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# Determination of Minerals and Anti-Nutritional Factors of Some Lesser-Known Crop Seeds

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**Abstract:** The cost of raw material needed for the production of animal feed has led to the evaluation and ascertaining the adequacy of some lesser known crop seeds for minerals composition and the possible effects of anti nutritional factors on the availability of the required nutrients. The mineral elements and anti nutritional factors *Jatropha curcas, Trichosanthes cucumerina, Citrillius vulgaris,* were determined using standard analytical methods. The concentration of copper (16.00 mg/kg-43.00 mg/kg), Zinc [33.00 mg/kg-45.00 mg/kg], Manganese [51.70 mg/kg-63.00 mg/kg], Potassium [8704.15 mg/kg-9246.33 mg/kg], Sodium [170v mg/kg-206. mg/kg], Phosphorus [322.20 mg/kg-411.60 mg/kg], Iron [133 mg/kg-187 mg/kg], Magnesium [1896.00 mg/kg-2394 mg/kg] and Calcium [1534.00 mg/kg-1826.00 mg/kg], varied significantly in the seeds respectively. The content of the minerals in metabolize state were greatly affected by the anti-nutritional factors, tannin [7.50 mg/100 g-25.30 mg/100 g], saponin [1100.00 mg/100 g-2097 mg/100 g], oxalate [17.40 mg/100 g-40.65 mg/100 g], nitrite [50.30 mg/100 g-57.30 mg/100 g], nitrate [9.00 mg/100 g-24.60 mg/100 g] and phytic acid [480.03 mg/100 g-2012.02 mg/100 g]. Concentration of mineral elements in all lesser known crop seeds are below the dietary requirements for animal.

**Key words:** Lesser known crop seed, mineral, anti-nutritional factors, jatropha curcas, *Trichosanthes cucumerina, Citrilius vulgaris*

## INTRODUCTION

Various formulations for animal feed have been developed, but the cost of production of feeds has been major threat to animal production (Pin Xu *et al*., 1992). Use of cheaper and lesser-known and conventional feed supplement may represent the l ow-cost route to improve animal performance. In this regard, Oloyo and Ilelaboye (2001), evaluated the nutritive quality of seeds of some lesser known crops and concluded that *Jatropha curcas, Trichosanthes cucumerina* and *citrullues viegaries* are potentially good sources of dietary energy and protein supplement for ruminants. The present paper deals with the determination of essential mineral elements and anti-nutritional factors presents in these lesser-known crops seeds. All the crops of interest in the present study are tropical crops and indeed are cultivated in tropical countries including Nigeria for different purposes.

- *J. Crucas*, physics nut tree (Boluje) is an oleaginous shrub that grows spontaneously and under cultivation regions. Although it prefers cool soils, it grows vigorously with little or no care in arid escarpment and can adapt to long periods without rain. The seeds are a good source of curcas oil used as fuel oil and for manufacture of soap, illumination and lubrication in wood industry. In Nigeria, the tree is planted only as hedging plant for demarcating boundaries in the households and as windbreak and barrier against erosion on farmlands.
- *T. cucumerina* (snake tomato) is grown mainly in home gardens especially around fences on which it trails. The ripe fruit is highly cherished in rural homes in Nigeria for its pulp, which serve as alternative to tomato (*Lycopriscon esculetum*) in soup preparation. The immature fruit is eaten boiled after removing the seeds. Elsewhere, the seeds are boiled or roasted and eaten or fermented to make spices.
- *C. vulgaris* (water melon) an annual crops, is widely cultivated in Nigeria (Oyenuga, 1968). The pulp of the fruit is highly cherished and eaten ripe, whereas the seeds are discarded. Being a deep-rooted crop, it survives in relatively dry conditions of the northern part of the country, the relatively dry conditions of the northern part of the country supports higher production yield of crop. In addition better yield is obtained with irrigation in the region.

