Nutrient Composition and Sensory Evaluation of Dry *Moringa Oleifera* Aqueous Extract

Madukwe E.U., Ezeugwu J.O and Eme, P.E.
Department of Home Science, Nutrition and Dietetics
University of Nigeria Nsukka
Enugu State, Nigeria

***Abstract*-- This study evaluated the nutrient composition of dry *Moringa oleifera* leaf aqueous extract and organoleptic properties of dry *Moringa oleifera* leaf powder. The proximate, mineral, vitamin and phytochemical composition of the leaf extract were analysed. The results showed that the ash, crude fibre, fat and moisture contents of dry Moringa oleifera were 0.04, 0.00, 0.001 and 96.68%, respectively. The protein and carbohydrate contents were 0.66 and 2.63%, each. Iron and calcium were 2.07 and 33.35mg, each. Vitamin C and beta-carotene contents were 6.26mg and 223RE, each, while flavonoids and alkaloids contents were 0.20 and 0.07%, respectively. Organoleptic evaluation revealed that *Moringa oleifera* beverage was generally accepted but the colour of lipton was preferred against that of Moringa beverage. There was no significant difference in the taste of both beverages (P > 0.05).**

***Index Term*-- (Nutrients, Moringa oleifera, organoleptic property)**

I. INTRODUCTION

Nutrients have been viewed as food components that either cannot be synthesized in the body (for example, vitamin C) or whose synthesis requires a specific factor that may in certain circumstances be absent or inadequate (for example, some amino acids, fatty acids, and vitamins). There is now recognition that many other compounds of plant food, such as dietary fiber, flavonoids, sterols, phenolic acids, and glucosinolates, are associated with lower disease risk. Phytochemicals contained in plant foods have been linked to many positive effects on human health, including coronary heart diseases, diabetes, high blood pressure, cataracs, degenerative diseases, and obesity [1].

Vegetables are an important part of the human diet and a major source of biologically active substances such as vitamins, dietary fiber, antioxidants, and cholesterol-lowering compounds. Vegetables constitute essential components of the diet, by contributing protein, vitamins, iron, calcium and other nutrients. Besides these bio-chemicals, the moisture, fiber and ash contents, and the energy values of vegetable and plant species have also been regarded of importance to human health [2]. Vegetables are good sources of oil, carbohydrates, minerals and vitamins depending on the vegetable consumed. Vegetable fats and oils lower blood lipids thereby reducing the occurrence of disease associated with the damage of the coronary artery. They are an important source of protein, minerals, and vitamins[3].

Moringa oleifera is one of the promising plants which could contribute to increased intake of some essential nutrients and health-promoting phytochemicals. *Moringa oleifera* is the best known of the thirteen species of the genus *Moringacae*. It is native to India but has been planted around the world and naturalised in many locales [4]. Recent studies indicate that its leaves have immense nutritional value. They are loaded with vitamins, minerals and all of the essential amino acids [5]. *Moringa oleifera* has in the past two decades been advocated as an excellent source of essential nutrients (protein, iron, calcium, vitamins, carotenoids and other phytochemicals) [6]. Hence this study aims to determine the proximate, mineral (iron and calcium), vitamin (ascorbate and beta-carotene) and phytochemical (flavonoids and alkaloids) composition of dry *Moringa oleifera* leaf extract and the organoleptic attributes of beverage made from its leaf powder.

II. MATERIALS AND METHODS

Plant materials: The leaves of *Moringa oleifera* were collected from home garden in the University of Nigeria, Nsukka campus, Nigeria.

Sample preparation: The leaves of *Moringa oleifera.* were shade-dried for three (3) days and were subsequently ground to powder using household blender.

Sample extraction: Two grammes of dry *Moringa oleifera* leaf powder was soaked in 200ml of boiling water for 30 minutes after which the solution was drained using a 1-mm mesh. The extract was used to determine its chemical composition.

Chemical analysis: Total nitrogen (N) was determined using the micro-kjeldahl method[5]. The crude protein was obtained by multiplying N by the conversion factor of 6.25 (%p = TN x 6.25). The fat content of the sample was determined using the method of AOAC [5]. The ash content of the sample was determined using AOAC [5] method. Moisture content of the sample was determined using the method described by Pearson [6] and total carbohydrate content was determined by difference as follows: 100 – (% ash + protein + fat + moisture). The iron (Fe) content was determined using the Phenanthroline method AOAC, [7]. The calcium (Ca) and ascorbate contents of the sample was determined using the AOAC [7] method. Beta-carotene was determined according to Pearson [7] method. Flavonoids and alkaloids contents were determined using Bohm and Kocipai-Abyazan [8] and Harborne [9] methods.

