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Phytochemical profiling of selected medicinal plants used by Paraja tribe of Koraput, India

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ABSTRACT

The present study reports the chemical profiling of 30 selected medicinal plants used by paraja tribe of Koraput. These plants were selected on the basis of their highest use value (UV) and Fidelity level (FL) from the ethomedicinal documentation of 104 plants used by the paraja tribe. The plants were subjected for phytochemical analysis to determine the presence of secondary metabolites, which may responsible for their therapeutic effects as claimed by the tribal people. Phytochemical analysis of these plant extracts indicateed that phenol, flavonoid, alkaloid, tannin and total antioxidant content were the major pharmaceutical parameters are present in varying proportions that are responsible for ethnomedicinal value. The plants were also contained significant amount of antioxidants that can be exploited as a potentiol sources for herbal remedy for various diseases. The study suggests that further work should be carried out to elucidate the possible mechanism of action of these extracts against various diseases.

Key words : *Antioxidants, Ethnomedicine, Phytochemical analysis, Paraja tribe*

Introduction

Medicinal plants are rich source of novel drugs that forms the ingredients in traditional systems of medicine, modern medicines, folk medicines, pharmaceuticals and lead compounds in synthetic drugs (Ncube 2008; Parveen *et al.* 2010). Medicinal plants are of greater importance to the health of individuals and communities to cure different types of diseases (Ishtiaq *et al.* 2007). The medicinal value of plants lies in some chemical substances that produce a definite physiological action on the human body (Ishtiaq *et al.* 2007). According to the World Health Organization almost 65% of the world's population has incorporated the value of plants as a methodology of medicinal agents into their primary modality of health care (Farnsworth *et al.* 1985). Medicinal and aromatic plants form a large group of economically important plants that provide the basic raw materials for indigenous pharmaceuticals, perfumery, flavor and cosmetic industries. Many of the plant material used in traditional medicine are readily available in rural areas at relatively cheaper than modern medicine (Mann *et al.* 2008).

Koraput is a tribal dominated district blessed with rich and diverse cultural heritage and the tribal people exhibit a vast traditional knowledge regarding usage of medicinal plants for treating various ailments (Mishra and Choudhry, 2012). Sixty two tribal communities constituting 54.45% of its population live in the district (Mishra and Choudhury, 2012). In the interior areas of Koraput, plants become the only source of medicine due to lack of modern facilities and remoteness. The Paraja tribe of Koraput is one of the leading tribal groups and has rich a ethnomedicinal knowledge of its own. Their

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traditional medicinal practice involves different medicinal plants against different common diseases like diarrhoea, dysentery, cold, vomiting, headache, jaundice, fever, malaria, earache, toothache, goiter, eye infection, boils, cuts, wounds, inflammation, mouth ulcer, scabies, skin diseases, ring worm, piles and paralysis. There are some earlier reports on the ethno-medicinal knowledge of Paraja tribes of Koraput (Das and Mishra, 1987; Mishra and Chaudhury, 2012; Raut *et al.* 2012). However, all these traditional knowledge on medicinal plants are present only in oral form and are transmitted from generation to generation. Most of these reports are incomplete and inadequate and no report is available about phytochemical profiling of medicinal plants used by Paraja tribe. As the traditional knowledge is rapidly degrading due to modernization of that area, much important information may have been lost in absence of proper documentation and evaluation. Keeping in view of above, the present study aims to evaluate the phytochemical profiling of selected medicinal plants frequently used by Paraja tribe of Koraput. Thus phytochemical investigation of these ethnomedicinal plants is necessary before some of them can be used as drugs to serve mankind.

Materials and Mehods

Collection and characterization of plant samples

The study was conducted by choosing 30 medicinal plants for phytochemical investigation for their highest use value (UV) and fidelity level (FL) after initial documentation of 104 plants used in ethnomedicine by Paraja tribe of Koraput. The plant samples for the study were collected from different forest patches of Koraput (18º 14′ to 19º 14′ N latitude and 82º 05′ to 83º 25′ E longitude). The information on medicinal plants against different aliments was collected through questionnaire and personal interviews with traditional healers and knowledge holders. The information on the medicinal plants, preparation method for medicine, application mode and dosage were recorded. The plants were identified with the help of Flora of Orissa and Bihar by Saxena and Brahmam, (1994 -1996). After collection of plant samples, the samples were oven dried at 40 ºC and powered mechanically, sheaved and stored in an air tight container for further phytochemical analysis (Harbone, 1973).

