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RESEARCH ARTICLE

PHYTOCHEMICAL ANALYSIS AND GC-MS STUDY OF *DIOSCOREA* (YAM) IN WAYANAD DISTRICT-KERALA STATE

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ABSTRACT

The present study deals with the identification, documentation, ethno-botanical exploration and Phytochemical analysis of *Dioscorea* species with respect to food value of wild edible plants from Northern parts of Kerala. *Dioscorea* – a genus of wild tuber crops is one of the major underground medicinal food sources among rural and tribal populace of Northern parts of Kerala. Eighteen species of *Dioscorea* are reported in Wayanad, Kannur and Kasaragod districts of Northern Kerala of which all except *Dioscorea alata* are wild while the latter is a cultivated one. The species are unique for their medicinal, food and economic values. The details in the terms of ethnobotanical values, bioactive compounds, pharmacological potentials, diversity in selected districts of Northern Kerala and their therapeutic uses in maintaining health care have been documented through field survey using passport data and from literature. The richness of these valuable tuber crops is declining due to various anthropogenic activities. Therefore, an attempt was made to document the therapeutic values, diversity and food potentials of these species. Most species contain different chemical compounds such as alkaloid, phenol, steroid etc. GC-MS analysis the selected species show the different components present in the methanolic extracts of *Dioscorea alata*. The implications of this study in terms of sustainable use of these tuber crops by the rural and tribal communities and their conservation have been discussed along highlights the medicinal potential of the *Dioscorea* species found in Northern Kerala.

KEY WORDS: *Dioscorea*, Ethnobotany, Biochemical Constituents, Gc-Ms, Northern Kerala

INTRODUCTION

Yam (*Dioscorea* spp) is an economically important food in many tropical countries particularly in West Africa and Caribbean, where it also has a social and cultural importance (Misra, 2009). By virtue of its excellent palatability, yam is a high value crop widespread throughout the world and forms about 10 % of the total roots and tubers produced in the world (FAO, 1993). The WHO reports that 80 % of the world's populations rely chiefly on traditional medicines. Plant extracts are valuable sources of natural products for maintaining human health. Since ancient times the aboriginals have been using plant parts against different diseases. In this modern era, synthetic drugs are being used extensively in an improper way thus creating a problem of increased resistance of pathogens against particulars drugs. It creates zero values of the particular allopathicagent and indicates the need of screening new plant or animal sources.

This screening is based on ethnobotanical survey followed by investigation of pharmacological activity and clinical trials. In the last few years a number of such studies have been conducted in Odisha with different plants and their extracts (Anilkumar *et al*., 2008; Narayanan *et al.*, 2013). The sources of ethnobotanical values are forests and their dwellers such as tribal and rural communities. They are the real treasure of this unexplored knowledge that transmits from generation to generation. The trifoliate yam, (*Dioscorea dumetorum* Pax), belongs to the family Dioscoreaceae and genus *Dioscorea* (Parekh, 2008).

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Dioscorea dumetorum originated in tropical Africa and occurs in both wild and cultivated forms but its cultivation is still restricted in West and Central Africa (Ayitey *et. al*, 1977). Root crops are not easily digested in their natural state and should be cooked before they are eaten. Cooking improves their digestibility, promotes palatability and improves their keeping quality as well as making the roots safer to eat. *Dioscorea dumetorum* has not been as widely studied as other species. There is need however to investigate on the components of this under-utilized specie of yam. This will be useful for potential uses of the tuber in the food industry, animal feed industry and cosmetic or pharmaceutical industry. Additionally, increased study on *Dioscorea dumetorum* could add to the likelihood of exploitation of the species as an economic plant and bring about further work on its cultivation. It is also important to verify if the phytochemical profile is affected during cooking, if so, to what extent. The objective of this work therefore is to identify, quantify and compare the nutritional and phytochemical composition of the raw and boiled tubers of *D. dumetorum*.

The study revealed the tribal groups have extensive knowledge regarding wild food and using a wide array of plants and animals with some variations amongst the different groups. There were 18 species of *Dioscorea*. Kattunaikka are well versed in the identification of Dioscorea in terms of its availability, habitat and associated plants. They are also adept at identifying the matured and sweet tuber ideal for consumption. The collected tuber is stored in the open, inside the huts. A wide range of methods is adopted for processing the tubers.

