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ORIGINAL ARTICLE

Traditional Applications and Phytochemical Investigation of *Andrographis paniculata* from Four Districts of Chhattisgarh, India

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ABSTRACT
Andrographis paniculata is an herbaceous plant in the family Acanthaceae and is popularly known as Kalmegh. In Chhattisgarh state, the plant is being used widely by traditional healers for treatment of different ailments, viz., cough, cold, jaundice, mental distress, diabetes etc. In the present study a database was prepared for wide application of the plant by the traditional healers of four tribal districts (Durg, Kanker, Bastar and Dantewada) of Chhattisgarh state on the basis of their experience. In the next step, major biochemical ingredients of the plant were investigated and a co-relative study of its therapeutic significance was carried out. We found Cardiac glycoside, Terpanoid, Steroid, Saponin, Tannin, Flavonoid & Alkaloid from various parts of plant in different solvents. A TLC chromatogram for different phytocompounds was also prepared. Maximum 10 bands were obtained in the methanolic extract of stem with RF values ranging from 0.07 to 0.93 and minimum of only 1 band was obtained in the aqueous extract of the root part. Based on our study we concluded the presence of a variety of active ingredients responsible for therapeutic significance of the medicinally important A paniculata. The result provides scientific validation of A paniculata for the medicinal use by traditional healers.
Key words *– A paniculata, Traditional healers, Database, Biochemical tests, TLC profiling, Chromatogram.*

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INTRODUCTION

Andrographis paniculata (Burm. F.) Wall. Ex Nees (AP) (Fig.1) belongs to the *Acanthaceae* family of the *Andrograhis* genus [1,2,3]. This genus is made up of 28 species, with *Andrographis paniculata*, or the King of Bitters, it has a similar strong bitter taste as that of *Azadirachta indica. Andrographis paniculata* grows erect to a height of 30–110 cm in moist, shady places, branches sharply quadrangular winged in the upper parts. The slender stem is dark green, squared in cross-section with longitudinal furrows and wings along the angles. The lance-shaped leaves have hairless blades measuring up to 8cm long by 2.5cm wide. The small flowers are borne in spreading racemes, they are solitary distant, in axillary of terminal in positions. Seeds are very small, sub-quadrate [4,5,6,7,8]. *A. paniculata* is native to India, China and Sri Lanka. It is widely cultivated in southern Asia, where it is used to treat infections and some diseases, often being used before antibiotics were created. The plant is found in tropical India from Himachal Pradesh to Assam and Mizoram, and all over South India and in the dry districts of Maharashtra, Rajasthan and Tamil Nadu. *A. paniculata* is also well distributed in other tropical Asian countries, often in isolated patches. It can be found in a variety of habitats, such as plains, hillsides, coastlines, roadsides, farms, and wastelands. The plant is known by many vernacular names like, in north-eastern India it is known as 'Maha-tita', literally 'king of bitters'. As an Ayurveda herb it is known as *Kalmegh* or *Kalamegha*, meaning "dark cloud". It is also known as *Bhui-neem*, meaning "neem of the ground", since the plant, though being a small annual

herb. In Malaysia, it is known as *Hempedu Bumi*, which literally means 'bile of earth' since it is one of the bitterest plants that are used in traditional medicine.

The WHO has also taken in note that plant is being widely used in Asia for cure of gastrointestinal tract, upper respiratory infections, fever, herpes, throat soar, diarrhea, liver disorders, inflammation and various other infectious chronic diseases [9]. According to the Indian Pharmacopoeia, it is a predominant constituent of at least 26 Ayurvedic formulations. According to the traditional Chinese system of Medicine, *Andrographis* is considered to possess an important "cold property" which is useful in the lowering and removal of heat of the body in fevers, and also to remove toxins from the body. In Scandinavian countries, it is used to treat common colds [10]. According to Ayurveda the plant has bitter, acrid, cooling, laxative, vulnerary, antipyretic, anti-inflammatory, anthelmintic, digestive properties and useful in burning sensation, wounds, ulcers, chronic fever, malarial and intermittent fevers, inflammations, cough, bronchitis, skin diseases, colic, diarrhoea, dysentery, haemorrhoids etc.[11]. In the Unani system of medicine, it is regarded as aperient, anti-inflammatory, emollient, astringent, diuretic, emmenagogue, gastric and liver tonic, carminative, antihelmintic, and antipyretic. Since it has blood purifying property, therefore it is used in cases of leprosy, gonorrhea, scabies, boils, skin eruptions, and chronic and seasonal fevers [12]. Fresh Juice of leaves or an infusion of this plant is given to infants for relieving griping, irregular bowel syndrome and appetite loss [13,14, 15], leaves and root are also traditionally used in general debility, during convalescence after fevers, dyspepsia associated with gaseous distension, and in severe dysentery [14, 15], and also for the treatment of pharyngolaryngitis, diarrhea, dysentery, cough, carbuncle, sores, epidemic encephalitis B, suppurative otitis media, neonatal subcutaneous annular ulcer, vaginitis, cervical erosion, pelvic inflammation, herpes zoster, chicken pox, mumps, neurodermatitis, eczema, and burns [16].