Use value (UV)

The relative importance of each plant species known locally to be used as herbal remedy is reported as use value (UV) and it was calculated using the following formula (Phillips *et al.* 1994).

$$UV = U/n$$

Where UV is the use value of a species, U is the number of use reports cited by each informant for a given plant species and n is the total number of informants interviewed for a given plant.

Fidelity level (FL)

To determine the most frequently used plant species for treating a particular ailment category by the informants of the study area, we calculated the delity level (FL). The FL was calculated using the following formula (Friedmen *et al.,* 1986):

$$FL\ (\%) = Np/N \times 100$$

Where Np is the number of use-reports cited for a given species for a particular ailment category and N is the total number of use reports cited for any given species.

Phytochemical analysis of selected plants

Estimation of total Phenol

Total phenol was estimated by Sadasivam and Manickam, (2007) with some modification. The dried plant samples (0.1g) were mixed with 5 mL of 80% ethanol and kept in for 10-12 h. Then samples were homogenized and centrifuged at 10,000rpm for 20 minutes. Supernatants were collected and make up the volume to 25 mL with distilled water (H_2O). Sample (0.1 mL) was taken in various test tubes ad 0.5 mL of FC reagent (Folin Ciocalteau Reagent) was mixed in each tube. The resulting mixture was allowed to stand at room temperature for 30 minutes and the absorbance was measured at 650 nm against a blank. Total phenolic content was expressed as mg of phenol equivalents per gram of dry weight of the sample by using the standard curve of phenol.

Estimation of total Flavonoid

Total flavonoid content was determined by aluminium chloride colorimetric assay (Chang *et al.,* 2002) with some modification. Dried plant samples of 0.5g was soaked in 10 mL of 80% ethanol, homog-

enized and centrifuged at 4000 rpm for 30 minutes. The crude extracts (0.5 mL) were diluted with 1.5m l of methanol. To this (10%) of 0.1 mL $AlCl_3$, 0.1 mL potassium acetate, 2.5 mL distilled water mixed well and allowed to incubation for 30 minutes. The absorbance was measured at 415 nm with a spectrophotometer. Results were expressed as mg flavonoid/g of dry samples using catechol as standard.

Estimation of total Alkaloid

Total alkaloid content was determined by Harbone, (1973). Dry powdered sample (1 g) was mixed with 40 mL of 10% acetic acid in methanol and covered it and allowed to stand for 4 hour. The solution was filtered and filtrate was concentrated on a water bath to one quarter of the original volume. Concentrated ammonium hydroxide was added drop wise to the extract until the precipitation was complete. Kept the solution for 2-3 hours and the precipitate was collected on filter paper by filtering the above mixture. Then the filtrate was washed with 1% ammonia solution and allowed to stand for half an hour. The residue is the alkaloid, dried in an oven and weighed to quantify the alkaloid.

Estimation of Tannin

The total tannin content was determined by Sadasivam and Manickam, (2007). Dry powdered sample of 0.5 g was boiled with 75 mL of distilled water for 30 minutes. The extract was collected after filtration. To 0.5 mL of sample extract, distilled water was added to make up the volume to 10 mL to that 0.5 mL of Folin-Denis reagent and 1 mL of 10% sodium carbonate solution was added to each tube. Each tube were mixed well and incubated for 30minutes and absorbance was taken at 760 nm against reagent blank. The tannin contents were expresses as mg/g dry samples using tannic acid as standard.

Estimation of total antioxidant capacity

The total Antioxidant capacity of the extract was evaluated by the phosphor-molybdenum method with some modification (Prieto *et al.*, 1999). For antioxidant capacity 0.05 g of dried plant sample was added to 10 mL of 70% ethanol (v/v) and homogenized by vortex agitation. An aliquot of 300 µL of plant extract was mixed with 3 mL of the reagent solution. This solution makes up 0.6 M sulfuric acid (H_2SO_4), 28 mM sodium dihydrophosphate dihydrate ($NaH_2PO_42H_2O$) and 4 Mm ammonium hepta molybdate tetrahydrate ($(NH_4)_6Mo_7O_{24.}4H_2O$). These vials were incubatedin water bath at maximum 90 ^{0}C of 90 minutes. Then samples cooled at room temperature and absorbeny was measured at 695 nm against blank. A typical blank solution contained 1ml of reagent solution and aooropriate volume of the ethanol (70%v/v) and it was incubated under the same condition. The standard solution of ascorbic acid (200µg/ml) was prepared. A volume of 300µl was used as % of Antioxidant activity as calculated by following equation.