Two genera- Taro and *Dioscorea* contribute much of the diversity of wild tuber crops and serve as a 'life saving' plant group to marginal farming and forest dwelling communities, during periods of food scarcity. More than 25 wild plant species/types in Wayanad are known for edible roots, tubers and rhizomes and are eaten by the tribe and non-tribe communities of the district. Of these, 19 are species/varieties of *Dioscorea,* which is the main tuber plant known and used in this region. Balakrishnan *et al* (2005) reported collections of 10 species of *Dioscorea* and seven less well-known varieties of it from the southern part of Western Ghats. They reported several morphologically distinguishable forms in species such as *D. pentaphylla, D. wallichii,D. hamiltonii* and *D. belophylla.* Among the different species of *Dioscorea*, Nallanoora (*D. pentaphylla* var. *pentaphylla*) is the most commonly consumed tuber. Keeping this in mind, an attempt has been made for conservation of these plants in various tibal hamlets of Northen Kerala especially Wayanad District through documentation of their diversity and therapeutic medicinal values through field as well as literature survey.

The present study has been undertaken with the aim of recording Ethnobotanical documentation and phytochemical screening of selected taxa of the genus *Dioscorea.* The species included in the investigation are wild plants. A few of them are actually cultivated species which over the years escaped and became wild. The presence of vegetative reproducing structures – the bulbils - produced by these species, greatly helped them to go wild. This is supported by the fact that cultivated species and varieties which do not produce bulbils are usually not found in wild state.

MATERIALS AND METHODS

Ethnobotanical studies on *Dioscorea*

The ethnic diversity of the three districts of Northern Kerala (Wayanad, Kannur and Kasaragod) are very impressive as evidenced by ten different tribal groups. Among them, three dominant tribal groups are Mullu Kuruma or Kuruma, Paniya, Karimbalar and Kattunaikka. These are the communities which still hold knowledge on biodiversity. The Paniya constitutes the single largest scheduled tribe in Kerala and is mainly found in the Wayanad district and the neighbouring areas of Karnataka. They have a distinct language of their own, closely related to Malayalam. There is a theory that the Paniyas were brought to Wayanad by the Gounders who were landlords, and they trained them to be agricultural labourers in their fields (Thurston, 1909).

The community, almost entirely, depend on wage-labour in the paddy fields and farms of the land-owning classes for their interviews using unstructured questionnaire with open-ended questions and discussions were carried out either in gender specific groups or in mixed gender groups. The discussions were held in the local language – Malayalam. People who seemed comparatively more knowledgeable among the group were contacted individually and in-depth interviews were held with them. Separate transect walks in different landscapes were undertaken with men and women of three different tribal groups. The ethno botanical survey was conducted in the panchayats of three districts of Northern Kerala. Based on the total forest cover and tribal populations, the study areas can be considered as ethno-botanical hotspots of Western Ghat.

Plant specimens were collected and identified, and deposited in the herbarium of the Department of Botany, Sir Syed College, Taliparamba, Kannur

Phytochemical analysis

Preparation of extracts fresh selected fresh *Dioscorea* were collected for each plant and dried at room temperature in an aerated laboratory for three weeks. The dried materials were ground using a mill with 2 mm sieve attached to it to yield a fine powder. One hundred grams of each powder was weighed and macerated three times in 1000 mL of acetone for 48 hours. The mixture was filtered using Whatman filter paper No. 1 and the filtrate concentrated under reduced pressure by rotary centrifuge at appropriate temperature. Residual solvent was removed by drying in air at room temperature (23 25 °C) and the extract weighed and stored at -20 °C until used. An aliquot of each crude extract obtained was used for phytochemical tests while the remaining fraction was kept for further studies was dissolved in methanol and 2 mL of concentrated hydrochloric acid added. A spatula full of magnesium turnings was added and the mixture observed for effervescence.

Qualitative tests

The concentrated residues from the acetone extracts were used to detect the secondary plant metabolites including alkaloids, flavanoids, steroids, saponins, glycosides, phenolics and tannins using standard methods with some modifications (Trease, 1989; Christen, 2000; Young and Woodside, 2001; MacNee, 2005) A brick red colouration observed indicated the presence flavonoids.

