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Investigation of Phytohormonal Potential of Some Selected Tropical Plants

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ABSTRACT

The aim of this study was to investigate the phytohormonal potential of eight selected tropical plants. Seeds of *Tribulus terrestris*, *Mucuna pruriens*, *Myristica fragrans*, *Glycine maximum*, leaves of *Hyptis suaveolens*, *Allium cepa*, root of *Daucus carota* and rhizomes of *Dioscorea villosa* were evaluated for phytohormonal and metabolite constituents for possible extraction to enhance reproductive performance in livestock. The selected plant parts were analyzed for metabolites such as saponin, alkaloids, flavonoids, oxalates and saponin, as well as plant hormones such as auxin, absussic, cytokinin and gibberellins. The result revealed that flavonoid was significantly low in all the selected plants. Saponin was highly significant ($p<0.05$) in *Tribulus terrestris*, *Myristica fragrans*, *Dioscorea villosa* and *Daucus carota*. Phytates was highly significant in *Mucuna pruriens*, *Hyptis suaveolens*, *Glycine maximum* and *Allium cepa*. Oxalates and alkaloids ranged between slightly low and medium in all the selected plants. Auxin was significantly high in *Mucuna pruriens*, *Myristica fragrans*, *Allium cepa*, *Hyptis suaveolens* and *Glycine maximum*, while gibberellins was significantly high in *Tribulus terrestris*, *Dioscorea villosa* and *Daucus carota*. Absussic and cytokinin flunctuate between low and medium in all the selected plants except in *Hyptis suaveolens* where cytokinin was not significantly different from auxin. In conclusion, selected plants such as *Tribulus terrestris*, *Myristica fragrans*, *Dioscorea villosa* and *Daucus carota* with high saponin will hypothetically be use to enhance reproductive performance of animals generally. *Myristica fragrans* might be useful in females due to its high saponin and auxin, while *Dioscorea villosa* and *Daucus carota* could be use on males due to its high saponin and gibberellins. *Tribulus terrestris*, *Allium cepa*, *Hyptis suaveolens* and *Glycine maximum* could be researched for phytohormonal effect on both sexes.

Key words: Phytochemical, phytohormone, seeds, rhizome, taproot, leaves

INTRODUCTION

Plants have been used for centuries as medicinal source for relief from illnesses by man and free range animals that are observed to browse selected herbal plant when ill (Shafaei *et al*., 2011; El-Said and Al-Barak, 2011). According to Mendonca-Filho (2006), supported by Hosseini *et al*. (2011), plants are biosynthetic laboratory for chemical compounds that are used for food (carbohydrates, proteins, fats) and those that exert physiological effects on the body (glycosides, alkaloids, terpenes). The potential for finding new compounds is enormous as till today only about 6% of the tropical species have been studied for biological activity, out of which 15% have been

screened for phytochemical constituents (Rahimi *et al*., 2010; Hasani-Ranjbar *et al*., 2009; Verpoorte, 2000). Phytochemical studies of plant preparations are necessary for standardization which helps in the understanding of the significance of the phytoconstituents in terms of their observed activities. Phytochemistry also helps in standardizing the herbal preparations so as to get the optimal concentrations of known active constituents and in preserving their activities (Fabricant and Farnsworth, 2001).

Phytochemicals may be either single chemical substances or mixtures of principles whose separation is neither practicable nor advantageous. The single chemicals are exemplified by primary metabolites (sugar, fats, amino-acids, etc.) and secondary metabolites (glycosides, steroids, alkaloids, terpenes, peptides, phenols, tannins, lignins, etc.) (Kayode and Kayode, 2011; Ghosh and Bandyopadhyay, 2007; Wang *et al*., 2000). The mixtures include secondary metabolites such as fixed oils, fats, waxes, volatile oils, resins, oleo-resins, oleo-gum-resins and balsams (Hosseini *et al*., 2011; Tyler *et al*., 1988).