Recent experimental finding indicated that of *A. paniculata* is having anti-typhoid, antifungal [17] and antibiotic properties [18]. It has been proved to be hepato-protective drug [19, 20, 21, 22]. The plant has also shown to possess hypoglycemic activity [23], cardiovascular activity [24], psychopharmacological activities [25], antihelminthic activity [26], anti-allergic activity [27], antiviral, choleretic, hypocholesterolemic, and adaptogenic effects [28].

The chief constituent of *A. paniculata* called andrographolide (a flavonoid) and its different forms are responsible for its diverse medicinal properties like liver protection under various experimental conditions of treatment with galactosamine [29]and paracetamol [30]. The hepatoprotective action of andrographolide is due to the activity of certain metabolic enzymes [31, 32, 33]. Andrographolide has been shown to be effective against certain cancers [34] and possess a strong anti-inflammatory activity [35]. Apart from this plant also possesses many diterpenoids which also contribute in its medicinal properties [2, 36].

Banking on such vast traditional use of *A paniculata* in the form of medicine, and reports from some local healers regarding its uses and benefits, we conducted a survey in four tribal districts of Chhattisgarh state for the traditional uses of the plant and also conducted a scientific evaluation for the presence of some active ingredients from the plant.

MATERIALS AND METHODS

In a scientific study of a Research Project (Isolation and Characterization of Biomolecules of Pharmaceutical, Nutritional and Cosmetic Importance from Native Plants of Chhattisgarh State) in sponsorship of Chhattisgarh State Medicinal Plants Board, Raipur, Ministry of Forest, Govt. of Chhattisgarh, India, within four tribal districts, i.e. Durg, Kanker, Bastar and Dantewada (Fig.2), we conducted s survey of application of different parts of *A. paniculata* by traditional healers. For scientific study all four districts were categorized into four zones -

District - Durg (Lat. 20°54′ to 21°32′ N and Long. 81° 10′ to 81°36′ E) -

Zone 1- Dondi (From Dondi, Kusumkasa, Balod to Gurur)

Zone 2- Durg (From Nankatti, Durg, Patan, Gunderdehi to Sikesa)

Zone 3- Saja (From Saja, Sardha, Berla to Dhamda)

Zone 4 – Nawagarh (From Nawagarh, Sambalpur, Bemetatra to Dotu)

District- Kanker (Lat. 20° 6′ to 20°24′ N and Long. 80°48′ to 81°48′ E) –

Zone 1- Kanker (Charama, Kanker, Bisrampuri to Jamgaon and Narharpur).

Zone 2- Antagarh (From Antagarh, Kolar, Bharenda to Kanagaon and Amabera).

Zone 3- Pakhanjur (From Kodapakha, Pratbpur, Pakhanjur to Bhondia and Parali)

Zone 4- Bhanupratappur (From Hatkondal, Barheli, Bhanupratappur, Bhiragaon and Karra).

District – Bastar (Lat. 19°10′ to 20° 55′ N and Long. 81° 39′ to 82°30′ E) –

Zone 1- Jagdalpur (From Kudragaon, Karkaner, Sivniguda and Jaitgiri to south of Jagdalpur).

Zone 2- Narayanpur (From Kanker border to Chhota Donger, Bemur and Banlapar)
Zone 3- Kondagaon (From Chota Dongar, Bemur, Lanjoda and Makri to Kudragaon, Karkaner, Sivniguda and Jaitgiri)
Zone 4- Keshkal (From Dhanora, Banskot in Kanker border to Banlapar Lanjoda and Makri).