Test for steroids

(Lieberman-Burchard test)

About one half gram (0.5 g) of the crude extract was dissolved in 0.5mL dichloromethane to give a dilute solution and then 0.5 mL of acetic anhydride added, followed by three drops of concentrated sulphuric acid. A blue-green colouration indicated the presence of steroids.

Test for saponins (Frothing test)

Saponins were tested by dissolving one half gram (0.5 g) of the crude extract in a testtube containing 3 mL of hot distilled water and then the mixture was shaken vigorously for one minute and persistent foaming observed indicated the presence of saponins.

Test for flavonoids (Cyanidine test)

One half gram (0.5 g) of the crude extract

Test for tannins (Ferric chloride test)

One half gram (0.5 g) of the crude extract was dissolved and added to a tube containing 20 mL of boiling distilled water and then boiled for an hour. A few drops of ferric chloride was added and allowed to stand for proper colour development. A blue-black colouration indicated the presence of tannins.

Test for Alkaloids (Dragendorf s test)

The sample was dissolved in dichloromethane and then spotted on a thin layer chromatographic plate which was developed in 20 % hexane in ethylacetate. The presence of alkaloids in the developed chromatogram was detected by spraying with freshly prepared Dragendorf s reagent in a fume chamber. A positive reaction on the chromatogram indicated by an orange or darker coloured spot against a yellow background is confirmatory evidence that the plant extract contained alkaloids.

Test for phenolics

To 1 mL of the plant extract, one drop of 5 % FeCl3 (w/v) was added. Formation of greenish precipitate indicated the presence of phenolics.

GC-MS Analysis GC-MS analysis of the methanol extract was performed using a Thermo GC –Trace ultra Ver: 5.0 system and Gas chromatograph interfaced to a Mass spectrometer (GC-MS)(Perkin-Elmer GC Clarus 500 system, R.D. Division, Sir Syed College, Taliparamba, Kannur) equipped with TR 5 – MS capillary standard non-polar column (30mmX0.25mm 1D X 1 µMdf). For GC-MS detection, an electron ionization system with ionizing energy oof 70 eV was used. Helium gas (99.999%) was used as the carrier gas at constant flow rate 1ml/min and an injection volume of 2µl was employed (split ratio of 10:1); Injector temperature 80°C; Ion-source temperature 250°C. The oven temperature was programmed from 110°C (isothermal for 2 min.), with an increase of 10°C/min, to 200°C, then 5°C/min to 250°C, ending with a 9min isothermal at 280°C. Mass spectra were taken at 70 eV; a scan interval of 0.5seconds and fragments from 45 to 450 Da. Total GC running time was 36.91 minutes. The components were identified based on comparison of their relative retention time and mass spectra with those of Wiley 7N Library data. The results were also confirmed by the comparison of the compounds elution and order with their relative retention indices on non-polar phases reported in the literature. The Name, Molecular weight and structure of the components of the test material was ascertained.

RESULTS AND DISCUSSION

Taxonomically it is a climber monocot, rarely erect, herbs or shrubs; rootstock tuberous or with a hard rhizome and tuberous roots. Leaves are opposite or alternate, sometimes both on the same plants (*Dioscorea alata* L.), simple, lobed or digitally 3-9 foliolate (*Dioscorea hispida a*nd *Dioscerea pentaphylla*), palminerved and reticulately veined; petiole often angular and twisted at the base. Flowers regular, small or minute, usually monoecious or dioeccious, rarely bisexual in spikes, racemes or panicles. Perianth tubular, urceolate or rotate, 6-cleft, often shortly connate below. Male flowers: stamens 3 or 6, or 3 perfect with 3 alternating staminodes inserted at the base of the perianth or on its lobes; anthers small, pistillate sometimes present. Female flowers: staminodes 6, 3 or 0, Ovary inferior, trimerous, usually 3 celled; ovules 2, superposed per cell; style-3, short; stigma entire or 2 – fid, recurved. Fruit berry or 3 valved capsule. Seeds flat or subglobose, winged or not (Haines, 1925; Saxena and Brahmam, 1995).

