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# Chemical composition, calcium, zinc and phytate interrelationships in *Aerva lanata* (Linn) Juss. ex Schult leaves

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**ABSTRACT**

The proximate, nutritive and anti-nutritive composition of the leaves of *Aerva lanata* were determined. The leaves were found to be moderately high in carbohydrate (26.6 g/100g), crude protein (22.6 g/100g) and ash (31.2 g/100g). Mineral composition (mg/100g) revealed that the leaves were high in P (187), and moderately high in other minerals such as K (47.9), Na (39.4), Ca (51.7), Mg (41.5), Zn(44.7), Fe(11.0) and low in Mn (1.04). Heavy metals such as Cu, Pb, Cd and Cr were not detected in the leaves. The anti-nutrient levels also revealed the presence of tannic acid, saponin, alkaloids, flavonoids and oxalate, with values ranging from (0.35-11.4)%. Other antinutrients were phytic acid and phytin - phosphorus, their low level was a good indication that the leaves would be safe for human consumption. The calcium ,zinc and phytate interrelationships showed the levels of Phy:Zn,Ca:Phy,[Ca][Phy]:[Zn] to be 0.05,36.9 and 0.000067 respectively. The result suggested that the bioavailability of zinc was relatively high due to the moderate phytate content of *Aerva lanata* leaves.

**Key words:** *Aerva lanata*, proximate, minerals, antinutrients.

## INTRODUCTION

*Aerva lanata* (Linn) Juss.ex Schult,popularly known as `ewi owo',`aje',and `efun ale' in Yoruba western Nigeria is a woody, prostrate or succulent, perennial herb in the Amaranthaceae family of the genus *Aerva* that sometimes flower in the first year[1]. It is also a struggling herb 0.3-2m high, flowers white; in moister localities than *A.Javanica*. Influorescence short and small,mostly axillary;stem and leaves with simple hairs,or glabrescent;leaves ovate-elliptic,1.5-5cm long and 1-3cm broad[2].The herb is available throughout India, Sri-Lanka, Tropical Africa, Java and Philippines. Its plant extract has been reported to possess diuretic, anti-inflammatory, antimalarial, anthelmintic, antivenin,analgesic and sedative activities[3-7]. Also it is used to treat urinary calculi, hematemesis, bronchitis, nasal bleeding, cough, scorpion stings, fractures, spermatorrhea, clearing of uterus after delivery and to prevent lactation[8-9]. Many biological active substances have been isolated and elucidated from *A.lanata*, among which are aervitrin, aevolanin, aervoside, amyrin and campesterol[7].

Phytic acid (phytate) is an important constituent of certain legumes,cereals and forage plants which is capable of chelating divalent cationic minerals like calcium, iron, magnesium and zinc. Such chelates make such elements nutritionally unavailable, thereby inducing dietary deficiency[9]. Phytic acid has been reported to cause reduced absorption of Calcium from the gastrointestinal tract and consequently implicated in the development of rickets when chicks are fed cereals such as sorghum. Zinc and iron deficiency symptoms have been reported in man and chicken[10] when fed diets high in phytic acid.

Only limited data are available on the critical Phy:Zn and [Ca][Phy]/[Zn] ratios associated with decreased zinc bioavailability for human diets[11]. Since the whole plant especially the leaves of *A.lanata* is edible, they are put into soup or eaten as spinach or vegetable. The plant also provides grazing for stock, game animals and chickens[12].

It is therefore pertinent to ascertain the proximate composition, nutritive mineral composition, calcium, zinc and phytate interrelationships of *A.lanata* leaves. The information obtained from this study would be useful to the numerous consumers of *A.lanata*.

## MATERIALS AND METHODS

*Aerva lanata* leaves were obtained from the premises of the University of Ado-Ekiti, Ekiti State, Nigeria and were identified at the Herbarium Section of the Department of Plant Science of the same University. The leave samples were air dried for two weeks and ground into uniform powder using a blender.

### Proximate and anti-nutritional analysis

Proximate composition and anti-nutritional analysis were carried out according to the procedure of Association of Official Analytical Chemist[13].

