

Full Length Research Paper

Effectiveness of dry *Moringa oleifera* leaf powder in treatment of anaemia

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This study evaluated the effectiveness of dry *Moringa oleifera* leaf powder in the management of anaemia in adult albino rats. The proximate, mineral, vitamin and phytochemical composition of dry *M. oleifera* leaf powder were analysed. Twelve adult albino rats grouped into three were used. Cyclophosphamide was used to induce anaemia into them. The percentage proximate values were protein (26.28%), ash (7.69%), carbohydrate (49.35%), crude fibre (7.48%) and moisture (7.05%). The rats whose feed were supplemented with *M. oleifera* leaf powder showed superior attributes to the unsupplemented group. The study showed dry *M. oleifera* leaf powder is promising in the management of anaemia.

Key words: Effectiveness, anaemia, treatment, *Moringa oleifera* leaf powder.

INTRODUCTION

Anaemia is a widespread public health problem associated with an increased risk of morbidity and mortality, especially in pregnant women and young children. It is a condition caused by both nutritional (vitamin and mineral deficiencies) and non-nutritional (infection) factors. One of the most contributing factors is iron deficiency which is considered the number one contributor to the global burden of diseases (Brandy, 2007). Anaemia can result in impaired cognitive development, reduced physical work capacity and in severe cases, increased risk of mortality, particularly during the perinatal period. Anaemia may also result in reduced growth and increased morbidity (WHO/UNU/UNICEF, 2001).

Green leafy vegetables are a great source of minerals such as zinc, iron and potassium. Leafy vegetables also contain bioactive phytochemicals that have been linked to protection against cardiovascular and other degenerative disease (Okeno and Chebert, 2003). The plant *Moringa oleifera* is the most widely cultivated species of a monogetic family, the Moringaceae that is native to the

Sub-Himalayan part of India, Pakistan, Bangladesh and Afghanistan (Palada and Chang, 2003). It is now cultivated and has become naturalised in many locales in the tropics. *M. oleifera* is reported to prevent malnutrition because of the high protein and micronutrient content of the leaves (Anjorin et al., 2010). The minerals contents in *M. oleifera* and their bioavailability have been a subject of tremendous studies. There are however limited reports on the influence of variation in geographical locations or agro-ecology of *M. oleifera* on the mineral composition in various organs of the plant in Nigeria. Confirmation of minerals content of plant materials across varied agro-ecologies is necessary in the selection and formulation of plant-based mineral supplement in animal and human nutrition (Anjorin et al., 2010). The leaves of this plant contain a profile of important trace elements and are a good source of proteins, beta-carotene, amino acids and various phenolics. The leaves contain phytochemicals which protect plants from predators that include alkaloids, anthraquinone, coumarins, flavones, phenols, quinines and

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Table 1. Chemical composition of dry *Moringa oleifera* leaf powder (per 100 g).

Nutrient	Composition
Moisture (%)	7.05 ± 0.17
Protein (%)	26.28 ± 0.06
Fat (%)	2.16 ± 0.01
Ash (%)	7.69 ± 0.13
Crude fibre (%)	7.48 ± 0.12
Carbohydrate (%)	49.35 ± 0.15
Iron (mg)	19.42 ± 0.13
Calcium (mg)	171.6 ± 5.66
Beta-carotene (RE)	7.30 ± 0.01
Vitamin C (mg)	18.72 ± 0.13
Flavonoid (%)	3.29 ± 0.03
Alkaloids (%)	1.18 ± 0.05

Means ± SD of three determinations.

and tannins (Kasolo et al., 2011). The plant has been said to be a promising remedy for anaemia especially iron deficiency anaemia. The plant *M. oleifera* (fresh) has been used to combat malnutrition, especially among infants and nursing mothers. Countries like Senegal, India, Benin and Zimbabwe are now using *Moringa* leaves for programmes to fight malnutrition (Fahey, 2005). This study aims to evaluate the effectiveness of dry *Moringa* leaf powder as remedy to manage anaemia.

MATERIALS AND METHODS

Sample collection and preparation

The leaves of *M. oleifera* were harvested from Orba Nsukka to ensure uniformity and to avoid variation. They were shade-dried for 4 days after which they were milled into fine powder with the aid of electric blender.

Chemical analysis

The proximate values of the dry *M. oleifera* leaf powder (moisture, crude protein, fat, crude fibre and ash) were determined by the AOAC (1995) method. However, carbohydrate was determined by difference as follows: 100 – (% ash + crude fibre + protein + fat + moisture). Iron and calcium and ascorbate content were analysed using the AOAC (1990) method. Beta-carotene was determined according to the method of Pearson (1976). Alkaloids and flavonoids content were determined by the method of Harborne (1973).