***Dioscorea*-as Wild Food**

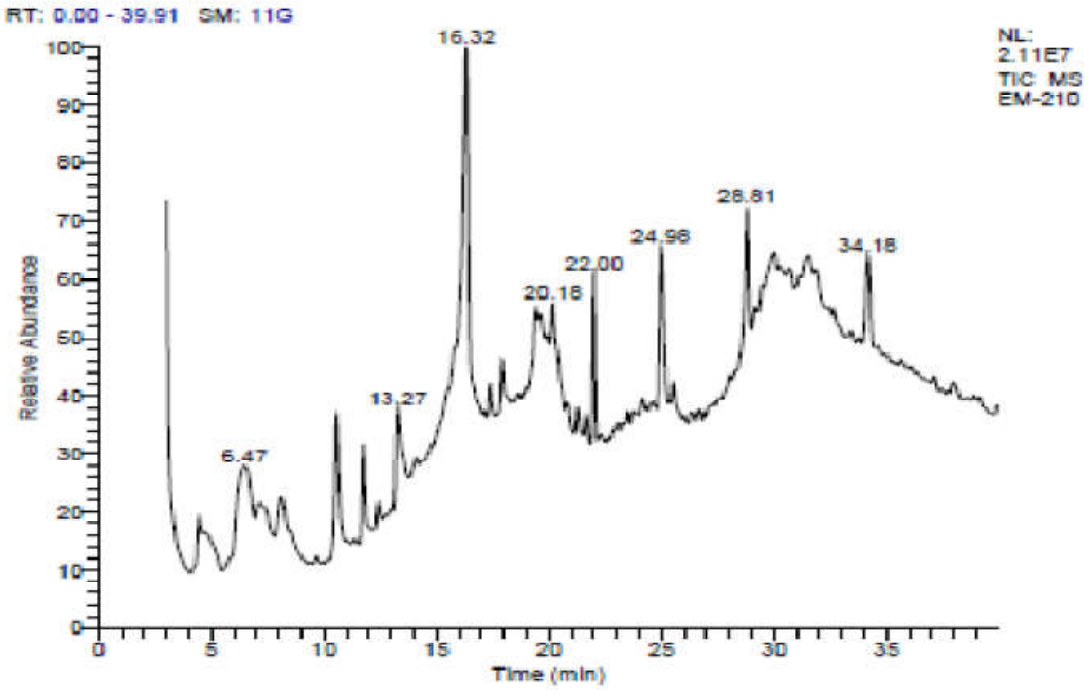
Edible tubers of 18 wild Verities of *Dioscorea* species are eaten by the tribal communities in various parts of Northern Kerala especially Wayanad district. These species are still a major source of food for forest-based communities like Kattunaikka and these serve as a 'life saving' plant group during periods of food scarcity. Kattunaikka call these tubers as Kalasu and they are knowledgeable about 18 taxa of *Dioscorea.* These communities who are dependent on wild *Dioscorea* for their food classify each member of this genus, based on characteristics like edibility, taste, colour, size, direction of growth, fiber content, cooking properties and occasionally the pattern of underground proliferation. Among the varieties known to them, *D. hamiltonii* (*Vennikalasu*), *D. belophylla* (*Hehkkukalasu*), *D. oppositifolia* (*Kavalakalasu*) are seen in interior evergreen and moist deciduous forests, and *Dioscorea wightii* (*Erakalasu*) in rocky grasslands. *D. pentaphylla* (*Noorakalasu*, *Nallanoora*), *D. wallichii (Narakalasu), D. bulbifera* (*Hendiridaekalasu*) are found among wayside-bushes and *D. pubera* (*Boojikavalakalasu*) in marshy areas. The Kattunaikkas collect *Dioscorea* tubers from almost all these places, but more frequently from the forests and other such unmanaged habitats. Among the different species of *Dioscorea*, *Dioscorea pentaphylla* (*Nallanoora*) is the most commonly consumed tuber. As the name indicates, '*nalla'* means safe or good to eat. The tuber is single, less fibrous and is smooth pasty when cooked and tastes good. This variety is common on the fringes of deciduous forests. *D. oppositifolia* (*Kavala*) is another very popular tuber among all the tribes of Wayanad. It is excellent in taste and is commonly found in moist forests on which the Kattunaikka community depends more.