### Mineral Composition

The sample was dry ashed at 550°C and the ash boiled with 10ml of 20% HCl solution in a beaker and then filtered into a 100ml volumetric flask. It was made up to the mark with deionized water and the mineral analysis of the resulting solution was determined using Atomic Absorption Spectroscopy (Pye, Unicam Sp9, Cambridge, UK).

## RESULTS AND DISCUSSION

Table 1 presents the result of the proximate analysis (%) of the leaves of *Aerva lanata*. *A .lanata* leaves had low moisture content 6.38 %, this is an indication that it would not be liable to microbial spoilage. The ash content (31.2%) in the present study was moderately high. This suggests that the leaves could probably provide essential, valuable and useful minerals needed for good body development. This value (31.2%) was found to be very much higher than the ones reported for other medicinal plants in Nigeria[15-16].

**Table 1: Proximate composition of *A.lanata* leaves(%)**

| Parameter | Concentration |
|---|---|
| Ash | 31.2±0.03 |
| Moisture content | 6.38±0.01 |
| Crude protein | 22.6±0.60 |
| Fat | 6.43±0.01 |
| Crude fibre | 6.75±0.02 |
| Carbohydrate | 26.6±0.58 |

Values expressed as means ± SD of three determinations.

The high content of crude protein (22.6%), is an indication that the leaves were good sources of protein for humans and could also be utilized as feed stocks for animals. The value here was found to be higher than the one reported for Anisopus mannii (8.4%) by Aliyu *et al.*[17]. *Aerva lanata* leaves were high in carbohydrate (26.6%) which were quick sources of energy and also needed in the diet to ensure efficient oxidation of fats[18]. The value for crude fibre was 6.75 % and since it has been found to possess hypocholesterolemic properties[19], *A. lanata* leaves might be exploited for this purpose.

From the present study, it was discovered that *A.lanata* leaves were rich sources of most essential minerals (Table 2)(mg/100g),with Na (39.4),K (47.9),Ca (51.7),Mg(41.5) Fe(44.7), and P(187) . For instance, both Ca and Mg are chiefly

**Table 2: Anti-nutrients and mineral levels of *A. lanata* leaves**

| Anti-nutrients | *A. lanata* leaves |
|---|---|
| Tannic acid(%) | 0.35 |
| Saponin(%) | 7.67 |
| Alkaloids(%) | 11.4 |
| Flavonoids(%) | 3.75 |
| Oxalate(%) | 3.69 |
| Phytin phosphorus(mg/100g) | 6.50 |
| Phytic acid(mg/100g) | 23.1 |
| Mineral(mg/100g) | |
| Sodium | 39.4 |
| Potassium | 47.9 |
| Calcium | 51.7 |
| Magnesium | 41.50 |
| Zinc | 44.7 |
| Iron | 11.0 |
| Phosphorus | 187 |
| Manganese | 1.04 |
| Copper | ND |
| Cadmium | ND |
| Chromium | ND |
| Lead | ND |

ND = not detected.
Values expressed as means of two determinations.

found in the skeleton.Ca helps in forming and maintaining bone, blood clotting and muscle contraction. In addition to its structural role: Mg also activates enzymatic processes. Na and K control water equilibrium levels in body tissues and are also involved in the transport of some non-electrolytes. Zn helps in DNA synthesis, storage, release and function of insulin and also in the development of sexual organs and bones[20-21]. Fe is essential for haemoglobin formation and P is for bone and teeth development, Mn also activates enzymes involved in the transfer of phosphate and hydroxyl groups as well as some hydrogenation reactions[22]. *A. lanata* leaves could therefore serve as additional sources of such minerals.The absence of heavy metals such as Pb,and Cd made it good and safe for human consumption as these heavy metals are known to be of no benefit to humans[23]. *A. lanata* leaves contained low levels of anti-nutrients, such as tannic acid(0.35%), saponin(7.67%) flavonoids(3.75%), oxalate(3.69%) and phytin- phosphorus(6.50%) but a little bit high in alkaloids(11.4%) and phytic acid(23.1%). This showed that consumption of *A. lanata* leaves would not be detrimental to humans, however some of these anti-nutrients could still be reduced by proper processing. Tannins have been reported to bring about their antinutritional influences (especially in the monogastric animals) largely by precipitating dietary proteins and digestive enzymes to form complexes which are not readily digestible[24]. Saponins can either be beneficial or deletorius. There are suggestions that saponin consumption be encouraged because of their hypocholesterolaemic activity, forage saponins have been reported by Cheeke *et al*[25]; to cause toxic and anorexia effects in the rats and swine thereby limiting the feeding value of high saponin animal feeds such as alfalfa.