Sensory Evaluation

Sensory evaluation method was used to evaluate beverage made from dry *Moringa oleifera* leaf powder. Thirty (30) panelists made up of undergraduate students of the Department of Home science, Nutrition and Dietetics, University of Nigeria, Nsukka, Nigeria were used for the study. A nine-point hedonic scale with ratings ranging from

1-9 was used for the study. In the hedonic scale, 9 represented the highest score (like extremely), 8 (like very much), 7 (like moderately, 6 (like slightly), 5 (neither like nor dislike), 4 (dislike slightly), 3 (dislike moderately), 2 (dislike very much) and 1 (dislike extremely). Colour, taste, aroma and overall acceptability were the attributes selected for use.

Prior to the day of the sensory evaluation, the panelists were given training in order to acquaint them with the test procedure and ensure that they give honest, individual opinion. They were reminded not to discuss with other panelists during the period of evaluation. They were instructed to rinse their mouths with water provided after tasting each sample. The sensory evaluation took place by mid-morning (10am-12pm). This was to ensure that the panelists were neither hungry nor full during the evaluation period.

Three samples were prepared and presented to the panelists. One sample contained extract from dry *Moringa oleifera* leaf powder. The second sample contained extract from popular tea leaves (lipton) and the third sample contained a mixture of both *Moringa oleifera* leaf extract and lipton tea in equal proportions. The samples were prepared using equal amounts of water (2g of each sample in 200ml of hot water) and milk and were presented in same type and colour of jugs and cups. Water was provided for the panelists to rinse their mouths after tasting each sample.

Statistical analysis

Means, standard deviation and standard error of the mean were calculated for two determinations. T-test and Duncan Multiple Range Test was used to separate and compare means [10] ($p < 0.05$).

III. Results

TABLE I
PROXIMATE, MICRONUTRIENT AND PHYTOCHEMICAL COMPOSITION OF DRY MORINGA OLEIFERA LEAF EXTRACT (% PER 100ML)

Moringa oleifera	
Moisture (%)	96.68± 0.028
Protein (%)	0.66±0.003
Fat (%)	0.001±0.000
Ash (%)	0.04± 0.001
Crude fibre (%)	0.00±0.000
Carbohydrate (%)	2.63± 0.021
Iron (mg)	2.07± 0.049
Calcium (mg)	33.35 ±0.919
Beta-carotene (RE)	223 ±5.657
Vitamin C (mg)	6.26 ± 0.028
Flavonoids (%)	0.20 ± 0.035
Alkaloids (%)	0.07 ± 0.00

Mean ± SD of two determinations

Table I presents the proximate, micronutrient and phytochemical composition of dry *Moringa oleifera* leaf extract (% per 100ml). The moisture content of dry *Moringa oleifera* leaf extract was high (96.68 %) and protein was 0.66%. Fat, ash, carbohydrate and crude fibre values for the leaf extract were 0.001, 0.04, 2.63 and 0.000%, respectively.

Micronutrients and phytochemical values for the leaf extract were 2.07mg iron, calcium 33.35mg, beta-carotene 223RE, and vitamin C 6.26mg. Flavonoids content and alkaloids values were 0.20% and 0.07%, each (Table I).

TABLE II
SENSORY EVALUATION OF BEVERAGE MADE FROM MORINGA OLEIFERA LEAF POWDER AND TEA LEAF

Quality attributes	Moringa beverage	Lipton tea
Colour	6.76^{b}	7.80^{a}
Taste	7.43^{b}	6.86^{b}
Flavour	7.33^{a}	6.16^{b}
Overall acceptability	7.5^{a}	6.57^{b}

Mean scores with different superscripts are statistically different at ($p < 0.05$)

Table II shows the mean score for sensory evaluation of *Moringa oleifera* beverage. Moringa beverage was more acceptable than lipton (control) in terms of flavour and overall acceptability ($p < 0.05$). However, the colour of the control was preferred over Moringa beverage ($p < 0.05$). There was no significant difference between the taste of Moringa beverage and lipton tea ($p > 0.05$).

IV. Discussion

The high moisture level of dry *Moringa oleifera* leaf extract indicates that it is susceptible to microbial growth. It also indicates that the shelf life is low. Also the low levels of protein, ash, crude fibre, fat and carbohydrate is as a result of its high moisture content. The higher the moisture contents of a food, the lower the nutrient density [11]. However the level of protein in dry *Moringa oleifera* leaf extract compares with other leaf extracts such as *Vernonia amygdalina* (0.66 vs. 0.78%) [12]. The high level of carbohydrates of the extract indicates that it can be ranked as a carbohydrate rich food when compared to the other levels of nutrients. However the moderate levels of protein and carbohydrate shows that it can form part of human diet. The low level of fibre in dry *Moringa oleifera* leaf extract indicates that it is suitable for infants and young children with lower dietary fibre requirements. Also the low level of fat shows that the vegetable is not a source of lipid accumulation which can cause arteriosclerosis; hence the extract will be suitable for individuals suffering from or who are prone to diseases of the cardiovascular system [13]. The extract of *Moringa oleifera* contains iron and calcium (2.07 and 33mg, each). Iron is an essential nutritional element. Functions of iron include involvement in energy metabolism, gene regulation, cell growth and differentiation, oxygen binding and transport, muscle oxygen use and storage, enzyme reactions, neurotransmitter synthesis, and protein synthesis. Deficiency of iron could result in lowered endurance, decreased work capacity, impaired temperature regulation, depressed immune, function, increased rates of infection, impaired cognitive functioning and memory, decreased school performance, compromised growth and