Dioscorea tomentosa (*Salukalasu*) is not consumed regularly due to its high mucilaginous content, and is eaten only during times of acute famine. Communities other than Kattunaikka keep away from this tuber as it has peculiar kind of fibres that leave an itching sensation when consumed, particularly among children. The Paniya community use roots and tubers of 15 plant species as their food. As in the case of Kattunaikkas, tubers of *Dioscorea* species (*Kattukachil* or *Kattukizhangu*) form important source of their food. They consume tubers of 9 taxa of *Dioscorea*, the most preferred being *D. oppositifolia* (*Kavalakizhangu*) and *D. pentaphylla* (*Noorakizhangu*). They consider the *Noorakizhangu* and *Kavalakizhangu* to be rich in '*podi*' (starch) and '*kozhuppu*' (pulp) and the *D. wallichii* (*Narakizhangu*) to be rich in '*naru*' (fibre*). Noora* and *Kavala* do not need any detoxification or pretreatment efore cooking. Kuruma tribe has the knowledge of about 6 species/varieties including 3 wild species of *Dioscorea* yielding edible tubers. Fifteen to twenty years ago, men of these communities used to collect Kavala and Nooran, but now a days wild tubers do not flavour their diets. They consider it too tedious a job to search and dig out the tuber, being otherwise engaged. They grow *Dioscorea alata* in their home gardens and these are not too costly in the markets either. The collected tubers are stored inside the huts in the open. Almost all the roots and tubers require processing to make it palatable (Roy *et al*., 1998). A wide range of methods is adopted by *Kattunaikka* for processing the tubers. The tuber of *Dioscorea hispida* (*Kottunoora*) requires thorough processing before consumption.

Table 1. List of Various *Dioscorea* species available at various parts of Northern Kerla

Sl.No	Scientific Name	Local name used by Different Tribal communities in Northern Kerala			
		Kattunaikka	Paniya	Kuruma	Karimbalar
1	*Dioscorea belophylla*	Hekku		-	Kachil
2	*D. hamiltonii*	Kaluvenni	Bennykilangu	Vennangu	Kachil
3	*D. hispida*	Kottunoora	-		Kachil
4	*D. intermedia*	Shoddikalasu	-	Kachil	Kachil
5	*D. kalkapershadii*	Nara	-	Kachil	-
6	*D. oppositifolia*	Kavalakalasu	Kavalaikilangu	Kachil	Kachi
7	*D. pentaphylla*	Noorakorana	Noorankilangu	-	-
8	*D. pentaphylla* var. *communis*	Hendhikorana	-	-	Kachil
9	*D. pentaphylla* var. *linnaei*	Chenakorana	-	Kachil	Kachil
10	*D. pentaphylla* var. *rheedii*	Korana	Koranakilangu	Kachil	Kachil
11	*D. pubera*	Boojikavala	-	Kachil	Kachil
12	*D. tomentosa*	Salu	-		-
13	*D. wallichii*	Narra	Naraikilangu	Nara	-
14	*D. wightii*	Narramooyan	Mooyankilangu		Kachi
15	*Dioscorea* sp	Erekalasu			
16	*Dioscorea* sp	Moodavenni	Cholabenny	Kachil	Kachil
17	*Dioscorea* sp	Hekkuheruman		Kachil	Kachil
18	*Dioscorea* sp	Heruman	Naravayan	Kachil	Kachil

Name of the *Dioscorea* species	**Table 2. Phytochemical constituents of selected *Dioscorea* species (Legend: +Low concentration, ++ Moderate concentration, +++ High concentration, - Absent)**						
	Photochemical Screening						
	Steroids	Alkaloids	Phenolics	Tannins	Flavonoids	Saponins	Terpenoid
D. hamiltonii	+	+	-	-	+++	+	+
D. hispida	+	+	+++	+	+	+++	++
D. intermedia	-	+	-	+++	+++	+	-
D. pentaphylla var. *communis*	+++	+	-	-	+++	+	++
D. pentaphylla var. *linnaei*	+++	+++	+++	-	+	+++	++
D. pentaphylla var. *rheedii*	-	+	-	+++	+++	+	+++
D. pubera	+++	+	-		+++	+	+
D. wallichii	+++	+++	+++	+++	+	+	+
D. wightii	-	+	-	+++	+++	+	++