Various plants are used in different parts of the world to treat a number of diseases as a result of their containing metabolites such as steroidal compounds, volatile oils, tannins, eugenol, alkaloids etc. which are useful as intermediates for the manufacture of corticosteroids and related hormones (Kokten *et al*., 2011; Mokhtari, 2007; Ghosh and Bandyopadhyay, 2007). Some of these compounds are suitable for chemical and/or microbiological transformation into therapeutically useful drugs (Sofowora, 2008). It is of interest to note that many microorganisms are today resistant to drugs and this has made it difficult to treat some infectious diseases both of generic and transferable ones between species and generic of bacteria (Momtaz, 2011; Karim, 2011; Al-Fifi, 2007). This has led to serious problems in developing countries, apart from cost of drugs and its residual effects on vital organs of the body. This led to the need to research into some common plants used locally for medicinal purpose. The selected plants are: *Tribulus terrestris*, *Mucuna pruriens*, *Myristica fragrans*, *Allium cepa*, *Dioscorea villosa*, *Hyptis suaveolens*, *Glycine maximum* and *Daucus carota*.

Tribulus terrestris or puncture vine is a taprooted herbaceous flowering plant of the family zygophyllaceae, native to tropical regions of the world. The extract is claimed to serve as tonic, increase the body's natural testosterone levels (Gauthaman *et al*., 2003) and thereby improve male sexual performance by stimulating androgen receptors in the brain and help to build muscle (Cabeza *et al*., 2010).

Mucuna pruriens or velvet bean is a tropical legume with ovate leaves, white, lavender or purple flower colour. It has hairy seed-pods which causes itching when in contact with the skin. The plants foliage can be used as forage and the seeds can be processed into ruminants feed. It is high in protein (Emenalom and Udedibie, 1998) but contain toxic substances such as 3, 4 dihydroxy-L-phenylalanine (L-Dopa) which enhances sexual stimulation (Mokhtari, 2007).

Myristica fragrans is an evergreen tree of the family myristicaceae, indigenous to the Banda Islands in the Moluccas of Indonesia. It produces a seed known as nutmeg covered with the mace. The nutmeg is used as spice in most confectioneries. The powdered seed may be sprinkled on sores especially those caused by guinea worm (Burkill, 1985) and its said to have aphrodisiac properties (Tajuddin *et al*., 2005).

Allium cepa or Onion belong to the family Allacease and order Asparagales. It is used as spice and in alternative medicine as digestive stimulants, diuretic and antispasmodic. Its leaves is said to have aphrodisiac property (Middleton *et al*., 2000).

Dioscorea villosa or wild yam is an herbaceous twinning perennial which belongs to the family Dioscoraceae. Common in China mainland, Mexico, east/ central United State. Twinning in hedges,

over bushes and fences, the slender tuberous root stock is crooked and laterally branched; the leaves are broadly ovate and cordate, glabrous on top and finely hairy underneath. The rhizomes are slightly cylindrical curved and slightly flattened, hard and solid with white/starchy surface when broken. Taste mild and slightly sour, sticky when chewed. Its contraceptive use is attributed to the action of various steroidal saponins (diosgenin and aglycone) and also to dioscorine, dioscine and other alkaloids derived from nicotinic acid. The root also contains phytosterols, alkaloids, tannins and a high level of starch (Cynthia and Hynes, 1993; Wren, 1994). It also shows antibacterial activity (Kelmanson *et al*., 2000).

Hyptis suaveolens or American mint or pignut is an erect, strongly aromatic branched annualor short- lived perennial herb of the Lamiaceae family. A native of Central America but recently introduced to many tropical areas along with foreign food aids (James, 1995). Grows up to 3 m tall. It contains a CP of 9.19-17.94%, CF 4.88-9.04%, Ash 5.68-6.88%, Carbohydrate 66.24-75.87%, Crude lipid 3.48-4.90% and food energy 357.68-373.26 mg cal^{-1} (Edeoga *et al*., 2006). It is used in traditional medicine to treat different diseases such as diabetes mellitus, fever, eczema, flatulence, cancers and headache (Danmalam *et al*., 2009; Nantitanon *et al*., 2007).

Glycine maximum or Soybeans is a member of the Fabaceae family native to East Asia. Dehulled soybean contains approximately 48% CP hence its use in animal feed (NRC, 1993). It contain antinutrients which limits its use in feed (Francis *et al*., 2001), some of which are estrogenic isoflavones or phytoestrogens (genistein).

Daucus carota or carrot is a root vegetable usually orange in colour, though purple, red, white and yellow varieties exist. It is native to Europe and Southwestern Asia. The commonly eaten part of the carrot is the taproot, although the greens are edible as well. Carrots are an excellent source of antioxidant compounds and the richest vegetable source of the provitamin A (carotenes) which helps protect against cardiovascular disease, cancer and promote good vision (Agte *et al*., 2000). In addition, it's a good source of vitamin C, K, P and dietary fibre (Edioga *et al*., 2003).

