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Phytochemical, nutritional and antibacterial properties of dried leaf powder of Moringa oleifera (Lam) from Edo Central Province, Nigeria

J. K. Mensah, *B. Ikhajiagbe, **N. E. Edema, J. Emokhor

Dept. of Botany, Ambrose Alli University, Ekpoma
**Dept. of Plant Biology and Biotechnology, University of Benin, Benin City, Edo State, Nigeria*
***Department of Botany, Delta State University, Abraka, Delta State, Nigeria*

ABSTRACT

Phytochemical, nutritional and anti-bacterial properties of the dried leaf powder of Moringa oleifera used as food supplement, or source of vegetable in soup preparation were investigated in this study. The phytochemicals identified in the leaf powder included tannis, saponins, alkaloids, phenols flavonoids and glycosides. The nutritional investigations revealed the presence of carbohydrates (29.08%), ascorbic acid (140mg/100g); fibre (2.1%), protein (6.88%) as well as iron (70mg/100g), calcium (1530 mg/100g)), vitamin C (17.8 mg/100g)) potassium (255 mg/100g)), magnesium (250 mg/100g)) and vitamin A (19.9 mg/100g)). These have far reaching nutritional importance in the health care system in these localities whose childhood malnutrition of 6-9year olds is 18 compared to the South -South average of 12.8. The zones of inhibition were very low or non-existence when tested against Staphylococcus aureus (0-7cm), Pseudomonas sp. (0), Klebsiella (0), and Escherichia coli (0). The dry leaf powder is a good source of phytochemicals/secondary metabolites and nutrients but not antimicrobials. The use of Moringa leaves as nutrient should therefore be encouraged in this locality.

Key words: Phytochemicals, nutritional and antibacterial properties, Body Mass Index (BMI).

INTRODUCTION

Moringa oleifera is a soft wooded tree whose fruits, roots and leaves have been advocated for traditional, medicinal and industrial uses [1]. The tree has in recent times been advocated as an outstanding indigenous source of highly digestible protein, calcium, iron, vitamin and carotenoids suitable for utilization in many of the developing regions of the world where undernourishment is a major concern.

The flowers can be eaten or used to make tea and provide good amounts of both calcium and potassium. The young pods can be looked and have a taste reminiscent to asparapus. The leaves are outstanding as a source of vitamins A when raw as a source of vitamin C. They are also good sources of vitamin B and are among the best plant sources of minerals [2].

The calcium content is high for a plant while the iron content of the leaves is very good and prescribed for anaemia in the Northern Nigeria and the Philippines. According to [3] the leaves are excellent source of protein with low sources of fat and carbohydrates. Thus the leaves are one of the best plant foods that can be found in addition, the leaves are incomparable as a source of the sulphur containing amino-acids: methionine and cystine which are often in short supply in the plant kingdom.

Moringa preparations have been cited in the scientific literature as having antibiotic, antitryponosomae, hypotensive, hypoglycemic and anti-inflammatory activities [4]. Unfortunately, many of these reports of efficiency in human beings are not supported by controlled, randomized clinical trials, nor have they been published in highly visible journals. Antibiotic activity is clearly the area in which the preponderance of evidence both classical scientific and extensive anecdotal evidence is overwhelming. The antibiotic properties *Moringa oleifera* has been attributed to the isolation of phytochemcials such as benzyl isothiocyarate and other isothiocynates [5]. These compounds had antibiotic activity against a wide range of bacteria and fungi.

Objectives: The objective of the present study is to investigate the phytochemical, nutritional and antibacterial properties of dried leaf powder of *Moringa oleifera* used as food supplement in this locality.

MATERIALS AND METHODS

The fresh leaves of *Moringa oleifera* (L) were collected form a home stead garden at Ekpoma in Edo Central Province, Edo State, Nigeria.

The leaves were washed under running tap water and air dried for 8 days under shade. With the aid of grinder, the leaves were homogenized to fine powder and stored in air tight glass vials. The dried leaf powder was soaked in 500ml distilled water for 72hrs before extractor. Thereafter it was filtered through Whitman filter paper No 1. The filtrate was concentrated using rotary evaporator and stored at 10^0C for further use.