GC-MS chromatogram of the Methanolic extract of *Dioscorea alata*

Table 3. Compounds present in the ethanolic extract of *Dioscorea alata*

S.NO	RT	Name	Molecular Formula	Molecular Weight
1	4.45	Cyclohexanone	$C_6H_{10}O$	98
2	4.45	2-Hydroxy- cyclopenta-2,4-dienone	$C_5H_6O_2$	98
3	6.41	2,3-Dimethoxy-succinicacid dimethyl ester	$C_8H_{14}O_6$	206
4	6.41	5-Diethylsilanyloxy-4-ethyl-2 phenyl-3a,4,7,7a-tetrahydro-isoindole-1,3-dione	$C_{22}H_{31}NO3Si$	385
5	6.41	Triethyl-(3-methyl sulfanyl-1-vinyl-pent-1-enyloxy)-silane	$C_{14}H_{28}OSSi$	272
6	7.18	(2-Methyl-thiiranyl)-methanol	C_4H_8OS	104
7	7.18	2-tert-Butoxy-tetrahydro-furan	$C_8H_{16}O_2$	144
8	7.18	Cis-2-(7-octynyl)cyclohexanol	$C_{17}H_{32}OS$	280
9	8.10	4-tert-Butyl-[1,3,2]dioxathiolane 2-oxide	$C_6H_{12}O_3S$	164
10	8.10	(2-Acetoxy-1-methyl-vinyl)-methylidyne-ammonium	$C_6H_7NO_2$	125
11	8.10	Tetradecane	$C_{14}H_{30}$	198
12	10.54	Cyclohepta-2,4,6-trienecarboxylic acid ethyl ester	$C_{10}H_{12}O_2$	164
13	10.54	Benzyl-butyl-amine	$C_{11}H_{17}N$	173
14	11.74	1-Ethoxymethyl-4-methyl-benzene	$C_{10}H_{14}O$	150
15	11.74	1-(4-Methoxy-cyclohexyl)-hex-5-en-1-one	$C_{13}H_{16}O_2$	204
16	11.74	9-(4-Methoxy-phenyl)-9-oxo-nonanoic acid methyl ester	$C_{17}H_{24}O_4$	292
17	12.42	2,6-Dimethoxy phenol	$C_8H_{10}O_3$	154
18	12.42	2- Methoxy-3-methyl-benzene-1,4-diol	$C_8H_{10}O_3$	154.766
19	12.42	2,4-Dimethoxy phenol	$C_8H_{10}O_3$	154
20	13.27	2-tert-Butyl-1,2-dimethyl-cyclopropane,carboxylic acid methyl ester	$C_{11}H_{20}O_2$	184
21	13.27	1,1,2,2-tetramethyl-3-oxo-octahydro-4-oxa-cyclobuta(α)naphthalene-2a-carbonitrile	$C_{16}H_{17}NO_2$	255
22	13.27	C-[2,2-Dimethyl-3-(2-methyl-propenyl)-1-phenylsulfanyl-cyclopropyl]-methylamine	$C_{16}H_{23}NS$	261
23	16.10	2-Phenoxysulfonyl-acetimidic acid methyl ester	$C_9H_{11}NO_4S$	229
24	16.32	2-Phenoxysulfonyl-acetimidic acid methyl ester, hydrochloride	$C_9H_{12}ClNO_4S$	265
25	16.32	3, 6, 10-Trimethyl-8,11-dihydro-7H-cyclodeca[b]furan-4-one.	$C_{15}H_{18}O_2$	230
26	16.32	1-Benzyl-4-tert-butyl-4,5-dihydro-1H[1,2,3,4,5]-thiatetrazoborole	$C_{12}H_{19}BN_4$	230
27	16.32	4-Ethoxymethylene-7,7-dimethyl-bicyclo[3.2.0] hept-2-en-6-one	$C_{12}H_{16}O_2$	192
28	17.36	2-(2-Nitroallyl)-cyclohexanone	$C_9H_{13}NO_3$	183
29	17.36	1,4,7,10,10-Pentamethyl-2,4,6,8,9-pentaaza-tricyclo[5.2.1.$0^{2,6}$]dec-8-ene-3,5-dione	$C_{10}H_{15}N_5O_2$	237
30	17.36	2,3,3,4,7 Pentamethyl 1,5,7 triaza tricyclo[3.3.0.$0^{2,4}$]octane-6,8-dione	$C_{10}H_{15}N_3O_2$	209
31	17.91	6-Chloro-3,4,4a,5,6,8a-hexahydro-2H-chromene	$C_9H_{13}ClO$	172