District – Dantewada (Lat. 18°46 to 19° 28 N and Long. 80° 15 to 81° 58 E) –

Zone 1- Konta (From Dharinawaram, Chitalnar and Sukma to Gollapalli and Konta)
Zone 2- Dantewada (From Barsur, Gonda palli, Jagargonda Chitalnar and Sukma to north of Dantewada).
Zone 3- Bijapur (From Dobe, Lanka, Toynar, Sonkanpalli and Daur to Barsur, Gond palli, Jagargonda, Dharinawaram and Chitalnar)
Zone 4- Bhopalpatnam (Pasewada, Sundra and Kotturu to Dobe, Lanka, Toynar, Sonkanpalli and Daur)

After survey we found that *Andrographis paniculata* has been widely used in the treatment of many ailments, alone and in combination with many other medicinal plants or different ingredients. Based on claims of traditional healers, we further conducted survey for population of the area taking *A. paniculata* as a whole or in combination in different ailments.

Depending upon the claims of the local healer regarding the patients treated in last one year period of time (December 2010 to November 2011) the population that received the drug (containing *A paniculata* as an ingredient) were categorized into three groups i.e., people with Mild relief, with Partial or Moderate relief & with Good relief and were interviewed, supported by a set of questionnaire(period of suffering, duration of the treatment, any side effects, any other drugs or treatment received during the prescribed period, addictions if any, benefit etc.).

On the basis of such vast use of *Andrographis paniculata* by the Local Traditional Healers (LTH), from the selected geographical area of all the four districts plants were collected (Leaf, Stem and Root) for screening of the principal phytochemical groups, they are shade dried and powdered. Plant extracts were prepared through Soxhlet Extraction Method in four solvents with increasing polarity respectively, like petroleum ether, chloroform, methanol and distilled water (aqueous). Phytochemical investigation of each part was done to detect some principles from the extracts like steroid, terpanoid, cardiac glycoside, alkaloid, tannin, saponin and flavonoid, using standard protocols [37,38]. From the methanol and aqueous extracts of leaf, stem and roots thin layer chromatography (TLC) of all four extracts was performed using silica gel G (Merck, TCL Grade) and calcium oxide (6:1) coated glass plates (0.8mm thickness) as stationary phase (air dried TLC plates were incubated at 100ºC for 30min. for activation) and solvent system containing Toluene / Ethanol /Methanol: (80:20:1.5) as mobile phase [39]. Samples were loaded over the activated TLC plates with the help of applicator and allowed to run for 2 hours. The plates were then exposed in UV light to observe the migration pattern of bands and Retention factor (Rf value) of band were calculated using the formula,

Rf = Distance Travelled by substance/ Distance Travelled by solvent

RESULTS AND DISCUSSION

The outcome of the survey we had conducted in all zones of said four districts of Chhattisgarh state is summarized in Table-1. According to Table -1, *A. paniculata* is being widely used by the Local Traditional Healers but mainly in the treatment of Cough & Cold, Fever, Jaundice and Diabetes apart from other ailment treatments. The plant is generally used in combination with some other medicinal plants or their parts as a compound drug.

The results of phytochemical investigation have been summarized in Table-2. We investigated the presence of Cardiac glycosides in leaves (Aqueous, Methanolic and Chloroform extracts), stem (Methanolic and Aqueous extracts), and root parts (only Methanolic extract) of the plant. Saponin was found in all the four solvent extracts of all the three parts of the plant. Terpanoid was found in all the solvents of stem and in Aqueous, Methanolic & Chloroform extracts of Leaves and Root. Flavonoid was found only in leaf extracts of all the solvents and in petroleum ether solvent of the Root only. No Flavonoid was detected in the stem extract of any of the four solvents. Likewise Tannin (Aqueous, Methanolic & Chloroform extracts of Leaf; Aqueous extract of Stem and Methanolic & Chloroform extract of Root), Steroid (Aqueous & Methanolic extracts of Leaf and Stem & Petroleum Ether extract of Root) and Alkaloid (Aqueous & Chlroroform extracts of Leaf; Aqueous extract of Stem and Chloroform extract of Root) were also found in most of the parts in some of the solvents. In earlier study Steroids from *A paniculata* has not been reported from the aqueous extracts but in our study we observed the presence of it in aqueous extract of leaf and stem. On the other hand the presence of Alkaloid has not been previously reported [40] form any of the tested solvents but we observed the presence of Alkaloid in Aqueous (Leaf and Stem) and Chloroform (Leaf and Root) extracts.