Phytochemical screening: Ten mililitres of the filtrate was subjected to qualitative tests using standard procedures to identify the phytochemcials constituents as described by [6] and [7]. About 0.5g of the powder was tested for alkaloid (Myers reagents) Saponin (chloroform and H_2SO_4 tests), inulin (molischs reagent), tannin (Ferric salt tests) and flavonoid (magnesium ribbon test) adopting the procedures described by [8].

Nutritional evaluation: Vitamin determinations were made following the methods of [9] for vitamins A, B, C, and amino-acid profile for the essential amino-acids required for healthy

human growth. The weight and height of 1005 pupils of ages 6-9 years were determined and used to assess the level of malnutrition.

Microbial Activity Tests: The effect of the alcoholic, aqueous and ethyl acetate extracts of the leaf extract was tested against three enteric microbes isolated from stools of patients with gastrointestinal infections *Staphyllococus aureus*, *Pseudomonas* sp, *Klebsiella* sp. and *Escherichia coli*. The antibiotics-tetracycline, ciproxacin and gentamycin were used as a check and their activity compared to the extracts in water, alcoholand ethyl acetate.

RESULTS AND DISCUSSION

Nutrients.

Table 1: Nutritional properties of dried leaf powder of *Moringa oleifera* from Central province of Edo State, Nigeria

Nutritional Parameters	Concentration (mg/100g) dried leaf powder
a. Nutrients	
Calories (Joules)	330
Carbohydrate (mg/100g)	41.2
Protein %	6.8
Fat %	0.5
Fibre %	19.2
Vitamin A (mg/100g)	18.9
Vitamin B_1 (mg/100g)	2.64
Vitamin B_2 (mg/100g)	20.5
Vitamin B_3 (mg/100g)	8.20
Vitamin C (mg/100g)	19.3
b. Minerals (mg/100g)	
Calcium	1530
Magnesium	255
Potassium	170
Phosphorus	158
Sulphur	925
Zinc	3.30
Manganese	36.5
Copper	0.60
Selenium	11.8
Iron	126.2

Table 2: Concentrations of essential amino acids from *Moringa* leaves

Essential Amino acids	Concentration (mg/100g) dried leaf powder
Ariginine	1250
Histidine	615
Isoleucin	1,500
Leucin	1995
Lysine	1300
Methionine	348
Phynylalanine	1390
Theonine	1,255
Cistein	122.225

It was observed that the distribution of the various chemicals under investigation depends on the source of materials tested. The nutrient value of the dried *Moringa* leaf is presented in Table 1. The leaf powder of *Moringa* is rich in nutrients. The average carbohydrate content of 41.2mg/100g, with 330 calories per grams makes it low in carbohydrates compared to the stable food stuff like cassava, plantain and rice in this locality. This is in agreement with [3] which reported that *Moringa* leaves provide low fat and the fibre content averaged 19.2mg/100g dried powder. Fibre taken as part of diet cleanses the digestive tract by removing potential carcinogens from the body and hence prevents the absorption of excess cholesterol. Fibre also adds bulk to food and reduces the intake of excess starchy food which is the characteristic of the diet of the indigenes in this locality and hence guard against metabolic conditions such as hypertension and diabetes mellitus. The protein content of fresh *Moringa* leaves averaged 6.8%. Many people in the developing world do not have enough to eat to meet their daily requirements for proteins . Thus food stuff with high protein content are recommended for patients with protein deficiency symptoms. In this locality, the fresh leaf is used as vegetables in soups or the dried leaf powder is used as nutrient supplement for managing the protein deficient disease in infants generally referred to as Kwashiorkor in West Africa. The dry leaf powder is sold on the open markets in Nigeria and Ghana. The leaf powder is rich in vitamin A (18.9mg/100g), vitamin B_1, (2.64), B_2 (20.5) B_3 (8.2) and vitamin C (19.3 mg/100g). These vitamins help to protect the body against degenerative diseases as well as strengthen the immune system [10]. The implication is that the leaves are good source of B vitamins and among the best. The leaves contain 170mg of potassium, 950mg/100g sulphur, and 3.30mg/100g zinc. Minerals are important nutrients which assist in various metabolic processes in the body [2]. The leaves are also rich sources of iron which is very essential for anaemic patients and are utilized as such in the Philippines [3] and Northern Nigeria (Table 2)