Continue……

32	17.91	5-(1-chloro-1-methyl-ethyl)-3,5-dimethyl-cyclopent-2-enone	$C_{10}H_{15}ClO$	186
33	17.91	7a-(2-Methoxy-ethyl)-1-methyl-1,2,3,6,7,7a-hexahydro-inden-5-one	$C_{13}H_{20}O_2$	208
34	17.91	3-3-(Methoxy-phenyl)-2-methyl-oxetan-3-ol	$C_{11}H_{14}O_3$	194
35	19.41	2-Benzyloxy-7-(tetrahydro-pyran-2-yloxy)-heptan-1-ol	$C_{19}H_{28}O_4$	320
36	19.41	(1-Acetyl-5-formyl-6-methyl-cyclohexa-2,4-dienyl)-acetic acid ethyl ester	$C_{14}H_{18}O_4$	250
37	19.41	3-Phenyl-1-(toluene-4-sulfonyl)-pyrrolidine-2,5-dicarboxylic acid 2- benzyl ester 5-tert-butyl ester	$C_{30}H_{33}NO_7S$	551
38	20.18	Cyclopropyl-oxo-acetic acid methyl ester	$C_6H_8O_3$	128
39	20.84	2-Allyl-5a-hydroxy-octahydro-5-oxa-2-aza-cyclopenta[c]inden-1-one	$C_{13}H_{19}NO_3$	237
40	21.26	Cyclohexylmethyl-diethyl-methoxy-silane	$C_{12}H_{20}OS$	208
41	21.26	2,2-Dimethoxy-4a,5,6,7,8,8a-hexahydro-2H-benzo[e][1,2]oxasilane	$C_{10}H_{20}O_3Si$	208
42	21.26	2,2-Dimethoxy-2H-benzo[e][1,2]oxasilane	$C_{10}H_{12}O_3Si$	208
43	21.26	4-(3,4-Dimethoxy-phenyl)-butan-1-ol	$C_{12}H_{16}O_3$	208
44	24.16	1,1-Diethoxy-2-methyl-propane	$C_8H_{18}O_2$	146
45	24.16	2,4'-Dimethyl-[2,4']bi[[1,3]dioxanyl]	$C_{10}H_{18}O_4$	202
46	24.16	2-Methyl-3,3-bis-(2-trimethylsilane-ethoxy)-propionic acid methyl ester	$C_{15}H_{34}O_4Si_2$	334
47	29.94	2-Methoxyimino-4-methyl-pentanoic acid benzyl ester	$C_{14}H_{19}NO_3$	249
48	29.94	2-(Benzyl-{2-[(dimethyl carbamoyl-phenyl-methylene)-hydrazino]-ethyl}-hydrazono)-N,N-dimethyl-2-phenyl-acetamide	$C_{36}H_{40}N_6O_2$	588
49	29.94	3-Methylene-1-oxa-spiro[3,6]decane	$C_{10}H_{16}O$	152