Thin layer chromatographic study of all the four extracts revealed that the leaf extract in methanol gave 8 bands with RF value ranging from 0.19 to 0.84; the aqueous extract of leaf gave 6 bands with RF value ranging from 0.09 to 0.62; the chloroform extract of leaf gave 4 bands with RF value ranging from 0.6 to 0.81, whereas the petroleum ether extract of the same part didn't generated any phytochemical bands (Table-3; Fig.3A). The stem extract in methanol gave a maximum number of 10 bands with RF values ranging from 0.07 to 0.93; the aqueous extract of stem gave 5 bands with RF value ranging from 0.16 to 0.75; the chloroform extract of stem gave 3 bands with RF values ranging from 0.53 to 0.78, whereas the petroleum ether extract of the same part didn't have any bands at all (Table-4; Fig. 3B). The methanol extract of root part of the plant gave 8 bands RF values ranging from 0.05 to 0.9; the aqueous extract of the root part gave a minimum of only 1 band with RF value of 0.9; the chloroform extract of the same part gave 4 bands with RF value ranging from 0.03 to 0.75, whereas the petroleum ether extract of the same part of the plant gave only 2 phytochemical bands with RF values of 0.11 and 0.6 (Table-5; Fig. 3C).

Further in a previous study conducted on phytochemical study on the methanolic and petroleum ether extracts of *A. paniculata* whole plant material, the presence of Steroids, Flavonoids, Tannins, Diterpanoids but no presence of Alkaloids and Saponins or glycosides has been reported [41]. Whereas in our study we found the presence of Saponins in all the extracts; Alkaloids in Chloroform (leaf & root) and Aqueous extracts (leaf & stem); Cardiac glycosides in Chloroform (leaf part), Methanolic (all three parts) and Aqueous extracts (leaf & stem parts). However study of Das *et al.,* in [42] was in agreement of our study who reported the presence of all the seven phytochemical ingredients (Alkaloids, Saponins, Tannins, Cardiac glycosides, Steroids, Terpanoids and Flavonoids)) in the plant. Among the principal phyochemicals the Cardiac glycosides was reported to possess specific inhibitory activity on Na^+/K^+-ATPase [43] and depending on this property, Inada *et al.,* [44]; Pathak *et al.,* [45] and Johnson *et al.,* [46], reported the anti cancer and antitumor activity of these compounds along with their usefulness in the treatment of various heart conditions, such as atrial tachyarrhythmias, and in producing positive ionotropic effect in congestive heart failure [47].

Steroidal compounds are important and of interest in pharmaceuticals due to their relationship with such compounds as sex hormones [48]. Steroids have also been reported to possess Cholesterol lowering property [49]. We found that traditional healers are using *A. paniculata* for relief in heart trouble and blood pressure control which might be due to the Cardiac glycoside and steroidal compounds present in the plant, which we have identified in our phytochemical analysis also. This is an indicative of its effectiveness in treatment of heart disease.

Flavonoids are known for their anti-bacterial (especially for *Mycobacterium tuberculosis*), anti-fungal, and antioxidant activity [50, 51, 52, 53, 54]. In our study we found that *A. paniculata* is being used by many local traditional healers in the treatment of bacterial infections especially tuberculosis and the fact that flavonoid is present as one of the phyto-ingredient of the plant in our phytochemical analysis, shows that it might be a key factor in the treatment of the disease.

Alkaloids are reported to possess antiarrhythmic, anti-cough, stimulant, antipyretic, antimalarial, antitumor, antiarrhythmic, muscle relaxant, acetylcholine esterase inhibitory [55, 56] activity. In our survey we also found that the population is getting relief in cough, cold and fever by A. paniculata in one hand and on the other hand we also found Alkaloid in our phytochemical study.

Tannins are important for their astringent properties. They are known to promote rapid healing and the formation of new tissues on wounds and inflamed mucosa. They are used in the treatment of varicose ulcers, hemorrhoids, minor burns, frostbite as well as inflammation of gums. Internally tannins are administered in cases of diarrhea, intestinal catarrh and in cases of heavy metal poisoning as an antidote. Recently, Tannins have proved their antiviral activities [57]. Tannins have been reported to possess high antioxidant [58], free radical scavenging [59], antimicrobial [60], gastro-protective, and anti-ulcerogenic activities [61], they are also regarded as potent inhibitors of lipid peroxidation in heart mitochondria [62] and possess anti-fibrotic activity [63]. In our survey we found that the plant *A. paniculata* is popular among traditional healers especially for control of jaundice and diabetes. The action might be due to antiviral activities and antioxidant activities of tannin compound of the plant.

Saponins are high molecular weight glycosylated plant secondary metabolites, containing sugar moiety linked to a triterpene or steroid aglycone [64], with detergent like properties. Saponin containing plants are used as folk medicines, especially in Asia, and are intensively used in food, veterinary and medical industries [65]. Saponin-glycosides are very toxic to cold-blooded organisms, but not to mammals [65, 66]. Plant extracts containing a high percentage of saponins are commonly used in Africa to treat water supplies and wells contaminated with disease vectors [66]. Other therapeutic properties of saponins include anti-inflammatory [67], hypocholesterolemic [68] and immune-stimulating [69] activities. The

presence of saponin in *A. paniculata* might be effective factor against infectious cough, cold and fever among treated population.

