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Comparative Studies on Some Anti-Nutritional Factors in Seeds of *Mucuna Pruriens* (Velvet Beans) and *Sphenostylis Stenocarpa* (African Yam Beans)

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Abstract
The concentrations of some anti-nutritional factors present in seeds of *Mucuna pruriens* (velvet beans) and those of *Sphenostylis stenocarpa* (african yam beans) were determined. The seeds of *Mucuna pruriens* were found to contain Saponin: 0.30mg/100g, Phytate: 8.33mg/100g, Oxalate: 28.79mg/100g, Cyanogenic glucoside: 9.80mg/100g, Tannin:0.26mg/100g while the seed of *Sphenostylis stenocarpa* were found to contain Saponin: 0.17mg/100g, Phytate: 6.63mg/100g, Oxalate: 16.33mg/100g, Cyanogenic glucoside: 17.80mg/100g and Tannin: 1.22mg/100g. Consequently, *Mucuna pruriens* seeds have lower concentration of Cyanogenic glucoside (9.80mg/100g) than *Sphenostylis stenocarpa* (17.80mg/100g) and this may make the seeds of *Mucuna pruriens* (velvet beans) more fit for consumption because cyanogenic glucoside appears to be the most toxic of all the anti-nutrients studied.
Keywords: Sphenostylis stenocarpa, Mucuna pruriens, Saponin, Oxalate, Phytate, Cyanogenic glucoside, Tannin.

Introduction

Mucuna pruriens is a tropical legume known as velvet beans or cowitch. The plant is an annual, climbing shrub with long vines that can reach over 15m in length. When the plant is young, it is almost completely covered with fuzzy hairs, but when older, it is almost completely free of hairs. The leaves are tripinnate, ovate, reverse ovate, rhombus shaped or widely ovate. The sides of the leaves are often heavily grooved and the tips pointy. In young *Mucuna pruriens* plants, both sides of the leaves have hairs. The steps of the leaflets are two to three millimeters long. Additional adjacent leaves are present and about 5mm long (Yerra *et al*, 2005).

In the fruit ripening stage, a 4 to 13cm long, a 1 to 2 cm wide, unwinged leguminous fruit develops. There is a ridge along the length of the fruit. The husk is very hairy and carries up to seven seeds. The seeds are flattened uniform ellipsoid, 1 to 1.9cm long, 0.8 to 1.3cm wide and 4 to 6.5cm thick. *Mucuna pruriens* plants have white, lavenders, or purple flowers. Its seed pods are about 10cm long and covered in loose orange hairs that cause a severe itch if they come in contact with skin. The chemical compounds responsible for the itch are a protein, mucunain and serotonin. It is found in tropical Africa, India and the Carribean (Yerra *et al*, 2005).

In many parts of the world *Mucuna pruriens* is used as an important forage, fallow and green manure crop. Since the plant is in the legume family (pear and beans), it with the help of nitrogen-fixing bacteria, take nitrogen gas from the air and combines it with other chemical compounds producing fertilizer and improving the soil. *Mucuna pruriens* is a wide spread fodder plant in the tropics and to that end, whole plant is fed to animals as silage, dried hay or dried seeds. *Mucuna pruriens* silage contains 11-25% crude protein, 35-40% crude fibre and the dried beans 20-35% crude protein (Katzenschlager *et al*, 2004).

In history, *Mucuna pruriens* have been used as an effective aphrodisiac. It is still used to increase libido in both men and women due to its dopamine inducing properties. Dopamine has a profound influence in sexual function. A typical dose for a man is 15g of ground seeds mixed with cow's milk (Yerra *et al*, 2005). *Mucuna pruriens* has also recently become popular among lucid dreaming enthusiasts. When combined with other supplements that stimulate the cholinergic system, the dopamine presumably produced from the consumption of *Mucuna pruriens* confers upon the lucid dreamer greater motivation and confidence (Manyam *et al*, 2004). *Mucuna pruriens* is one of the most important sources of L-dopa, a common component of nootropics ("smart drugs"), it also contain serotonin 5-HTP, nicotine and some decidedly psychoactive compound (Ramachandran, 2006). *Mucuna pruriens* pods hairs are a common ingredient in itching powder.