The chopped tubers are wrapped in a white cloth and kept in running water in the streams for over 24 th before being cooked. This species is considered toxic and except Kattunaikka none of the other communities consume it. After the tuber is dug out, the apical portion of it, along with the stem (vine) is put back in the pit and filled with soil up to three-fourth levels for regeneration. Another piece is placed in a small pit close by to confuse the wild boars, which are in constant competition with the tribals for wild tubers.After performing the analysis of bioactive compounds of the studied medicinal plants extracts, results obtained are as shown in Table 2. The phytochemicals, steroids, alkaloids, phenolics, Cardiac glycosides, tannins, saponins, flavonoids, were detected as present in the medicinal plants in different proportions and classes. The results from the phytochemical screening of the studied medicinal plants extracts have shown that flavonoids are found in eighteen of the twenty plants, with *D. hamiltonii, D. pentaphylla* var. *communis, D. pentaphylla* var. *communis, D. pentaphylla* var. *rheedii* and *D. pubera* Extracts being very rich in these compounds. Steroids are found in most of the plant extracts, except for those obtained from *D. wightii*. In contrast, the extract from *D. intermedia* and *D. wallichii* were very rich in steroids. The highest contents of alkaloids were found in *D. pentaphylla* var. *communis* followed *D. wallichii* while seventeen plant extracts did not contain this type of compounds. Saponins were present in six studied plants, with *D. wightii* habouring the highest content. *D. intermedia* and *D. hamiltonii,* are moderately rich in tannins. Phenolics are present in great quantities in *D. pentaphylla* var. *rheedii* and *D. hamiltonii and D. pentaphylla* var. *communis*. Analyzing the results further, it can be observed that the studied medicinal plants containing the largest number of bioactive compounds were *D. pentaphylla* var. *communis*, and *D. wightii* while *D. intermedia* registered the lowest presence of phytochemicals (Singh, 1994; Nisha and Sivadasan, 2007; Shanavaskhan, 2011; Rgaraci, 2012; Stalin,

2012; Vishnupay, 2012). The studied bioactive compounds have a broad range of biological activities. For example, phytochemicals such as saponins have anti-inflammatory effects (Hema *et al*., 2006 and Harmayani, 2011), hemolytic activity, and cholesterol binding properties (Nyarko and Addy, 1990). Glycosides are known to lower blood pressure (Hertog *et al*., 1993 and Ika *et al*., 2012.) and tannins exhibit antioxidant, antimicrobial and antiviral effects (Ivanora *et al*., 2005; Jana and Res, 2012)). The plant extracts were also revealed to contain steroids, which are known to produce an inhibitory effect on inflammation (Luiz, 1962 and Janah,1994)) and alkaloids that have been reported to exert analgesic, antispasmodic and antibacterial activities (Mathew and Sasikumar,2007 and Alfarhan, 2010)). The phytochemical screening results of the extracts are consistent with the results reported by (Mathew and Unnikrishnan, 1992), where authors mentioned the presence of tannins, alkaloids, saponin and terpenoids in screened medicinal plants. Phenolic acids are the most commonly occurring natural products noted for allelopathic activities (Mini and Sivadhi, 2007). Muojab *et al*., (2003) have also included alkaloids, coumarin, flavonoids, saponnins and volatile constituents of the essential oils as being allelopathic agents. Generally, the presence of different phytochemicals in crude plant extracts has been linked to the detrimental effects of leachates, root exudates or decomposing residues of such plants on the other vegetation or succeeding crops (Nair 1911 and Muralidharan, 1997) . It is difficult to compare the data with the literature because several variables influence the results. According to some authors, the quantity and the composition of bioactive compounds present in plants are influenced by the genotype, extraction procedure, geographic and climatic conditions, and the growth phase of the plants (Narayanan *et al*., 2007, 2010). Plant cells produce two types of metabolites. Primary metabolites are involved directly in growth and metabolism (carbohydrates, lipids and proteins).

Conclusion

The present study shows that the tribal communities of Northern Kerala possess great knowledge about the wild food especially the *Dioscorea* and from the studies around eighteen different cultivars of *Dioscorea* has been explored. Also ethno medicinal uses of 18 species of *Dioscorea* have been documented for their therapeutic properties for curing various ailments such as cough, cold, stomach ache, leprosy, burns, fungal diseases, skin diseases, contraceptive, dysentery, arthritis, rheumatism, etc and among these species *Dioscorea alata, D. pentaphylla,* and *D. bulbifera* showed the maximum medicinal properties. *D. deltoidea* is quite exceptional because extract of its tubers is mostly used as a detergent to wash clothes and as an insecticide. Moreover the GC-MS analysis clearly shows the different chemical compounds present in the methanolic extracts of *Dioscorea alata*. The consumsption of wild food plants has been and still is being underestimated, and research, particularly concerning the socio-economic, cultural, traditional, and nutritional aspects of wild-food plants still lacks adequate attention.

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