Terpanoids group has been shown to exhibit significant pharmacological activities, such as anti-viral, anti-bacterial, anti-malarial, anti-inflammatory, inhibition of cholesterol synthesis and anti-cancer, ichthyotoxicity and anti-tumor, anti-inflammatory and antibacterial activities [70, 71, 72, 73, 74]. Apart from these different terpenoid molecules have antifungal, anti-parasitic, antiallergenic, antispasmodic, antihyperglycemic, chemotherapeutic, and immunomodulatory properties [75, 76,77,78,79]. Terpenoid is another important compound reported for *A. paniculata* which is very effective antihyperglycemic and immunomodulatory property beside antimicrobial property.

The feature of presence of alkaloid is a very good co-relative facts about application of *A. paniculata* by traditional healers for control of diabetes and infectious cough & cod. Its immunomodulatory property might be helpful for control of jaundice also.

In the present study the TLC profiling of all 4 extracts (Petroleum ether, Chloroform, Methanol and Aqueous) gives an impressive result indicating towards the presence of number of phytochemicals in *A paniculata* and may serve as characteristic fingerprint of *A. paniculata*, particularly for its leaf, stem and root part. The phytochemical analysis of all the four extracts of *A. paniculata* revealed the presence of Steroids, Terpanoids, Tannins, alkaloids, Saponins, flavonoids and cardiac glycosides.

Table -1: Medicinal Application of *A paniculata* by Some Local Traditional Healers (LTH) in four districts (Durg, Kanker, Bastar & Dantewada) of Chhattisgarh State, India for the period of Dec. 2010 to Nov. 2011.

District	Local Traditional Healers (LTH)	Village /Area	Ailment Treated	Parts of *A. paniculata* used for treatment	In Combination with	No. of Patients Treated/ Interviewed	No. of Patients with No Relief	No. of Patients with Partial or Moderate Relief	No. of Patients with Complete Relief
Durg	LTH-D1	Okhan/ Nawagarh	Gastric trouble	Leaves	*	23	-	9	14
	LTH-D2	Khursipar/ Bhilai/Durg	Paralysis	Whole plant	*Occimunm sanctum, Gymnema sylvestris* & *Trygonella foemum graecum*	06	02	04	-
	LTH-D3	Banbarad	Fever	Areal parts	*Bacopa monneri*	31	05	17	09
	LTH-D4	Karamal/ Sodh/ Belra/ Durg	Fever	Leaves	*	20	03	11	06
	LTH-D5	Pinkapar/ Gunderdehi	Cough & Cold	Leaves	*Achyranthus aspera*	20	03	06	11
	LTH-D6	Bhilai-3/ Patan/Durg	Skin diseases	Whole plant	*Tinospora cordifolia, Azadiracta indica, Terminalia chebula,Terminalia belerica and Aloe indica*	17	02	11	04
	LTH-D7	Muktnagar/ Durg	Diabetes	Leaves	*Gymnema sylvestris*	35	08	15	12
	LTH-D8	Barhi/ Gurur	Blood pressure	Whole plant	*Tinospora cordifolia &**	16	04	09	03
	LTH-D9	Sahgaon/ Balod	Jaundice	Areal parts	*Sacharum officinarum, Raphanus sativus & Flowers of Curcuma longa*	28	06	09	13
	LTH-D10	Sahgaon/ Balod	Asthma	Areal parts	*Gingiber officinalis, Curcuma longa & Piper nigrum*	12	03	07	02
	LTH-D11	Mangchua/ Balod	Obesity	Leaves	*Vitex nigundo* and *Azadiacta indica*	24	-	15	09
	LTH-D12	Markatola/ Balod	Weakness	Whole plant	*Chlorophytum borivilianum*	09	02	05	02
	LTH-D13	Hanoda/ Durg	Piles	Leaves	*Agel marmalose, Curcuma longa*	13	00	09	04
	LTH-D14	Atari/Patan/ Durg	General Disorders	Whole plant	*Occimum Sanctum, Agel marmalose, Tinospora cordifolia*	14	04	07	03
Kanker	LTH-K1	Jamgaon	Paralysis	Areal parts	*	07	03	04	00
	LTH-K2	Jesakarra/ Charama	Tuberculos	Leaves	*Vitex nigundo,*	09	02	06	01