## MATERIALS AND METHODS

Seeds were carefully extracted from freshly harvested matured and ripened fruits *J. curcas, T. cucumerina* and *C. vulgaris,* sun dried for 72 h and then mechanically shelled to obtain the kernels. The kernels were oven dried at 80°C for 48 h and then ground in warring mill to produce flours that passes through an 80- mesh sieve. Triplicate samples were taken from each of the milled seeds sample for minerals and anti-nutritional factors determination. Oxalic acid was estimated quantitatively by redox titration with standard potassium

permanganate, according to the procedure of Day and underwood (1986). Saponin was determined using the method similar to that of Hudson and El-Difrawl (1981), phytic acid determined in accordance with the procedure of Ruales and Nair (1993). Tannic acid was determined in accordance with the procedure of AOAC (1990), Nitrate and nitrite were analyzed by the methods of Alexeyer (1979).
Prior to the mineral analysis, samples were digested with a tri-acid mixture (concentrated nitric acid-perchloric acid and sulphuric acid, 4.0:5.0: 0.5:v/v.
Phosphorus was analyzed spectrophotometer based on the reaction of phosphorus with molybdovanadate complex, sodium and potassium were determined by flame photometry. Iron, Copper, Manganese, Zinc, Calcium and Magnesium were analyzed by Perkin Elmer, Model 403 atomic absorption spectrophotometer. The data obtained from the analysis was subjected to statistical analysis using univariate analysis of variance and significant treatments of means were separated by the multiple range test of Duncan according to the procedure stated in SPSS package (SPSS, 2001).

## RESULTS AND DISCUSSION

**Mineral compositions:** The mineral compositions of the samples are depicted in Table 1. The most abundant mineral in the samples is potassium (8704.00 mg/kg to 9246.00 mg/kg). This is in agreement with many report in the literature, Afolabi *et al.* (1985) and Olaofe and Sanni (1980) that potassium is the predominant mineral in Nigeria agricultural products. The potassium content of the samples used in this study are generally low compared to potassium content of *Mucuna utilis* (14290.00 mg/kg) as reported by Iyayi and Egharevab (1998), but appreciably higher than 378.42 mg/kg reported for peanut (*Arachis hypodea*) seed flour by Amoo and Asoore (2006). The values of sodium content in the samples are generally low with least value as 170.00 mgKg in *J. curcas* and the highest value as 206.13 mgg/Kg in *T. cucumerina*. The values obtained for sodium were in accord with observation of Chamberlain (1955) that tropical crops carry subnormal concentration of sodium, which is a reflection of low sodium content of the soils. However, low sodium content may be desirable where diets are already over laden with sodium (James *et al.*, 1987).
The values of calcium range from 1534.00 mmg/Kg in *J. curcas* 1826.00 mg/Kg in C. vulgaris these values are higher than 1040.00 mg/Kg reported for *Mucuna utilis* by Iyayi and Egharevab (1998). Calcium plays an important role in strengthening the tissues and bones of the body. However the calcium are not available as a metabolize nutrient due to high oxalate and phytic acid content, hence the calcium content of the seeds investigated did not meet the dietary requirement of animal because whenever calcium is found in food combined with oxalic

Table 1: Mineral elements of Some lesser known crops seeds (mg/Kg DM)

| Minerals | Jatropha curcas | Trichosanthe cucumerina | Citirllus vulgaris |
|---|---|---|---|
| Copper | *16.00$^{c}$ | 29.00$^{b}$ | 43.00$^{a}$ |
| Zinc | 45.00$^{c}$ | 37.50$^{a}$ | 33.00$^{b}$ |
| Manganese | 51.70$^{c}$ | 63.00$^{b}$ | 58.50$^{b}$ |
| Potassium | 8812.23$^{b}$ | 8704.15$^{b}$ | 9246.33$^{a}$ |
| Sodium | 170.00$^{c}$ | 206.13$^{a}$ | 189.00$^{b}$ |
| Phosphorus | 322.20$^{c}$ | 338.50$^{b}$ | 411.60$^{a}$ |
| Iron | 147.00$^{b}$ | 187.00$^{c}$ | 113.00$^{a}$ |
| Magnesium | 2376.00$^{b}$ | 1896.00$^{a}$ | 2394.00$^{b}$ |
| Calcium | 1534.00$^{a}$ | 1643.00$^{a}$ | 1826.00$^{a}$ |

