Quantitative analysis revealed that M.oleifera contained appreciable amounts of phytochemicals ranging from 1.10±0.10 to 18.70±0.50%. Flavonoids a nd saponins were the major compounds recorded in this study (18.70±0.50% &13.65±4.56% in the seeds); this makes the seeds the richest part of M.leifera. However, alkaloids were recorded in high amounts in all the plant parts (5.60±0.60 to13.83±1.03%). Phenols and anthocyanins were the minor compounds (ranging from 1.10±0.10 to 2.65±1.15%).The results of quantitati ve analysis showed that M.oleifera contained bioactive compounds in varying quantities. This makes the plant useful in treating, or to prevent various ailments and determines its therapeutic potential and medicinal value.

Key worlds: solvent extract, *Moringa oleifera*, phytochemical, analysis, medicinal

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INTRODUCTION

Moringa oleifera Lam. (Moringaceae) is native to the southern foothills of the Himalayas in northwestern India and is the most widely cultivated species of the genus *Moringa* [1]. It has become naturalized in many tropical countries of Africa, Arabia, South East Asia, the Pacific, the Caribbean Islands and South America [2]. The leaves are cooked as vegetables.

Moringa seed also has antimicrobial activity [3]. *Moringa* leaf is used to increase milk production in lactating mothers and is also useful in treating scurvy, respiratory ailments and as an emesis remedy [3,4]. The juice from the leaf of Moringa can reduce glucose levels; it has purgative, anti-inflammatory and strong antimalarial properties [5,6]. It also serves as a treatment for piles, fever, sore throat, bronchitis, catarrh, eye and ear infections as well as healing sores and relieving headaches [5]. *M. oleifera* flower is used for the treatment of inflammation, muscle diseases, tumors, and enlargement of the spleen. It is reported to decrease serum cholesterol and also phospholipid, triglyceride [3].

The aqueous seed extract of *Moringa oleifera* contains tannins, carbohydrate at low concentration, saponins, alkaloids, cardiac glycosides, anthraquinones moderately, and a high concentration of flavonoids. [7].From the literature, the species from the Congo was assessed for proximate and its oil constituents such as fatty acids [8]but no study was found on the phytochemical profile of *M.oleifera*.

MATERIALS AND METHODS

Plant materials

The vegetal materials were collected from Makelekele, South–Brazzaville on 20th March, 2014. The plant samples were identified by Makita from the department of Botany, Faculty of Sciences, Marien NGOUABI University and authenticated by Nkouka Saminou from the National Herbarium of the Vegetal Research Centre of Brazzaville (ex-OROSTOM-Congo),where voucher specimens are conserved. *Moringa oleifera* parts were sun-dried for 30 days and milled into a powder. The powder was stored under dry conditions before analysis.

Chemical analysis:

Preparation of solvent extracts:

Extraction of bioactive compounds was carried out in various solvents (ethanol, ethyl acetate and dichloromethane) according to the following procedure. Twenty grams of the sun-dried and powdered sample were weighed and transferred to a beaker, then 150 ml of the solvent was added and after agitation were allowed to extract at laboratory temperature for 72h. The mixture was then filtered and the filtrate evaporated and concentrated using a boiling water bath. The crude extract thus obtained was submitted to phytochemical screening.

Preliminary phytochemical screening:

Qualitative analysis was carried out following the methods used previously**(**Andzouana & Mombouli, PJN, 2012). Phytochemical analysis was conducted to determine the presence of alkaloids, flavonoids, glycosides, tannins, steroids and saponins.

Quantitative phytochemical analysis

Quantitative phytochemical analysis was realized by using standard laboratory procedures [10-13].

RESULTS AND DISCUSSION

Physico-chemical characteristics of *M.olifeira* extracts

Table-1: Physico-chemical characteristics of *M.oleifera* part extracts

Plant extract (in water)	Physico-chemical characteristics			Method of extraction &Yield (%)		
	Acidity(g/l)	PH	T°C	Ma	If	De
bark	0.06	5.19	28.20	2.20	4.40	4.10
leaves	0.32	6.77	28.10	6.50	9.80	4.00
flours	0.4	5.67	28.00	5.10	9.90	2.80
seeds	0.16	6.29	27.80	5.60	9.20	7.50