According to [11], *Moringa* leaves contain more vitamin C than oranges and more potassium than bananas and that the protein quality of *Moringa* rivals that of milk and eggs. However, the dried leaf extract contains higher concentrations compared to the fresh leavesand the outcome is dependent on the method of handling the samples. The amino-acid profile of the sample investigated showed the presence of all the essential amino-acids required for human existence(Table 2) The leaves are incomparable as a source of sulphur containing amino-acids (methionine and cystine) which are often in short supply. In the current investigation the methionine concentrations average 348mg/100g while the cystine concentration was 122.225mg/100g. The malnutritional status of school going pupils of 6-9 years is below the National Rural average of 26.5 (Table 3) The stunting / malnutrition level in this community is 18.2 % in chidren compared to the National Rural average of 26.5 and 12% in South-South region of Nigeria.

Table 3: A comparison of the prevalence of childhood malnutrition

Study Area Average	South-South Average	National Rural Average	National Urban Average
18.2	12.8	26.5	15.8

Phytochemicals and Antimicrobials: The medicinal importance of tannins, alkaloids, saponins, phenols, glycosides and flavonoids (Table 4) recorded in the present study is also common in various antibiotics used in treatment of common pathogenic strains and has earlier been reported by [12] and [13]. Saponins are known for their antihypertension properties and may account for the use of the vegetable in meals by those who are recovering from stroke and

other heart diseases. *Moringa* leaves are used to prepare diet for hypertensive patients probably due to the presence of Saponins. Similarly, herbal preparations containing glycosides are given to patients for the treatment of congestive heart failure and cardiac arrhythmia.

Table 4: Some Phytochemical properties of dried leaf powder of *Moringa oleifera*

Phytochemical	Availability
Tannin	+
Alkaloid	+
Phenol	+
Glycoside	+
Flavonoid	+
Glycoside	+

Microbial. The antibacterial properties of the alcohol, ethyl acetate and aqueous extracts on four enteric bacterial are presented in Table 5. The results from the antibacterial properties of *Moringa oleifera* show that the alcoholic leaf extracts inhibited the growth of S*taphylococcus aureus*. Generally the alcoholic extract was more active but showed no inhibition activity against *Pseudomonas, Klebseilla* and *Escherichia coli*. The ethyl acetate extracts of the leaf also showed no inhibition activity against *S. aureus, Pseudomonas* sp, *Klebseilla* sp and *E. coli*. The antibiotic controls used were tetracycline, gentamycin and ciproxacine, which exhibited high levels of inhibition to the growth of these microbes with zones of inhibition between 25-40mm.

Table 5: Antibacterial Properties of *Moringa oleifera* zones of inhibition (mm) of water, alcohol and ethyl acetate extracts of *Moringa oleifera* on four enteric microbes

Organisms	Extracts						Standard antibiotics		
	Sterilized			Unsterilized					
	W	AL	E	W	AL	E	TE	CIP	CN
Staphylococcus aureus	0	7	0	0	8	0	40	40	34
Pseudomonas sp	0	0	0	0	0	0	10	40	27
Klebseilla sp	0	0	0	0	0	0	8	35	15
Escherichia coli sp	0	0	0	0	0	0	25	40	25

W = Water, AL = Alcohol, E = Ethyl acetate, TE = Tetracyclin, CIP = Ciproxcin, CN = Gentamycin

It is apparent from this study that although earlier reports have shown relationships between phytochemicals such as tannins, glycosides, phenols, saponins among others, the concentrations used in the present study appear inadequate to exert significant antibacterial properties.

CONCLUSION

The nutritional contents including the vitamins, essential amino acids and phytochemicals of the leaf powder makes the leaf a good nutrient source to be used as supplements for food and it also has the potential to improve the health status of its users. In fact, the indigenes use *Moringa* to manage a number of disease conditions including inflammations, tumors, ulcers and gastro enteritis. However, the present result reveals that the use of *Moringa* leaves as an antibacterial agent is limited since only the alcoholic extract of the leaf exhibited some antibacterial effects on one out of the three bacteria species used in this study. The effect on zone of inhibition was very low compared to the orthodox antibiotics used in this study. Traditionally, it is the alcoholic extract from the stem which is used to control infections. Since traditional medicine is mostly

used as self care, *Moringa oleifera*, which is an herbal plant that can be used in treating different ailments and malnutrition, it should be cultivated by growing them in backyard gardens for ready availability.

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