Alkaloids have been reported to have analgesic properties[26]. Reviews by Fasset [27], concluded that there is very little danger associated with the ingestion of oxalate-containing plants while studies by Oke,[28] suggested contrary view especially with respect to magnesium whose metabolism is reported to be impaired by oxalic acid(oxalate).

Table 3, presents the result of concentration of Ca,Zn,Phytate,Phy:Zn,Ca:Phy, and [Ca][Phy]/[Zn]. Oberleas[29] showed that foods with a mole ratio of Phy:Zn less than 10 showed adequate availability of zinc and problems were encountered when the value was greater than 15. In this study ,the Phy:Zn ratio(0.05) was less than 10, so the zinc content of *A .lanata* leaves would be highly available.

Phytic acids markedly decrease Ca bioavailability and the Ca:Phy molar ratio has been proposed as an indicator of Ca bioavailability. The critical molar ratio of Ca:Phy is reported to be 6:1 [30]. The molar ratio of Ca:Phy obtained in *A.lanata* leaves was 36.9. This value was higher than the reported critical molar ratio of Ca:Phy, indicating that absorption of calcium would not be affected by phytate in these leaves.

Ellis et al; [31] and Davies and Warrignton[32] indicated that the ratio of CaxPhy/Zn is a better predictor of Zn availability and that if the values were greater than0.5 mol/kg,there would be interferences with the availability of Zn. Our result was less than 0.5,following the indicator above, it means there would not be interferences in the availability of Zinc in *A.lanata* leaves.Ekpedeme *et al*;[33] reported that high levels of anti-nutrients, such as oxalate, phytic acid and HCN, are known to be very poisonous to humans. Since the results indicated that *A.lanata* leaves have low amount of phytates,(3.48% phytin-phosphorus/phosphorus), the bioavailabiltiy of essential dietary minerals, especially Ca and Zn,were assured.However proper processing before consumption is recommended.

**Table 3: Concentration of Ca,Zn,phytate and calculated Phy:Zn,Ca:Phy and [Ca][Phy]/[Zn] mole ratios of *A. lanata* leaves**

| Mineral/antinutrient | Concentration |
|---|---|
| Phytin-phosphorus(%) | 3.48 |
| Ca(mg/100g) | 51.7 |
| Zn(mg/100g) | 44.7 |
| Phytate(mg/100g) | 23.1 |
| Phy:Zna | 0.05 |
| Ca:Phyb | 36.9 |
| [Ca][Phy]/[Zn]c | 0.000067 |

[a](mg of Phy/MW (molecular weight) of Phy:mg of Zn/MW of Zn
[b](mg of Ca/MW of Ca:mg of Phy/MW of Phy)
[c][mol/kg Ca][mol/kg Phy]/[mol/kg Zn]