Antioxidant Activity (%) = $(A_{sample} – A_{blank} / A_{ascorbic\ acid} - A_{blank})^*100$

Results and Discussion

The study provides ethnomedicinal information and scientific evidences of 30 plants, which are commonly used by Paraja tribe of Koraput. The plants are enumerated according to their scientific name, family, mode of preparation and medicinal uses (Table 1). The Use Value (UV) and Fedility level (FL) of each plant species was shown in Table 1. The UV and FL of plant scpcies indicated that there was a high agreement among the users for the use of plants in the treatment of jaundice, fever, malaria, ear ache, tooth ache, goiter, eye infection, boils, cuts, wounds, inflammation, mouth ulcer, scabies, skin diseases, mumps and ring worm.

Phytochemical analysis of these plants revealed that some plants are promising sources of several chemical constituents like phenol, alkaloids, flavonoids, tannin and total antioxidant capacity in different proportions (Table 2). The total phenol content varied significantly among the plant sample and was ranged from 4.7 to 124.5 mg/g dry wt. The highest phenol content was found in *Phyllanthus urinaria* (L.) followed by *Helicteres isora* (L.), *Careya arborea* Roxb., *Ageratum conyzoides* (L.), *Cissus quadrangularis* (L.), *Premna coriacea* C. B. Clarke, *Crossandra infundibuliformis* (L.) Nees. and least phenol was observed in *Tephrosia purpurea* (L.) Pers. The flavonoid content varied significantly among the plants and was ranged from 1.59 to 41.3 mg/g dry wt. The highest flavonoid content was found in *Kaempferia galangal* (L.) followed by *Vitex negund* (L.), *Phyllanthus urinaria* (L.), *Sida acuta* Burm.f., *Sesbania grandiflora* (L.) Poiret and lowest was recorded in *Achyranthes aspera* (L.). The total alkaloid content was ranged from 1.75 to 69.5 mg/g dry wt.

Table 1. List of medicinal plants used by Paraja tribe with their use value (UV) and fidelity level (FL).

Sl. No	Botanical name	Local name	Medicinal use	Use Value	Fidelity Level
1	*Streblus taxoides* (Heyne ex Roth) Kurz	Jhumpuri	Bark paste is taken orally to cure cold and sores. Bark paste is applied externally to get relief from toothache.	0.14	18.33
2	*Crossandra infundibuliformis* (L.) Nees.	Etimalli	Leaf paste is applied externally to cure from cuts and wounds.	0.14	18.33
3	*Physalis minima* (L.)	Badaphutaphutika	Leaf paste is taken internally to get relief from urinary disorder.	0.12	21.05
4	*Boerhavia diffusa* (L.) nom. Cons.	Purnisago	Whole plant powder is given twice a day with rice water to treat jaundice. Leaves are also cooked and eaten as vegetable to treat jaundice.	0.11	100
5	*Premna coriacea* C.B. Clarke.	Agibathu	Root paste is applied externally to cure rheumatism.	0.14	18.33
6	*Pongamia glabra* Vent.	Karanja	The oil extracted from seed in applied on chest and leg to get relief from cold.	0.11	26.31
7	*Emilia sonchifolia* (L.) DC. Ex Wight	Musakani	Stem is made into paste and given orally to cure from fever.	0.11	53.33
8	*Andrographis paniculata* (Burm.f.) Wallich ex Nees.	Bhuin nimba	Leaves are crushed with turmeric and applied externally to cure Itches and skin infection.	0.22	18.33
9	*Cardiosperum halicacaubum* (L.)	Phutaphutika	Leaf juice is used internally to cure from earache. Paste of leaf is applied on effected area to cure any inflammation and also used on hair for dandruff.	0.17	18.33
10	*Sida acuta* (Burm. f.)	Bajramuli	Juice of the leaves applied externally to cure cuts and wounds.	0.17	18.33
11	*Argyreia nervosa* (Burm. f.) Bojer	Hatikano	The root is grinded and taken orally to get relieve from weakness. Root paste is boiled with *Ricinus communis* oil and applied; also the root paste is made like peels and taken orally to get relief from joint pain	0.17	100
12	*Sesbania grandiflora* (L.) Poiret	Agasti	Leave paste is used orally to cure fever. Cooked leaf is taken as a vegetable against night blindness.	0.12	100
13	*Adhatoda vasica* Nees	Basanga	To cure cough daily morning 7 fresh leaves are taken orally for one week.	0.18	53.47
14	*Mimosa pudica* (L.)	Lajakuli	Root paste is taken with water to cure dysentery.	0.18	15.87
15	*Phyllanthus urinaria* (L.)	Bhuin amla	Whole plant paste is taken orally to cure in case of fever, stomach ache and headache.	0.20	12.11
16	*Careya arborea*. ROXB.	Kumbhi	Bark paste is tied over the cuts to get relieve from it.	0.11	15.00
17	*Vitex negundo* (L.)	Nirgundi	Fresh leaf-juice mixed in honey is taken on empty stomach to cure Asthma. Fresh leaves are boiled in water till vaporization, the vapour are inhaled through mouth to reduce cough.	0.20	63.33
18	*Plumbago zeylanica* (L.)	Swetachitaparu	Bark paste is taken orally to cure dysentery.	0.15	15.00