Mucuna pruriens beans have been wining its popularity over the last few years in the natural products market mainly because of the sport industry, though it has plenty of health benefits. As *Mucuna pruriens* seed is proved to increase testosterone and stimulate growth hormone, it makes it rather desirable for men in sport as it increases muscle mass. Various products (as powders, tinctures, extracts and decoctions) help to gain weight loss, improve memory, increase libido and for visual enhancement. The seeds of velvet bean are high in protein (20-29%), lipids (6-7%), dietary fiber (8-10%), ash (3%), carbohydrates (50-60%) and minerals (Adebowale and Lawal, 2003).

According to studies on men, oral intake of the seeds of *Mucuna pruriens* promotes fertility and sperm production and also improves erection, duration of coitus, and post-coital satisfaction after only four weeks of treatment. For years it has been used in folk medicine for treating diarrhea, impotence, intestinal gas, worms, rheumatic disorders, tuberculosis, cough, sterility, muscular pain, menstrual disorders, diabetes and even snakebites. All these issues have been proven by animal studies (Guiliano and Allard, 2001).

Sphenostylis stenocarpa (african yam beans) like other legumes, is grown both for its edible seeds and tubers. It is a vigorous vine, which twines and climbs to a height of about 3m and requires staking. It flowers profusely in 100 to 150 days, producing a bright colour flowers which may be pink, purple or greenish white. The slightly woody pods contain 20 to 30seeds and mature within 170 days. The plant produces underground tubers that are used as food in some parts of African countries that serve as agent of perennation in the wilds (Duke *et al*, 1977).

A major factor limiting the wider food use of many tropical plants (including legumes) or also making the processing lengthen before fit for eating is the ubiquitous occurrence in them of a diverse range of natural compounds capable of precipitating deleterious effects in man and animals. Manifestation of toxicity range from source reduction in food intake and nutrients utilization to profound neurological effects and death. Compound, which act to reduce nutrient and/or food intake are often referred to as anti-nutritional factors (Osagie, 1998).

The medical implication of plants have been highly researched and it has been proven to result from active principles such as saponins, glycosides, oxalases, acid phenols, toxins, amino acids etc. These agents have been implicated to have antimicrobial activities (Sofowora, 1987; Asakawa, 1990).

Although toxic compounds are widely distributed in the plant kingdom, it is generally considered that tropical legumes contain a more complex array of these substances followed by cassava than other crop species. The presence of these anti-nutritional factors constitute a major setback, limiting the nutritional and food qualities of plant because they are known to exert a deleterious effect when ingested by man or animal without adequate processing (Ogun *et al*, 1989).

Saponins are steroid or terpenoid glycoside often referred to as 'natural detergents'. There are a group that are now classified as subgroup of the glycosides and are characterized by their bitter and astringent taste, foaming properties and their hemolytic effect on the red blood cells. They are widely distributed in the plant kingdom being found in over five hundred genera (Mahato and Nand, 1991). Saponin have been shown to possess both beneficial (cholesterol lowering, inhibition of cancer cells, energy booster, antibiotic) and deleterious properties (Oakenful and Sidhu, 1989).

Oxalate, a C_2 dicarboxylic acid anion is produced and accumulated in many crop plants and pasture weeds. Oxalate may be present in plants as the soluble salts, potassium, sodium or ammonium oxalic acid or as insoluble calcium oxalate. They possess inhibitory effect on digestion. Oxalate affect calcium and magnesium metabolism (Oke, 1968) and react with proteins to form complexes, thus presenting an inhibitory action on peptic digestion (Oboh and Tenic, 1986).

Phytic acid (phytate), a hexaphosphate derivative of inositol is an important storage form of phosphorous in plants. It is insoluble and cannot be absorbed in the human intestine. Phytic acid has 12 replaceable hydrogen atoms with which it could form soluble salts with metals such as calcium, iron, zinc and magnesium. Phytate can also inhibit digestibility by chelating with calcium binding with substrate or proteolytic enzyme (Osagie, 1998).

Glycosides are a group of compound sometimes referred to as glucoside when the basic organic component is glucose. Glycosides vary considerably in their chemical composition but have in common the production of a sugar and other substrate known as genin or a glycone on enzyme or acid hydrolysis. Some glycosides following enzyme hydrolysis, produce hydrocyanic acid and are known as cyanogenic glycosides. Cyanogenic glycosides are a group of 0-glycosides formed from decarboxylated amino acids (the group arises from $\propto$-carbon atom and the amino group).