The aim of this study therefore, is to assess the specific phytochemical and phytohormonal properties of the selected plants and their levels in the various plants to recommend specific combinations to meet a desired goal.

MATERIALS AND METHODS

Selection of plants: Selection of plant material for the bioactive plant constituents followed the World Health Organisation guidelines (WHO, 2003), though slightly modified following the zoopharmacognosy approach which proposes the selection of plant species regularly ingested by animals, mostly primates for reducing pain, microbial or worm infestation (Berry *et al*., 1995).

About 1 kg of each of the selected plant material (*Tribulus terrestris, Mucuna pruriens, Myristica fragrans, Allium cepa, Dioscorea villosa, Hyptis suaveolens, Glycine maximum* and *Daucus carota*) were obtained from in and around the Teaching and Research Farm, University of Ilorin, Nigeria. The seeds were handpicked to eliminate all unwanted materials. The samples were identified at the department of plant biology, University of Ilorin.

Sample preparation: Each of the sample were carefully cleaned and divided into 10 lots to represent 10 replications. Each of the replicate was sundried for three days, later milled and kept in individual labeled airtight containers until needed for analysis.

Sample analysis: The phytochemical analysis of the samples comprised of the following basic determinations which were carried out according to the method of AOAC (1990): Saponin, Phytate,

Alkaloids, Oxalate and Flavonoids was done using the method of Bohm and Koupai-Abyazani (1994). Phytohormonal analysis of the samples were determined for Auxin, Absussic, Cytokinin and Gibberellin using colorimetric technique (James, 1995) and the peroxidase oxidation method of Hinman and Lang (1965).

Statistical analysis: All data collected were subjected to analysis of variance of a completely randomized design model (n = 10) while significant treatment means were compared using the Duncan multiple range test (Duncan, 1955; Steel and Torrie, 1990).

RESULTS

The phytochemical composition of the selected tropical plants is presented in Table 1 where *Tribulus terrestris*, *Myristica fragrans*, *Dioscorea villosa* and *Daucus carota* had significantly high saponin levels. *Mucuna pruriens*, *Hyptis suaveolens*, *Glycine maximum* and *Allium cepa* had significantly high phytate levels. All the selected plants had low flavonoid level, which were significantly different ($p<0.05$) from the other phytochemicals. Oxalates and alkaloids were varying from slightly high to medium in all the selected plants. It was significantly different ($p<0.05$) in all the selected plants. Table 2 shows the hormonal constituents of the selected plants. Auxin was significantly high in *Mucuna pruriens*, *Myristica fragrans*, *Allium cepa*, *Hyptis suaveolens* and *Glycine maximum*. Gibberellin was significantly high in Tribulus terrestris, Dioscorea villosa and Daucus carota. Absussic and Cytokinin flunctuate between low and intermediate in all the plants, except in *Hyptis suaveolens* where cytokinin was not significantly different from auxin.

DISCUSSION

There is a metabolite concentration relationship between plants and its use in herbal medication as shown in Table 1. Plants with high saponin level such as *Tribulus terrestris*, *Myristica fragrans* and *Dioscorea villosa* have been used in various herbal preparations for treatment of erectile

Table 1: Phytochemical composition of some selected tropical plants

Plants	Flavonoid (%)	Oxalate (mg g^{-1})	Saponin (%)	Alkaloid (%)	Phytate (%)	±SEM
Tribulus terrestris	0.90^{e}	10.25^{d}	47.02^{a}	13.56^{c}	22.45^{b}	0.15
Mucuna pruriens	0.46^{e}	35.88^{b}	13.64^{c}	12.29^{d}	39.55^{a}	0.33
Myristica fragrans	1.37^{e}	22.14^{b}	49.32^{a}	8.42^{d}	16.00^{c}	0.18
Allium cepa	2.02^{e}	30.08^{c}	47.95^{b}	12.60^{d}	68.56^{a}	0.36
Dioscorea villosa	1.17^{e}	16.28^{c}	45.56^{a}	13.40^{d}	28.40^{b}	0.30
Hyptis suaveolens	0.86^{e}	16.97^{c}	18.32^{b}	13.28^{d}	25.82^{a}	0.32
Glycine maximum	1.21^{e}	14.92^{c}	39.87^{b}	13.17^{d}	48.84^{a}	0.22
Daucus carota	5.11^{e}	25.14^{b}	41.61^{a}	9.56^{d}	17.29^{c}	0.18