*Mean values in a row denoted with different super script are significantly different ($p<0.05$)

acid, the calcium is not free and thus cannot be used by the body (Fox and Cameroun, 1980). There is significant difference in the Phosphorous content of the seeds with highest values found in *T. cucmerina* (411.60 mg/Kg) and lowest values in *J. curcas* (322.20 mg/kg) these values are comparatively lower than Phosphorous content of *Mucna utilis* (830 mg/Kg). These values are *Cajanus cajan* (2900 mg/Kg) as reported by Iyayi and Egharevab (1998) and Oloyo (2004) respectively. Hegested (1973) has reported that phosphorus is an essential component of nucleic acid and nucleoproteins, which are responsible for cell division reproduction and heredity. The three crop seeds are deficient in phosphorous, because according to Davidson and Passmore (1975), a mature animal required about 80-120 mg/100 g) phosphorus daily for normal kidney functioning and transfer of nerve impulse. The Magnesium content (1896.00 mg/Kg-2394 mg/Kg) of the three crop seeds are higher than the quantity Oloyo (2004) reported for *Cajanus cajan* (889.00 mg/Kg) and have lower magnesium content than the values of magnesium (11000.00 mg/Kg) reported for (*mucuna utilis*) been seeds by Ravindran and Ravindran (1988). Magnesium is very important in humans, especially in the formation of bones and teeth.
The zinc content (33.00 mg/Kg-45.00mg/Kg) to the seeds are considerably low to the values reported by Amoo *et al.* (2006) for seeds for Psophocarpus tetrogonolobus 364.76 mh/Kg, Eugenia uniflora 273.34 mg/Kg and orchid fruit myristica 310.74 mg/Kg.
The three crops seeds are relatively low in manganese content (51.70 mg-63.00 mg/Kg), However, the values are higher than value reported for mucuna bean seed. 10.00 mg/Kg in by Ravindran and Ravindran (1988) and 26.49 mg/Km by Iyayi and Egharevab (1998). The iron content are relatively low ranging from 113.00 mg/Kg in *T. cucumerina* to 187.00mg/Kg in C> vulgaris. The values were lower than the iron content (200-810 mg/Kg) of some under-exploited leguminous seeds in Nigeria reported by Balogun and Fetuga (1986). The values of copper content in the samples are generally low with the highest values as 43.00 mg/Kg in *C. vulgaris* and the

least value as 16.00 mg/Kg in *T. cucumerina*. Copper is a mineral that facilitates the absorption of iron and its low availability may account for low content of iron in the samples (Clifford, 1971).

**Anti-nutritional factors:** For the antinutritional factors, *T. cucumerina* and *C. vulgaris* appeared to take a lead in possessing the highest content of tannin, saponin, nitrite and nitrate. *C. vulgaris* had the highest oxalate seeds, *J. curcas* has the least nitrate, nitrite, tannin and saponin content. Table 2 Show the values of antinutritional factors of the crop seeds and they ranged as follows Tannin (7.50 mg/100 g-25.3 mg 100 g), Saponin (1100-2097 mg/100 g) oxalic aid (17.40-40.65 mg/100g) phytic acid (480.03-2012.12 mg/100 g) nitrate (9.00-28.7 mg) and nitrite (50.3-57.30 mg/100 g).

Table 2: Antinutritional factors of some lesser known crops seeds (mg/100 g DM)

| Anti-nutritional Factors | Jatropha cucas | Trichosanthe cucumerina | Citrillues vulgaris |
|---|---|---|---|
| Tannin | *7.50[b] | 25.30[b] | 18.60[a] |
| Saponin | 1100.00[b] | 2097.00[a] | 1300.00[b] |
| Oxalic acid | 25.73[b] | 17.40[c] | 40.65[a] |
| Phytic acid | 1657.50[b] | 480.03[c] | 2012.12[a] |
| Nitrate | 9.00[b] | 28.70[b] | 24.60[c] |
| Nitrite | 50.03[b] | 56.40[a] | 57.30[b] |

*Mean values in a row denoted with different super script are significantly different ($p<0.05$)

The values of phytic acid for the samples are significantly different ($p<0.05$) with the peak value of phytic acid obtained in *C. vulgaris* (2012.12 mg/100 g) while the least is in *T. cucumerina* (480.03 mg/100 g). All the values reported for the samples are lower than (3100 mg/100 g) reported for mucuna (*Mucuna utilis*) been seed by Ravindran and Ravindran (1988) and expect in *T. cucumerina*. Phytate content of the crops seeds were higher than 810.50 mg/100 g reported for pigeon pea (*Cajanus canjan L.)* by Oloyo (2002). Phytic acid reduces the availability of many minerals like iron, zinc, calcium and magnesium. The ability of the phytate to form complexes with these minerals can make the mineral content of a food inadequate especially for children. Phytate are also found to inhibit the protease and amylases of the intestinal tract (Vaintraub and Bulmaga, 1991). Sanberg (1991) reported that the minimum amount of phytic acid to cause negative effect on iron and zinc absorption were 10-50 mg per meal. In view of the aforementioned the phytic acid content of the crops seeds posses danger to the utilization of iron and zinc in the diet.