Table 1. List of medicinal plants used by Paraja tribe with their use value (UV) and fidelity level (FL).

Sl. No	Botanical name	Local name	Medicinal use	Use Value	Fidelity Level
19	*Withania somnifera* Dunal.	Aswagandha	Burnt root powder with butter is taken every day early morning to cure asthma.	0.17	13.33
20	*Barleria prionitis* (L.)	Daskerenta	Flower is chewed orally every morning to cure from lower blood sugar and diabetes. Leaves paste is applied externally on face pimples to cure.	0.14	100
21	*Helicteres isora* Linn.	Modimodika	Bark paste is used internally once a day to cure chronic dysentery.	0.11	18.95
22	*Ocimum canum* Sims	Banatulasi	Leaf is crushed along with garlic and applied along with oil to get relief from migraine.	0.15	21.42
23	*Asparagus racemosus Willd.*	Satabari	To cure joint pain; tuber is crushed with water and applied externally on affected area.To cure stomach pain; tuber is boiled in water and the water is taken orally.	0.15	53.96
24	*Kaempferia galanga* Linn	Ramakedara	Tuber paste is taken orally to cure from malaria and weakness. Also the tuber paste is applied externally to cure from skin diseases.	0.15	23.07
25	*Achyranthes aspera* (L.)	Apamaranga	Root paste is taken orally to cure labour pain and applied externally on cuts and wounds to cure it.	0.13	64.28
26	*Tephrosia purpurea* (L.) Pers.	Duma kolatha	Root paste is applied externally to get relief from tooth ache	0.15	19.12
27	*Euphorbia tirucalli* (L.)	Khadisiju	First *Pongamia glabra* oil is applied in waist then the stem pasteof Euphorbia tirucalli is heated and applied in that place to get relieve from waist pain.	0.16	72.61
28	*Ageratum conyzoides* (L.)	Pokasungha	Leaf paste is applied externally to cure scabies.	0.15	12.19
29	*Flemingia strobilifera* (L.) W.T.Aiton	Phoolbuta	Tuber paste is taken orally to cure from dysentery.	0.14	100
30	*Cissus quadrangularis* (L.)	Hadabhanga	A coating of castor oil is applied on the affected area and then plastered with the paste of stem.	0.13	62.14

The highest alkaloid content was found in *Careya arborea* Roxb. followed by *Asparagus racemosus* WILLD., *Physalis minima* (L.), *Ocimum canum* Sims, *Premna coriacea* C.B.Clarke, *pongamia glabra* Vent and least was recorded in *Withania somnifera* Dunal. The total tannin content was ranged from 0.70 to 93.2 mg/g dry wt. The highest tannin content was found in *Pongamia glabra* Vent followed by *Phyllanthus urinaria* (L.), *Helicteres isora* (L.), *Premna coriacea* C.B.Clarke and least tannin content was recorded in *Adhatoda vasica* Nees. The screening for antioxidant properties of medicinal plants have been performed increasingly for the last few decades in hope of finding an efficient remedy for several present day diseases (Halliwell, 2008). The total antioxidant capacity (%) of plants varied significantly among the plant sample and the value ranged from 3.57% to 31.29%. The more antioxidant capacity (%) was observed in *Phyllanthus urinaria* (31.29%), *Pongamia glabra* (23.80%), *Mimosa pudica* (20.23%), *Careya arborea* (18.11%) followed by *Flemingia strobilifera* (17.39%), *Andrographis paniculata* (17.01%), *Premna coriacea* (17.85%), *Sesbania grandiflora* (16.66%) and least antioxidant capacity was recorded in *Euphorbia tirucalli* (L.) (3.57%).