Ma = maceration; If = infusion; De = decoction

Analysis of the physico-chemical characteristics of the plant extracts (Table1) showed that they had all the lower values of titratable acidity (0.06-0.4g/l).These values were in line with those of 0.09 & 0.14 reported for *Morinda citrifolia* and *Morinda pubescens* respectively[14]. The pH values of *M.oleifera* extracts (5.19-6.77) were below the neutral value (<7), indicating that the plant extracts were found to be acidic. This trend was observed for *Morinda* fruit pulp[14] and *Averrhoa carambola* fruit[15].These values were slightly higher than those reported for *Morinda* species (3.8-4.2)[14] and *Vitex doniana* pulp[16].The low pH values found in the present study may be justified by the presence of acidic compounds in the sample as observed for *A.carambola*[15] and could serve as a preservative for *M.oleifera* plant parts[14]. The temperature values of water extracts of *M.Oleifera* parts were not significantly different from each other (≈28°C).The results (Table 1) showed also high extract yields(> 1) for all the plant extracts. The highest extract yield was obtained with the infusion method(4.40 to 9.90%) and the lowest in maceration (2.20-6.50%). It is thus suggested that infusion is the best method for extraction. The physico-chemical data could serve as a knowledge basis for industrial or domestic processing of plant materials.

Phytochemical analysis of *M.oleifera*

Qualitative analysis of plant extracts

The results of phytochemical screening in Tables 2, 3,4 showed the presence of alkaloids, flavonoids, cardiac glycosides, Tannins, saponins and steroids in the screened extracts. This result correlated with those reported for ethanolic extract of *M.oleifera* leaves from Enugu state [17].The flours were found to be the richest phytochemical

part of *M.oleifera* due to the presence in high concentrations of most of the screened phytochemicals in all the solvent extracts. This fact was also observed for aqueous and methanolic extracts[18]. The seeds were the plant part which contained the second largest quantity of phytochemicals, followed by the bark and the leaves.

Table 2: Qualitative analysis of *M. oleifera* parts in ethanol

Phytochemical	bark	leaf	flour	seed
Alkaloids	+	+	+ + +	+ +
Flavonoids	—	+	+ + +	+
Card.glycosides	—	+	+ +	+ +
Tannins	+	+ +	+ + +	+
Steroids	—	+	+ +	+ +
Saponins	+ +	+ +	—	—

It was also noticed that alkaloids were the most present compounds in all the plant extracts screened, and also that tannins were present in all the ethanolic extracts. This result was also observed for aqueous and ethanolic extracts of *M.oleifera* [19].

From the results it was observed that phytochemicals were highly present in ethanolic extracts of *M.oleifera* while in dichloromethane they were less present. This was is in agreement with the report on the leaf extracts of *M.oleifera* [19] which showed the presence of these compounds in ethanolic extract of *M.oleifera*. This may be explained by the increased polarity in dilute ethanol leading to an increase in concentration of polyphenolic compounds such as flavonoids [20]. On the other hand, ethanol was reported to possess high penetration capacity to cellular membrane to extract intracellular ingredients[21]. As observed for ethanolic extract of *M.oleifera* from Ekiti and Kano, Nigeria[17] saponins were not found in the flour and seed extracts but they were present in the bark, along with alkaloids and tannins.

Table 3:Qualitative analysis of *M.oleifera* parts in ethyl acetate

Phytochemicals	bark	leaf	flour	seed
Alcaloids	+	+	+ + +	+ +
Flavonoids	—	+ + +	+ +	+
Card.glycosides	+	—	+ + +	+
Tannins	+	—	+ + +	+
Steroids	+	—	+ +	+
Saponins	—	—	—	+ + +

Beside alkaloids, glycosides and tannins were detected in high concentrations in ethyl acetate extract of flours and also flavonoids were present in the leaf and seed ethyl acetate extracts. However, saponins were present only in the seed extract of ethyl acetate and were completely absent in all the other part extracts. This was also observed for the leaves, which showed only the presence of two compounds: alkaloids and flavonoids. The absence of glycosides and steroids in ethanolic and dichloromethane extracts of the bark and the leaves respectively correlated with the previous reports on *M.oleifera* leaves [22].

Table 4:Qualitative analysis of *M. oleifera* parts in dichloromethane

Phytochemial	bark	leaf	flour	seed
Alcaloids	+	+	+ +	+ + +
Flavonoids	—	+ + +	+	—
Card.glycosides	—	—	+ +	+
Tannins	+	—	+ +	—
Steroids	+	—	+ +	—
Saponins	—	—	—	—

+ + +=highly present ; + +=moderatly present ; + =trace ; —=absent

Saponins were found to be the least present of the screened compounds in the present work. As observed for ethyl acetate extracts, they were not detected in any of the dichloromethane extracts of *M.oleifera* parts. This is agreement with the results reported previously for *C.bondus* [23], which revealed the absence of these compounds in all the leaf extracts.

Solvents with very high polarity, such as water, or very low solvent strength, such as chloroform and hexane, did not result in good extraction of bioactive compounds from the medicinal herb[24]. This is in contrast with the present results due to the higher presence of phytochemicals in ethanol than in dichloromethane.