## REFERENCES


1. Aluka,http://en.wikipedia.org/wiki/Aerva-lanata (2008).
2. Hutchinson J, Daziel JM Flora of west tropical Africa 2nd ed.Crown agent for overseas and govt. and admin, Millibank, London (1954).
3. Chopra RN , Indigenous Drugs of India. Art Press, Calcutta India, 550 (1933).
4. Zagari A, Medicinal plants publication no. 1810(4), vol. 4. Tehran University, Tehran, Iran(1992).
5. Gesseler MC, Nkunyak MHH, Muuasumbi LV, Heinnrich M. Tanner, *Acta tropica.* **56:** 65 (1994).
6. Selvanayagam ZE,Gnanavendhan SG,Rao RB. Antisnake venom botanicals from ethnomedicine,*Journal of Herbs spices and Medicinal Plants* **2**: 45-100(1994).
7. Vetrichelvan T, Jegadeesan M, Senthil palaniappan M, Murail NP, *Indian Journal of Pharmaceutical Sciences* **62**: 301( 2000).
8. Vetrichelvan,T Jegadeesan M, *Journal of Ethnopharmacol.* **80**: 103(2002).
9. Tushar AD, Bapuso VY, Sachin LB, Subhash LB, Sunnil RD, *J. Appl. Biomed* **6:** 81(2008).
10. Nelson TS, Ferrara LW ,Stover NL, *Poul.sci.,* **47:** 1372 (1968).
11. Lease JG, *Poul.sci.* **45:** 237(1966)
12. Adeyeye EI, Arogundade LA, Akintayo ET, Aisida OA,. Alao PA, *Food Chemistry* **71**: 435 (2000).
13. Wikipedia,http: //en.wikipedia.org/wiki/ Aerva_lanata" (2008).
14. AOAC, Official Methods of Analysis of Association of Analytical Chemists International Maryland (2005).
15. Asaolu MF, Omotayo FO, Recent progress in medicinal plant. **17:** 339(2007).
16. Omotayo FO, Omoyeni OA, *Bull. Biol. Sci*. **7:** 1-6 (2009).
17. Aliyu, AB, Musa AM, Sallau MS, Oyewale AO, *Trends in Applied Sciences Research,* **4:** 68(2009).
18. Mudambi SR, Rajagopal MW,Fundamentals of food and nutrition, 2nd edn, New Delhi, Wiley Eastern Ltd (1983).
19. Selvendran RR, Ring SG, Duport MS, Chem., *Industry* **7**: 225(1979).
20. Crosby NT, *The Analyst.* **102:** 225(1977).
21. Wardlaw GM, Smith AM, Contemporary Nutrition. McGraw Hill Higher Education 353-367(2006).
22. Champe PC, Harvey RA, Lippincott's illustrated reviews; Biochemistry 2nd ed. Lippincott Raven publishers, New Jersey, USA 303-340 (1994).
23. Anderlini VC, Zarba MA, An assessment of trace metal pollution in the Kuwait marine environment R. Halwagy, D. Clayton, Kuwait University, Faculty of Science KFAS and EPC Kuwait, 133-156(1986).
24. Aletor VA, Nutritional, *Biochemical and human toxicology.* **35**(1): 57(1993).
25. Cheeke PR,Pederson MW,England DC. *J Animal Sci.* **58:** 783(1978).
26. Harbone JB,Phytochemistry,Acad.Press London, **21**: 2785 (1993).
27. Fasset DW ,Oxalates intoxicants occurring naturally in foods, Natl Acad Sci,Nat Res Council, Washington DC (1966).
28. Oke,OL,Oxalic acid in plants and nutrition, *World Rev Nut and Dietetics.* **10:** 262-302 (1969).
29. Oberleas D, Phytate content in cereals and legumes and methods of determination. *Cereal Food World.* **28:** 352-357(1983).
30. Oladimeji MO, Akindahunsi AA, Okafor AF, Investigation of the bioavailability of zinc and calcium from some tropical tubers, *Nahrung* **44,** 136-137(2000).
31. Ellis R, Kelsay JL, Reynolds RD, Morris ER , Moser PB, Frazier CW, *Journal of the American Dietary Association.* **87,** 1043 (1987).
32. Davies NT, Warrignton S, The phytic acid, mineral, trace element, protein and moisture content of UK Asian immigrant food, *Human Nutrition and Applied Nutrition.* **40A**: 49-59(1986).
33. Ekpedeme UA, Bassey AN, Ekaete UE, *Food Chemistry* **70**: 235(2000).