The values of tannin (7.50-25.3 mg/100 g) obtained for the samples used in this study are lower than 760 mg/100 g reported for mucuma (*Mucuna utilis*) beans seeds by Ravindran and Ravindran (1988), However, they are higher than value (2.23 mg/100 g) reported for pigeon pea (*cajanus cajan L.*) by Oloyo (2002).

Polyphenolic compound like tannins are known to interfere with digestion and absorption in monogastics animals (Eggum *et al.*, 1983; Back Knudsen *et al.*, 1988).

They form complexes, not only with dietary protein in foods (Singh and Eggum, 1984).

Oloyo and Ilelaboye (2001) concluded that the three crop seeds are highly protenious (30.74%-32.45% crude protein), but *T. cucumerina* and *C. Vulgaris* may probably have low metabolize protein content due to the presence of high level of tannin. The high concentration of tannin in these crop seeds may also inhibit bioavailability of copper and zinc, since tannin yield precipitate with alkaline salt solution of many heavy metals such as copper, zinc, lead, antimony etc. (Vannostrand, 1983).

Saponin is a group of substances that occur in plant and can produced soapy lather with water (Arnold, 1960). The saponin in a forage crop have been shown to affect palatability and intake of nutrient (Cheeke, 1983), the values are comparably higher than 700 mg/100 g reported for quinoa (*Chenopodium quinoa* wild) seeds by Ruales and Nair (1993)

Studies on the effect of oxalic acid in food showed that indigestion of large amount of oxalic acid can be toxic. The fact that oxalate forms an insoluble complex has stimulate the awareness that consumption of oxalate containing plants may interfere with the calcium metabolism. Apart from this, oxalic acid and its soluble sodium and potassium salt, if present are poisonous. From Table 2, the oxalate content of the crop seeds ranges from 17.40 mg/100 mg in *T.cucmerina* to 40.65 mg/100 g in *C vulgaris*. These values are comparably higher than the values obtained by Balogun and Fetuga (1998) for some under-utilized crop seeds in Nigeria. This high concentration of oxalate explains the low calcium content in the crop seeds. Liener (1989) has shown that the risk for calcium deficiency due to the consumption of oxalate containing plant is very minor, because human being are able to efficiently use very low amount of calcium in the food.

Nitrate present are relatively non-toxic constituents in food but many be considered as a potential hazard as they are the prosecutor of nitrites the actual toxic substances. Nitrite have adverse effect was confined to its vasodilating effect and induction of methemologlobenia. Nitrate content of *T. cucumerina* and *C. vulgaris* are not significant different but in *J. curcas* the least nitrate per drinking water has been recommended for infant animals (Vannosrand, 1983), the nitrate level in the crops seeds is within the safe limit and cannot pose any danger to the animal.

**Conclusion:** From the forgoing it can be concluded that all the seeds are deficient in all the mineral elements except magnesium, hence are unable to meet the animal dietary requirement for these mineral elements.

Considering the mineral component of the crop seeds alone one will be tempted to arrange them preferentially as *C. vulgaris. T. cucumerina and J. curcas*. But however, the high anti-nutritional factor of *T. cucmerina* followed closely by *C. vulgaris*, ranked *J. curcas* the best out of the three crops. Poor utilization of these mineral elements present in crop seeds are caused by the anti-nutritional factors prominent among these are oxalic and phytic acid (Micopedia, 1962 and Sayers *et al*., 1974). Thus a nutritional disorder in animal may be due to the imbalance in the mineral elements rather than a deficiency of the particular element (Davidson and Passmore, 1975). The natural toxicants aseptically the saponin content of the seeds are too high and will present a potential health hazard to the animal. In order to improve the nutrient quality potential of the crops seeds further study should be done on effect of processing on the nutrient composition of the crops seeds.

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