The present study showed the baseline informa-

Table 2. Phytochemicals such as phenol, flavonoid, alkaloid, tannin and total antioxidant capacity in selected plant species.

Plant name	Phenol (mg/g dry wt)	Flavonoid (mg/g dry wt)	Alkaloid (mg/g dry wt)	Tannin (mg/g dry wt)	Total Antioxidant capacity (%)
Streblus taxoides (Heyne ex Roth) Kurz	35.43±2.12	5.77±0.06	6.10±1.27	14.10±0.42	12.84±3.24
Crossandra infundibuliformis (L.) Nees.	76.66±4.14	11.85±0.14	18.50±3.53	26.00±1.27	13.86±2.76
Physalis minima (L.)	10.46±1.31	14.86±0.07	37.00±4.24	2.60±0.84	10.71±1.68
Boerhavia diffusa (L.) nom. Cons.	15.90±1.27	14.77±0.06	27.00±5.65	8.40±0.28	12.24±2.16
Premna coriacea C.B. Clarke.	81.56±3.34	2.59±0.04	20.50±2.02	47.40±2.82	17.85±2.64
Pongamia glabra Vent.	10.70±0.80	4.96±0.02	22.50±1.60	94.00±1.13	23.80±1.44
Emilia sonchifolia (L.) DC. Ex Wight	22.20±1.79	7.49±0.03	9.00±2.24	10.60±0.42	11.81±2.04
Andrographis paniculata (Burm.f.) Wallich ex Nees.	49.36±3.25	18.68±0.02	28.00±4.24	44.80±0.98	17.01±4.44
Cardiosperum halicacaubum (L.)	16.00±4.33	22.2±0.03	31.00±7.07	17.40±1.83	13.43±1.92
Sida acuta Burm. f.	34.53±3.20	26.44±0.04	2.75±0.35	22.00±0.42	15.39±3.24
Argyreia nervosa (Burm. f.) Bojer	12.86±0.09	23.61±0.02	40.00±2.82	8.00±0.14	11.13±2.28
Sesbania grandiflora (L.) Poiret	25.63±0.32	26.72±0.00	7.00±2.82	16.80±0.00	17.85±3.12
Adhatoda vasica Nees	60.76±1.74	18.58±0.07	14.50±6.36	0.60±0.14	13.25±3.36
Mimosa pudica (L.)	23.46±1.03	22.47±0.06	22.50±2.02	22.80±0.00	20.23±4.56
Phyllanthus urinaria (L.)	124.50±0.04	30.79±0.00	30.00±1.31	86.00±0.98	31.29±5.77
Careya arborea.ROXB.	98.93±0.75	10.54±1.11	69.50±2.12	62.00±0.98	18.11±1.32
Vitex negundo (L.)	34.50±0.70	36.16±0.05	54.00±3.94	23.60±0.28	5.61±0.24
Plumbago zeylanica (L.)	64.76±1.17	18.84±0.67	16.50±2.77	16.80±0.56	8.67±0.24
Withania somnifera Dunal.	8.00±0.09	23.54±0.26	1.75±0.35	4.60±0.42	3.65±0.36
Barleria prionitis (L.)	30.20±0.09	14.2±0.87	33.00±2.72	4.80±3.11	6.29±0.72
Helicteres isora Linn.	113.36±0.89	4.32±0.05	12.50±0.70	47.00±0.70	14.54±0.36
Ocimum canum Sims	76.83±3.44	22.11±0.20	36.50±1.09	36.40±1.13	15.22±0.60
Asparagus racemosus Willd.	7.63±0.32	4.31±0.07	46.50±7.67	4.00±0.00	10.96±0.84
Kaempferia galanga Linn	26.10±12.86	41.32±0.77	26.00±2.48	11.80±0.14	5.18±0.36
Achyranthes aspera (L.)	10.16±0.42	1.59±0.02	12.50±3.53	5.40±0.28	6.80±1.92
Tephrosia purpurea (L.) Pers	4.76±0.14	8.62±0.02	19.00±4.24	3.00±0.42	5.44±0.96
Euphorbia tirucalli (L.)	39.23±0.14	14.18±0.04	4.50±2.12	8.60±1.13	3.57±1.68
Ageratum conyzoides (L.)	83.66±1.22	18.18±0.12	3.75±0.35	17.00±0.70	10.28±0.60
Flemingia strobilifera (L.) W.T. Aiton	37.33±0.37	23.22±0.02	13.50±2.12	10.80±0.56	17.34±0.96
Cissus quadrangularis (L.)	78.00.±0.09	22.16±0.02	6.00±1.41	14.00±0.28	15.56±0.84
LSD (P<0.05)	6.07	1.37	19.95	1.90	4.80
F value	253.15**	422.7**	5.42*	1262**	13.3*