Any plant phenolic substance with a molecular weight greater than about 500 can be considered to be a tannin. The two distinctive groups are the hydrolysable tannin so called because they may be readily hydrolysed into a mixture of carbohydrate and phenols and condensed tannins which are complex flavonoid polymers. Tannins may decrease protein quantity by decreasing digestibility and palatability. Other nutritional effects which have been attributed to tannin include damage to intestinal tract, toxicity of tannin absorbed from the gut and interference with the absorption of iron, a possible carcinogenic effect (Osagie and Eka, 1998). Tannin compounds accumulate in considerable amount in tissue such as barks, roots, wood, leaves and fruits and prevent effective utilization of forages by binding to dietary protein, thereby causing digestive problems for grazing animals.

In this study, results are presented to show the desirability or otherwise of the fitness of seeds of *Mucuna pruriens* (velvet beans) for human and animal consumption when compared with seeds of *Sphenostylis stenocarpa* (african yam beans) on the basis of the concentrations of some anti-nutritional factors present in them.

Materials and Methods

Dry seeds of *Mucuna pruriens* (velvet beans) were obtained from the compound of Federal Polytechnic, Ado-Ekiti and the identity authenticated at the soil and crops unit of the Department of Agricultural Technology, Federal Polytechnic, Ado-Ekiti, Ekikti State, Nigeria. Dry seeds of *Sphenostylis stenocarpa* (african yam bean) were purchased from Erinfun Market, Ado-Ekiti and the identity authenticated at the soil and crops unit of the Department of Agricultural Technology, Federal Polytechnic, Ado-Ekiti, Ekiti State, Nigeria.

Saponin content of the samples was determined using filtration and crystallization methods (Harringer, 1994). Determination of oxalate content was accomplished using both filtration and titration methods while the phytate contents of the samples obtained were determined using filtration and titration method (AOAC, 1984). The concentration of cyanogenic glucoside in the bean samples was determined by distillation, condensation and titration (Wang and Filled, 1992). Tannin concentration was determined using colorimetric method (AOAC, 1984).

Results

Table 1 shows the concentration of saponin, oxalate, phytate, cyanogenic glucoside and tannin as determined for seeds of *Mucuna pruriens* (velvet bean) and *Sphenostylis stenocarpa* (african yam bean).

***Table 1*:** Concentrations of saponin, oxalate, phytate, cyanogenic glucoside and tannin of seeds of *Mucuna pruriens* (velvet beans) and *Sphenostylis stenocarpa* (african yam bean).

Sample	Saponin	Oxalate	Phytate	Cyanogenic glucoside	Tannin
	Concentration in mg/100g				
Mucuna pruriens	030±0.001	28.79±0.02	8.33±0.01	9.80±0.01	0.26±0.001
Sphenostylis stenocarpa	0.17±0.001	16.33±0.01	6.63±0.005	17.80±0.01	1.22±0.002

Values are Mean±S.D. obtained in triplicates.