			is		*Terminelia chebula, Terminalia belerica & Emblica officinalis*				
	LTH-K3	Koylibeda/ Pakhanjur	Fever	Areal parts	*Hemidesmus indicus*	24	05	07	12
	LTH-K4	Chichgaon/Bhanupratapur	Malaria	Leaves	*Phyllanthus amarsschum*	22	09	05	08
	LTH-K5	Bhanuprappur/ Bhanupratappur	Diabetes	Areal parts	*Asparagus resimose*	33	04	13	16
	LTH-K6	Kaspai	Cough & Cold	Leaves	*Eugenia jambolinia, Catharanthus roseus & Agel marmalos*	15	03	08	04
	LTH-K7	Hatkondal/ Durgkondal	Tuberculosis	Whole plant	*Terminelia chebula, Terminalia belerica & Emblica officinalis*	03	01	02	00
	LTH-K7		Mental Distress	Areal parts	*Tinospora cordifoilia*	08	00	03	05
Bastar	LTH-B1	Banskot/ Keshkal	Cough & Cold	Leaves	*	21	05	10	06
	LTH-B2	Dongar/ Keshkal	Jaundice	Whole plant	*	15	04	09	02
	LTH-B3	Rsajagaon/ Kondagaon	Bleeding	Whole plant	*Curcuma longa &Cow Milk*	03	00	03	00
	LTH-B4	Hatkoli/ Kondagaon	Dog Bite	Whole plant	*	05	01	01	03
	LTH-B4	Chote Dondar/ Antagarh	Back Pain	Areal parts	*	18	03	10	05
	LTH-B5	Chote Dondar/ Antagarh	Dental problems	Leaves	*Azdiracta indica & Accasia indica*	20	04	09	07
	LTH-B7	Koilybera/ Naraynpur	Epilepsy	Whole plant	*	03	01	02	00
	LTH-B8	Kanger Valley/ Jagdalpur	General Weakness	Areal parts	*	12	02	07	03
	LTH-B9	Chitrakote/Jagdalpur	Rheumatism	Leaves	*Withania somnifera,* *	14	04	08	02
	LTH-B10	Suklapara/ Jagdalpur	Malaria		*Gingiber officinalis & Allium cepa*	07	02	05	00
Dantewada	LTH-D1	Gumda/ Gidam	Eczema	Leaves	*	13	04	06	03
	LTH-D2	Nimed/ Bijapur	Mental Distress	Whole plant	*Asparagus resimose*	05	02	03	00
	LTH-D3	Bhopalpatnam	Leukhorea	Leaves	*Asparagus resimose, Curcuma longa & Fresh Curd*	07	02	03	02
	LTH-D4	Sukma	Heart Trouble	Whole plant	*Terminalia arjuna &**	11	04	07	00
	LTH-D5	Bacheli/ Kirandul	Psoriasis	Leaves	*	19	03	11	05
	LTH-D6	Burgam/ Sukma	Cold & Cough	Areal parts	*Withania somnifera, piper nigrum & Trachyspermum ammi*	26	06	08	12
	LTH-D7	Penta/ Dantewada	Gastric trouble	Areal parts	*Agel marmalos, Delbergia sissu, Azadiracta indica & Embelica officinalis*	20	03	07	10
	LTH-D7	Penta/ Dantewada	Parasitic infections	Leaves	*	09	01	05	03
	LTH-D8	Beri/ Konta	Obesity	Whole plant	*Withania somnifera & Vitex nigundo*	15	04	07	04

* = Not disclosed or some secret ingredient; + = Present - = Absent

Table 2: Showing presence of some Active Principle Groups in different parts of *Andrographis paniculata*

Plant Part	Steroid				Terpanoid				Cardiac Glycoside				Saponnin				Tannin				Alkaloid				Flavonoid			
	P	**C**	**M**	**A**	**P**	**C**	**M**	**A**	**P**	**C**	**M**	**A**	**P**	**C**	**M**	**A**	**P**	**C**	**M**	**A**	**P**	**C**	**M**	**A**	**P**	**C**	**M**	**A**
Leaf	-	-	+	+	-	+	+	+	-	+	+	+	+	+	+	+	-	+	+	+	-	+	-	+	+	+	+	+
Stem	-	-	+	+	+	+	+	+	-	-	+	+	+	+	+	+	-	-	-	+	-	-	-	+	-	-	-	-
Root	+	-	-	-	-	+	+	+	-	-	+	-	+	+	+	+	-	+	+	-	-	+	-	-	+	-	-	-

Note - P – Petroleum Ether, C – Chloroform, M- Methanol, A – Aqueous (Distilled Water)
+ = Present - = Absent