development, increased lead and cadmium absorption, increased risk of pregnancy complications, including prematurity and fetal growth retardation [14]. Calcium is essential in the body for blood clotting, stabilizes blood pressure, contributes to normal brain function and bone health. *Moringa oleifera* leaves is also rich in vitamin A and C. Vitamin C is important in the body as an antioxidant and its deficiency affects the cardiovascular system, immune system and collagen synthesis. Vitamin A also function in the body in vision, immune function, reproduction, bone metabolism, haematopoiesis etc. Phytochemicals are non-nutritive plant chemicals that have protective or disease preventive properties. Dry *Moringa oleifera* leaf extract is rich in flavonoids and alkaloids. Dietary flavonoids possess antiviral, anti-inflammatory, antihistamine and antioxidant properties. The panellists preferred the flavour of *Moringa oleifera* beverage and generally preffered it to lipton tea.

V. CONCLUSION

Dry Moringa leaf extract is rich in essential nutrients and is suitable in food supplementation. Moringa plant is drought resistant and grows all the year round. Hence it can serve as an economically nutrient –rich option in the fight against micronutrient deficiencies and malnutrition. Dry *Moringa oleifera* leaf extract can serve as an alternative to lipton tea. Its nutritional value surpasses lipton tea and this makes it suitable for infants, pregnant women and nursing mothers.

VI. RECOMMENDATIONS

Moringa oleifera leaf powder should be advocated for supplementation in households' diets especially in rural and disadvantaged communities. Efforts should be made to package and commercialise Moringa leaf powder.

REFERENCES

[1] Liu S., Manson J.E., Lee I.M., Cole S.R., Hennekens C.H., Willett W.C. and Buring J.E. (2000). Fruit and vegetable intake and risk of cardiovasculardisease: the women's health study. American Journal of Clinical Nutrition, 72:922–8.

[2] Adenipekun C.O and Oyetunji O.J (2010) Nutritional value of some tropical vegetables. Journal of Applied Bioscienes, 35: 2294-2300.

[3] Martin, L. P. (2007). "The Moringa Tree". ECHO Technical Note. North Forth Myers, USA.

[4] Balbir, M. (2006). Moringa for cattle fodder and plant growth. Trees for Life.

[5] Fahey, J. (2005). '*Moringa oleifera*: A review of the Medical Evidence for its Nutritional, Therapeutic, and Prophylactic Properties Part 1', Trees for Life Journal.

[6] AOAC, (1995). Official Methods of Analysis. Association of Official analytical Chemists, Washington D.C.

[7] AOAC, (1980). "Official methods of Analysis" Association of Analytical Chemists, Washington D.C.

[8] Pearson, D. (1976). Laboratory techniques in food analysis, Butterworth and Co. Ltd., 6-7.

[9] AOAC, (1990). Official Methods of Analysis. Association of Official analytical Chemists, Washington D.C.

[10] Harborne J.B. (1973), Phytochemical methods, (London: Chapman and Hall, Ltd) 49-188.

[11] Steel, R.G. and Torrie J.H. (1960). Principles and procedures of Statistics. McGraw-Hill Book Company, Inc, New York, 99-128.

[12] Udofia, I. and Obizoba I.C. (2005). Effects of sun and shade drying on nutrient and antinutrient content of some green leafy vegetables consumed in Uyo communities, Akwa Ibom state. Journal of Biochemical Investigation, 3(1), 1-5.

[13] Oboh, F.O and Masodje H.I. (2009). Nutritional and antimicrobial properties of Vernonia amygdalina leaves. International Journal of Biomedical and Health Sciences, 5(2), 53-55.

[14] Antia, B.S., E.J. Akpan, P.A. Okon and I.U. Umoren, 2006. Nutritive and anti-nutritive evaluation of sweet potatoes (Ipomoea batatas) leaves. Pak. J. Nutr., 5: 166-168.

[15] Stang J. and Story M. (2005). Guidelines for Adolescent Nutrition Services, http..//www.epi.umn.edu/lets/pubs/adol_books.shtm.