tion on phytochemicals present in selected plants used by Paraja tribe of Koraput and their traditional medicinal inportance. Phytochemical analysis of these plants revealed that some plants are promising sources of several chemical constituents like phenols, flavonoids, alkaloids and tanin in varying proportions and possess therapeutic substances. The plants are also containing significant amounts of antioxidants that can be exploited as a potential source for herbal remedy for various diseases. Thus public awareness and community based programmes need to be encouraged at all levels for *ex situ* and *in situ* conservation of such species and will further use in exploration of new drugs for pharmaceutical industries. It is also suggested that further work should be carried out to elucidate the possible mechanism of action of these extracts against different diseases.

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References

Chang, C.C., Yang, M. Y. and Wen, H. M., 2002. Estima-

tion of total flavonoid content in propolis by two complementary colorimetric methods. *Journal of Food Drug Analysis*. 10 : 178-182.

Das, P.K. and Mishra, M.K. 1987. Some medicinal plants used by the tribal's of Deomali and adjacent Areas of Koraput District, Orissa, India. *Journal of Forestry*. 10 : 301-303.

Farnsworth, N.R., Akerele, O., Bingle, A.S., Soejarto, D.D. and Guo, Z. 1985. Medicinal plants in therapy. *Bulletin of the World Health Organization*. 63 : 965 -981.

Friedmen, J., Yaniv, Z., Dafni, A. and Palewitch, D. 1986. A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethno-pharmacological field survey among Bedouins in the Negev desert, Israel. *Journal of Ethnopharmacology*. 16 : 275-287.

Harborne, J.B. 1973. Phytochemical Methods Chapman and Hall Ltd., London: U.K., 49- 88.

Ishtiaq, M., He, Q., Xiao, P.G. and Cheng, Y.Y. 2007. Clematis huchouensis Tamura. A Traditional Chinese herbal medicine and its quality control using a high performance liquid chromatography technique. *Biology Pharmacy Bulletin*: 30(1) : 165-168.

Mann, A., Banso, A. and Clifford, L.C. 2008. An antifungal property of crude plant extracts from *Anogeissus leiocarpus* and *Terminalia avicennioides* Tanzania. *Journal of Health*. 10(1) : 34-38.

Mishra, S. and Chaudhury, S.S. 2012. Ethnobotanical flora used by four major tribes of Koraput, Odisha, India: *Genetic Resources and Crop Evolution*. 59 : 793–804.

Ncube, N.S., Afolayan, A.J. and Okah, A.I. 2008. Assessment techniques of antimicrobial properties of natural compounds of plant origin, current methods and future trends. *African Journal of Biotechnology*. 7 (12): 1797-1806.

Phillips, O., Gentry, A.H., Reynel, C., Wilkin, P. and Galvez-Durand, B.C. 1994. Quantitative ethnobotany and Amazonian conservation. *Conservation Biology*. 8 : 225-248.

Praveen, N., Nayak, S., Kar, D.M. and Das, P. 2010. Pharmacological evaluation of ethanolic extracts of the plant *Alternanthera sessilis* against temperature regulation. *Journal of Pharmacology*. 3(6) : 1381-1383.

Prieto, P., Pineda, M. and Anguilar, M. 1999. Spectrophotometric quantisation of antioxidant capacity through the formation of a phospho-molybdenum complex specific application to the determination of Vitamin E. *Analytical Biochemistry*. 269 : 337-341.

Raut, S., Raut, S., Sen, S.K., Satpathy, S. and Pattnaik, D., 2012. An ethnobotanical survery of medicinal plants in Semiliguda of Koraput district, Odisha, India. *International Journal of Botanical Research*. 5(4) : 97-107.

Sadasivam, S. and Manickam, A. 2007. Biochemical Methods. New Age International (P) Limited. *Biochemistry*. 284.

Saxena, H.O. and Brahmam, M. 1994-1996. The flora of Orissa, Orissa Forest Development Corporation Ltd. and Regional Research Laboratory, Bhubaneswar, India.