Table 3: TLC Retention Factor (Rf value) of Phyotochemicals of Leaf Extract

No. of Bands	Methanol Extract	Aqueous Extract	Chloroform Extract	Petroleum Ether Extract
1	0.19	0.09	0.6	-
2	0.31	0.15	0.63	-
3	0.4	0.25	0.69	-
4	0.5	0.34	0.81	-
5	0.53	0.5	-	-
6	0.63	0.62	-	-
7	0.68	-	-	-
8	0.84	-	-	-

Table 4: TLC Retention Factor (Rf value) of Phyotochemicals of Stem Extract

No. of Bands	Methanol Extract	Aqueous Extract	Chloroform Extract	Petroleum Ether Extract
1	0.07	0.16	0.53	-
2	0.17	0.52	0.6	-
3	0.28	0.58	0.78	-
4	0.37	0.71	-	-
5	0.5	0.75	-	-
6	0.63	-	-	-
7	0.7	-	-	-
8	0.83	-	-	-
9	0.89	-	-	-
10	0.93	-	-	-

Table 5: TLC Retention Factor (Rf value) of Phyotochemicals of Root Extract.

No. of Bands	Methanol Extract	Aqueous Extract	Chloroform Extract	Petroleum Ether Extract
1	0.05	0.9	0.03	0.11
2	0.08	-	0.19	0.6
3	0.22	-	0.59	-
4	0.4	-	0.75	-
5	0.51	-	-	-
6	0.63	-	-	-
7	0.71	-	-	-
8	0.9	-	-	-