SEM: Standard error of means; $^{a, b, c, d, e}$Treatment means within rows followed by different superscripts are significantly different

Table 2: Phytohormonal composition of some selected tropical medicinal plants

Hormones	*Tribulus terrestris*	*Mucuna pruriens*	*Myristica fragrans*	*Allium cepa*	*Dioscorea villosa*
Auxin	0.027^{d}	0.133^{a}	0.127^{a}	0.115^{a}	0.007^{c}
Absussic	0.121^{c}	0.013^{c}	0.009^{c}	0.002^{b}	0.003^{d}
Cytokinin	0.133^{b}	0.044^{b}	0.116^{b}	0.006^{b}	0.027^{b}
Gibberellin	0.155^{a}	0.014^{c}	0.011^{c}	0.003^{b}	0.143^{a}
±SEM ($\times 10^{-3}$)	0.5	0.3	0.7	0.4	0.2

dysfunction, libido enhancement, body building, etc., which may be as a result of the concentration and type of saponin compound contained in them. This supports the finding of Evans *et al.* (2009) and Mokhtari (2007), supported by Wang *et al.* (2000) that steroidal saponins are of great pharmaceutical importance because of their relationships to compounds such as the sex hormones, cortisone, diuretic steroids, Vitamin D and the cardiac glycosides. They are sometimes use as the starting material for these compounds. According to Petropoulos (2002) diosgenin found in Dioscorea species is suitable for the manufacture of oral contraceptives, sex hormones and corticosteroid production.

Alkaloids participate in plant metabolism and are not solely the waste end products of metabolism. Larson and Marley (1984) suggested that alkaloids may have a role in the defence of plants against singlet oxygen ($^1O_2$) produced in presence of light during photosynthesis, which is damaging to living organisms. Alkaloids help to quench the effect of singlet oxygen (Iribhogbe *et al.*, 2011; Brossi and Cordell, 2000). Since it was not significantly different in all the selected plants all the plants could be used to confer protection on animals. Flavonoids, though significantly low in all the plants along the row, it was highest in *Daucus carota* along the column. Many flavonoid containing plants have diuretic or antispasmodic, antitumour, antibacterial or antifungal properties (Neuhouser, 2004; Gross, 2004). Isoflavones are non-steroidal phytoestrogen which exert weak oestrogenic effects on animals (Cos *et al.*, 2003). *Daucus carota*, *Allium cepa*, *Myristica fragrans*, *Glycine maximum* and *Dioscorea villosa* could exert oestrogenic effect on animals due to their flavonoid level. Phytoestrogen are well documented as producing infertility in animals as in clover disease in sheep grazing on clovers containing a high phytooestrogen content (Cos *et al.*, 2003; Gross, 2004). According to Neuhouser (2004) there was reduced prostate and breast cancer as well as pre-and post-menopausal syndrome in soy consumers due to its oestrogenic activity by serving as a potential replacement for oestrogen deficiency.

Auxin (Indole Acetic Acid) which is chemically similar to the amino acid tryptophan has been reported to be responsible for the induction of fruit setting, stimulate growth of flower parts, promotes femaleness in dioecious flowers (via ethylene production) and cell elongation (Davies, 1995). On the other hand, gibberellins, according to Ross *et al.* (1992) and Salisbury and Clean (1992) are diterpenes which helps to stimulate cell division, cell elongation, breaks seed dormancy and induces maleness in dioecious flowers. Hypothetically, *Mucuna pruriens*, *Myristica fragrans*, *Allium cepa*, *Hyptis suaveolens* and *Glycine maximum* which had significantly high auxin could be researched for its effect on reproductive performance of the female animals. On the other hand, Tribulus terrestris, Dioscorea villosa and Daucus carota could be tested on male reproductive performance.

CONCLUSION

In conclusion, selected plants such as *Tribulus terrestris*, *Myristica fragrans*, *Dioscorea villosa* and *Daucus carota* with high saponin will hypothetically be use to enhance reproductive performance of animals generally. *Myristica fragrans* might be useful in females due to its high saponin and auxin, while *Dioscorea villosa* and *Daucus carota* could be use on males due to its high saponin and gibberellins. *Tribulus terrestris*, *Allium cepa*, *Hyptis suaveolens* and *Glycine maximum* could be researched for phytohormonal effect on both sexes.

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