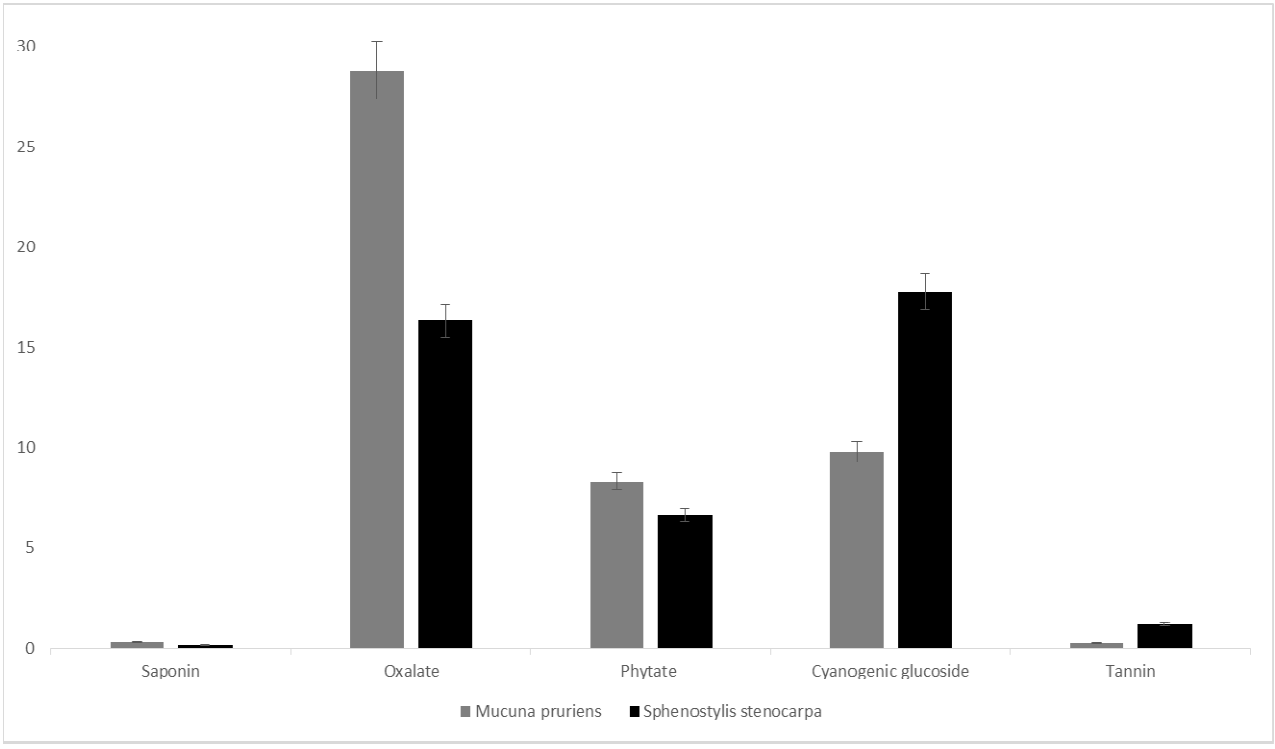

Fig. 1: Concentration of saponin, oxalate, phytate, cyanogenic glucoside and tannin in seeds of *Mucuna pruriens* and *Sphenostylis stenocarpa.*

Discussion

From the results presented, the concentration of saponin in *Mucuna pruriens* (velvet beans) is higher than those in *Sphenostylis stenocarpa* (african yam beans) and saponin have been shown to be beneficial in cholesterol lowering, inhibition of cancer cells and energy boosting (Oakenful and Sidhu, 1989).

The concentration of oxalate in *Mucuna pruriens* is higher than that in *Sphenostylis stenocarpa* and

oxalate affect calcium and magnesium metabolism (Oke, 1968) and react with proteins to form complexes, thus presenting an inhibitory action on peptic digestion (Oboh and Tenic, 1986).

The concentrations of phytate in both *Mucuna pruriens* seeds and *Sphenostylis stenocarpa* are about the same. Phytate can also inhibit digestibility by chelating with calcium binding with substrate or proteolytic enzyme (Osagie, 1998).

The concentration of cyanogenic glucoside in seeds of *Sphenostylis stenocarpa* is very much higher than that in seeds of *Mucuna pruriens* and this may make the seeds of *Mucuna pruriens* more fit for consumption because cyanogenic glucoside appears to be the most toxic of all the anti-nutrients studied.

The concentration of tannin in seeds of *Mucuna pruriens* (0.26mg/100g) is much lower than that in seeds of *Sphenostylis stenocarpa* (1.22mg/100g). Tannin may decrease protein digestibility and palatability. Other nutritional effects which have been associated with tannin include damage to intestinal tract, toxicity of tannin absorbed from the gut and interference with the absorption of iron and a possible carcinogenic effect (Osagie and Eka, 1998).

Conclusion

This study has established the presence of anti-nutritional factors in seeds of both the velvet beans (*Mucuna pruriens*) and african yam beans (*Sphenostylis stenocarpa*). But from the results obtained, seeds of velvet beans (*Mucuna pruriens*), if properly processed, may be fit for human consumption as well as those of african yam beans (*Sphenostylis stenocarpa*). However because of lower cyanogenic glucoside and tannin levels in seeds of *Mucuna pruriens* and its numerous beneficial health effects, it may be recommended that meals that include seeds of *Mucuna pruriens* be advocated in our diets.

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