Fig.1: Picture of *Andrographis paniculata*

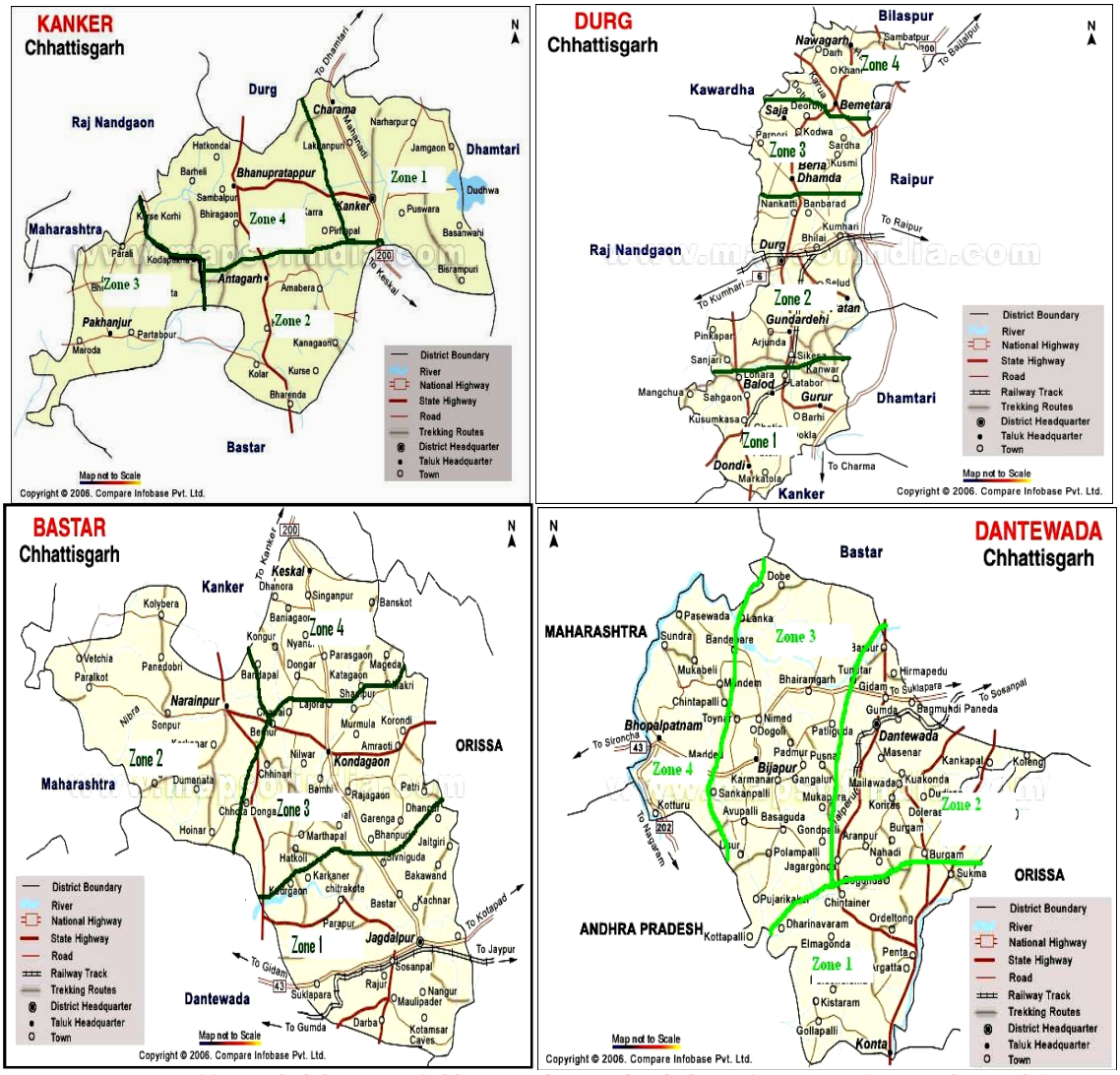
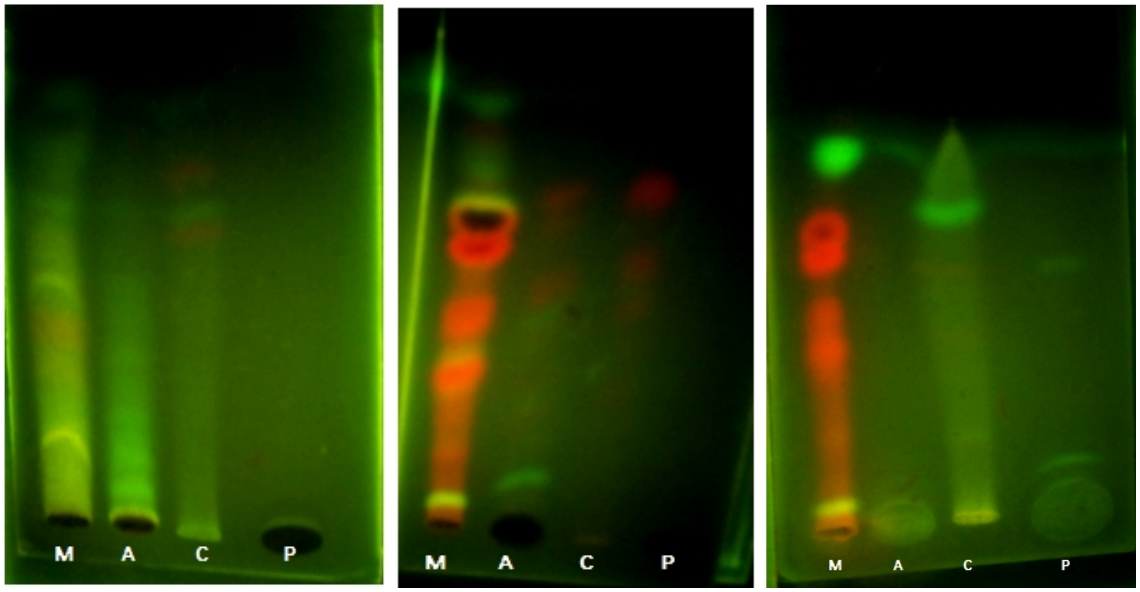


Fig.2: Maps of four tribal districts of Chhattisgarh State divided into four zones (Area under study).



(A) Leaf Extract (B) Stem Extract (C) Root Extract

Figure 3: TLC Chromatograms of Leaf, Stem and Root extracts of *Andrographis paniculata*.
M = Methanol extract; A = Aqueous extract; C = Chloroform extract
P= Petroleum Ether extract.

Thus from the above discussion we have tried to correlate the scientific studies conducted on principal phytochemical groups with the traditional medicinal uses of *A paniculata* that we observed in the four tribal districts of Chhattisgarh state. The present study has been carried out in an attempt to give a scientific recognition to the traditional knowledge specifically with respect to *Andrographis paniculata* by analyzing the efficacy of the drugs containing the plant material as one of the ingredient or plant parts alone. But our findings is based on survey for the claims of traditional healers, questionnaire based interview of the patients, phytochemical investigation based on biochemical tests of the principal phytochemical groups and thin layer chromatogram. But before recommendation, some further studies are also required, like qualitative and quantitative analysis of specific ingredients, specific identification of phytocompounds, and their mode of actions, metabolism, excretion, toxicity and side effect by clinical trials.

The plant has much potential evidenced by present study for pharmaceutical, industrial and commercial point of view.

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