In dichloromethane, the leaves showed the same trend as observed in ethyl acetate; in spite of the absence of most of the tested compounds alkaloids and flavonoids were present.

The study showed the variation in the presence of phytochemicals. This is lie to such factors as solvent extraction capabilities, phytoconstituent solubility [25], variation in agronomic conditions (plant organ, pH), season, climatic factors, water availability, light and CO2, which are reported to affect the phytochemical content and profile in plants [26].

The presence of phytochemicals in M.oleifera parts suggested that the plant is of medicinal importance. To confirm the presence of certain phytochemicals, the quantitative analysis of *M.oleifera* parts was carried out.

Quantitative phytochemical analysis of *M.oleifera*

The quantitative analysis(Table 4) revealed that all the *M.oleifera* parts used contained appreciable amounts of phytochemicals (1.10±0.10-18.70±0.50%(DW).The results also revealed that the major compounds in this study were flavonoids with the highest values of 18.70±0.50% followed by saponins with the values of 13.65±4.56% in the seeds. Similarly high flavonoid and saponin contents were reported for *M.oleifera* leaves (865 & 880mg.100 g^{-1} respectively)[27].

Table5: Phytochemical composition of *M.oleifera* parts

Phytochemical	Plant part (content)			
	bark	leaf	flour	seed
Phenols	1.95±1.63	2.65±1.15	1.20±0.70	1.10±0.10
Flavonoids	3.70±0.30	2.50±0.14	2.73±0.11	18.70±0.50
saponins	1.20±0.70	3.20±0.90	1.75±0.53	13.65±4.56
anthocyanins	1.25±0.11	1.60±0.70	2.30±0.20	2.15±0.35
alkaloids	13.83±1.23	6.17±3.84	6.47±4.30	5.60±0.60

The high flavonoid content of *M.oleifera* provided the plant with antioxidant and anticancer properties and biological functions such as protection against allergies, inflammation, free radicals, platelet aggregation, microbes, ulcers, hepatoxins, viruses and tumors[28]. The therapeutic properties of *M.oleifera* could be justified by the high saponin content. Their presence is lie to the precipitating and coagulating red blood cells and cholesterol binding properties, hemolytic activity[29]. Saponins are reported to be useful for treating diabetes and hyperglycemia[30].

The presence of these phytochemicals justified the use of *M.olifeira* as a potential antidiabetic medicinal plant. It was also found that appreciable amount of flavonoids and saponins were also recorded in the bark and the leaves, with the content values of 3.70 ±0.30 & 3.20±0.90%.

Alkaloids were found in high amounts in all the plant parts screened (5.60±0.60 -13.83±1.03%).This agrees with the results of phytochemical screening which indicated their presence in all the plant extracts. Similarly, other reports have indicated that they exist in high amounts in *M.oleifera* leaves (460mg.100g^{-1})[27].Together with saponins they make *M.oleifera* useful for treatment of hypertension due to their property of preventing excessive intestinal cholesterol absorption, thus reducing the risk of cardiovascular diseases [31]**.**

Phenols and anthocyanins were minor compounds found in the present study with the least concentrations in the range of 1.10±0.10-2.65±1.15%. Nevertheless, phenolic compounds have been reported to inhibit UV and carcinogenic tumors [32] and to exhibit anti-mutagenic, anti-bacterial, anti-viral and anti-inflammatory effects [33]. Phenolic compounds are reported to exert biological functions such as being singlet and triplet oxygen quenchers, free radical scavengers, peroxide decomposers, enzyme inhibitors and synergists [34]. Anthocyanins exhibit antimicrobial properties, they act through binding the cell and inactive the enzymes [35].

The lower concentrations of these compounds suggested that they could not be the major contributors to the therapeutic potential of *M.oleifera* but at these levels they are needed in human health care since they participle to many physiological activities.

The quantitative analysis of *M.oleifera* showed that the plant contained appreciable amounts of phytochemicals, especially high flavonoid, saponin and alkaloid contents. The biological properties of these compounds justify the therapeutic use of *M.oleifera*. Thus, the plant could be used for treating or preventing various ailments and could be recommended to be incorporated in the diet as a food ingredient or in medicinal receipt for therapeutic uses.

CONCLUSION

Phytochemicals are bioachemical substances with biological propreties. The study has shown the presence of these phytochemicals in *M.oleifera*, which justifies the contribution of the plant to nutrition as vegetable as well as to folk medicine. Therefore, *M.oleifera* could be used as a good source of useful drugs for treatment of various ailments, and could also be recommended as a food supplement due to its medicinal potential. Further studies should be carried out to clarify the biochemical status of this plant by isolation, purification, and characterization the active principles responsible for the claimed properties of *M.oleifera*.

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