Metabolic (anaemia) study

Twelve rats used for the study were bought from Department of Veterinary Medicine, University of Nigeria, Nsukka. They were allotted individually into metabolic cages equipped to separate urine and faeces and were fed animal feed and water *ad-libitum* for five days to get them acclimatised to both the feed and environment. Cyclophosphamide was used to induce anaemia intraperitoneally in

the three groups of rats. On establishment of anaemia, they were grouped into three (3) according to their body weight in such a way that the difference between each group was not more than 5 g. They were subsequently fed their respective diets and water (*ad libitum*) for five (5) days. The first group (A) served as the control. This group continued to receive only commercial animal feed. The second group (B) was fed the commercial animal feed supplemented with *M. oleifera* leaf powder (at 5% protein level). The third group was fed the commercial animal diet supplemented with *M. oleifera* leaf powder (at 10% protein level).

On the fifth day, they were weighed and blood samples were drawn from the rats through the ocular vein to determine their packed cell volume (PCV), haemoglobin and red blood count level.

Statistical analysis

Means and standard deviation were calculated from three determinations. One-Way Analysis of Variance (ANOVA) was calculated and Duncan's New Multiple Range Test was used to separate and compare means (Steel and Torrie, 1960).

RESULTS

Table 1 presents the chemical composition of dry *M. oleifera* leaf powder. The moisture content was 7.05%, protein 26.28%, while fat, ash and crude fibre were 2.16, 7.69 and 7.48%, respectively. Iron was 19.42% and vitamin C was 18.72 mg. Flavonoids and alkaloids contents were 3.29 and 1.18%, respectively.

Table 2 presents the levels of PCV, HB, RBC and weight gain of anaemic rats. Rats in group B had the highest PCV (37.50%), HB (13.00 g/dl) and RBC (10.69) when compared with the other groups. Rats in group C had higher PCV (34.00%), HB (10.38 g/dl) and RBC (910.58) than the control (group A). Group A had the lowest PCV (22.75%), HB (6.73 g/dl) and RBC (6.52). The PCV, HB and RBC of rats in the control differed significantly from the test groups ($P = 0.013$). The weight gain of rats in groups A, B and C were 10.00, 15.06 and 12.05 g, respectively. Rats in the control group differed significantly from the test groups ($p < 0.05$) in terms of weight gain. In all the attributes assessed, group A showed inferior values.

DISCUSSION

The moisture content of dry *M. oleifera* leaf powder was low. This explains the higher values of protein, fat, carbohydrate and crude fibre. The lower the moisture contents of a food, the higher the nutrient density (Udofia and Obizoba, 2005). The low moisture content suggests that the storage life will be high. Dry *M. oleifera* leaf powder can be classified as carbohydrate rich food because of its high carbohydrate contents. The protein found in the dry leaf powder was lower than that reported by Fahey (2005). This might be due to differences in processing methods and environmental conditions. However the fat, ash and crude fibre contents were similar to literature

Table 2. Packed cell volume (PCV), Haemoglobin (HB), Red Blood Cell (RBC) and weight gain of anaemic rats after treatment.

Experimental group	PCV	HB	RBC	Weight gain
Group A (control)	22.75 ± 3.59 ^a	6.73 ± 0.57 ^a	6.52 ± 2.63 ^a	10.00 ± 1.39 ^a
Group B (5% <i>Moringa oleifera</i> powder)	37.50 ± 6.25 ^b	13.00 ± 1.75 ^b	10.69 ± 0.84 ^b	15.06 ± 0.71 ^b
Group C (10% <i>Moringa oleifera</i>)	34.00 ± 3.27 ^c	10.38 ± 1.18 ^c	10.58 ± 0.63 ^b	12.00 ± 0.76 ^c

Means ± SD of three determination, Means followed by the same letters on the vertical column are not significantly different from each other (P<0.05).

reports (Fahey, 2005). The iron, calcium, beta-carotene and vitamin C contents were also high. This accounts for its effectiveness as a remedy for malnutrition. The presence of phytochemicals (flavonoids and alkaloids) in the leaves shows that it may have antioxidant property.

Results of the metabolic (anaemia) study revealed true to literature reports dry *M. oleifera* leaf powder is effective in treatment of anaemia (Fahey, 2005). This evidently is because of its content of quality protein, iron, vitamins A and C. It also implies that the nutrients are bioavailable in rats. Rats are monogastric just like humans. If the nutrients are biologically available in rats, it is an indication or prediction of their bioavailability in man. Anaemia is caused by mineral (for example iron) and vitamin (for example Vitamins A and C) deficiencies as well as infections. Proteins being a fundamental component of blood are found in high quantity in the leaf powder. Rats whose diets were supplemented with dry *M. oleifera* leaf powder had higher mean weight gain than the control. This confirms the report of (Nambiar and Seshadri, 2001) that supplementation of food with *M. oleifera* leaf powder results both in increased food intake and weight gain. Supplementation of feed with *M. oleifera* leaf powder at 5% protein level produced better results than at 10% protein level.

Conclusion

Dry *M. oleifera* leaves are rich in essential nutrients and might be used in food supplementation to improve the nutritional status of individuals and communities especially the vulnerable groups. The leaf powder was also effective in management of anaemia in adult rats.

RECOMMENDATIONS

Dry *M. oleifera* leaves could be used as a nutrient supplement in foods to improve the nutritional status of people both in terms of micronutrient nutrition and weight gain. However, confirmatory studies should be carried out in humans to establish a sound evidence-based nutrition advice.

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