

Analysis of nutrient composition and phytochemicals of wild yams *Dioscorea pentaphylla* L. and *Dioscorea oppositifolia* Griseb.

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Abstract. Yam is common name for the genus *Dioscorea* and considered as good sources of essential dietary nutrients. It has nutritional superiority over the tropical root crops. Understanding the nutritional values of yams, the nutrient contents of two yams, *Dioscorea pentaphylla* and *Dioscorea oppositifolia* have been analysed in the present study. During the study, the higher amount of moisture, crude protein, nitrogen, free sugars and buffer protein were estimated and analysed. The rich carbohydrate and calorific value, higher amount of fat and amino acids were observed in *D. pentaphylla* as compared to *D. oppositifolia*. The crude fiber and ash contents were comparatively higher in *D. oppositifolia*. Preliminary phytochemical analysis reveals the presence of alkaloids, flavonoids, glycosides, phenol, reducing sugars, saponins, steroids, tannins and triterpinoids in methanolic extract of both tubers.

Keywords: Buffer protein; Carbohydrate; Moisture; Nutrients; Phytochemical.

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Introduction

India has a rich culture of medicinal herbs which includes about 8,000 species of known medicinal plants and about more than 2,000 species and has a vast geographical area with high potential abilities for Ayurvedic, Unani, and Siddha medicines but only very few have been studied chemically and pharmacologically for their potential medicinal values (Guptha et al., 2005). It is one of the countries with largest tribal populations. The forest plays a vital role

in the economy as well as daily needs of the tribal communities. In time of scarcity when staple food is in short of supply, they collect wild roots and tubers to supplement their meagre food availability at home (Vidyardhi, 1987). Yams are edible tubers of various species of the genus *Dioscorea*. They are important staple food in many tropical countries (Kouakou et al., 2010).

Yams have been suggested to have nutritional superiority than tropical root crops. Tubers are good sources of essential dietary nutrients (Baquar and

Oke 1976). The tubers are found with a high amount of protein, a good proportion of essential amino acids and fairly a good source of many dietary minerals. However, its wider utilization is limited due to the presence of some toxic and anti nutritional factors. In India, cooked tubers are known to be consumed by the Palliyars and Kanikkars Tribes living in South-Eastern slopes of Western Ghats, Tamil Nadu (Shanthakumari et al., 2008).

Dioscorea pentaphylla L. (five leaf yam) is a twining shrub and its mature tuber mainly composed of starch (75%-84% of the dry weight) with small amounts of proteins, lipids and mostly vitamins with high mineral content (Finar, 2003). Moreover its tuber extracts can reduce blood sugar and blood lipid contents (Sadasivam and Manickam, 1996). The active components of *Dioscorea* species include steroidal sapogenin, glycan and storage protein. Diosgenin is a natural steroidal sapogenin extracted from *Dioscorea* species, used as a precursor in the industrial synthesis of steroids (Boussaada et al., 2008).

D. oppositifolia Griseb. (Chinese yam) is rich in nutrients including proteins (3.5% -8.93%) amino acids (2.31% -7.26%) starch (43.7%) sugars (3.39%) vitamins and amylases, among other species of *Dioscorea* (Nie et al., 1993). In addition, numerous active constituents such as allantoin which promotes wound healing, speeds up cell regeneration and exhibit a keratolytic effect. It is also popular edible and medicinal plant that promotes health and longevity (Yang and Lin, 2008). Hence, in the present study, an attempt has been made to analyze the nutrient composition and phytochemicals of two wild yams.

Materials and methods

The application of biotechnological principles for the establishment of Nutritive,

phytochemical analysis of *D. pentaphylla* and *D. oppositifolia* have been studied by following methods as given below.

Source of plants materials

The tubers of *D. pentaphylla* and *D. oppositifolia* were collected from Matheswaran hills Mysuru district, Karnataka, India. (Figure 1)

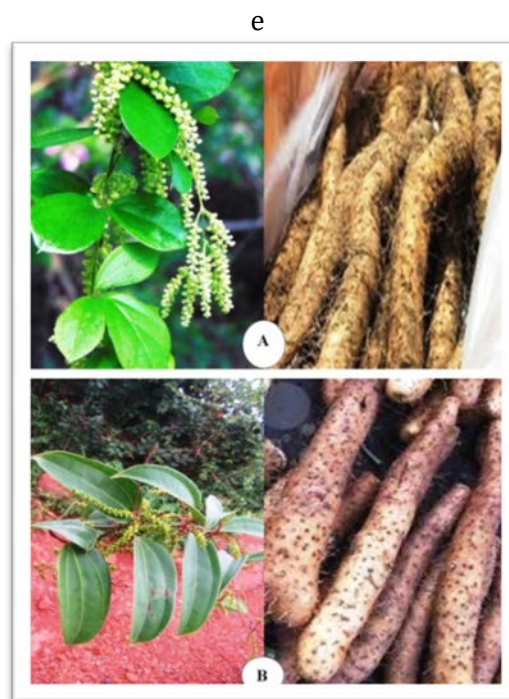


Figure 1. Habit and Tubers of *D. pentaphylla* (A) and *D. oppositifolia* (B).

Sample preparation

The sun dried tubers were powdered separately in a Willey Mill to 60 mesh size. This was used for nutritive and phytochemical analysis.

Nutritive analysis

The moisture content of the tubers was estimated by weighing air dried tuber powder, before and after incubation in hot air oven at 80 °C for 24 h followed by cooling desiccators. The average loss in weight of the samples was calculated and expressed as

moisture percentage. Nitrogen content was determined by microkjeldhal method (Humphries, 1956). The crude protein content was calculated by multiplying the percent nitrogen content of the sample with the factor 6.25. The crude lipid, crude fiber and ash were estimated by (AOAC) method (AOAC 1970). The nitrogen free extractive (NFE) or crude carbohydrate was calculated by difference $NFE = 100 - \% \text{ crude protein} - \% \text{ of crude lipid} - \% \text{ of crude fiber} - \% \text{ of ash}$ (Mullor and Tobin 1980). The calorific value was determined by multiplying the percentages of crude protein crude fiber, carbohydrates with the factors 4, 9, and 4 respectively. Amino acid, free sugars and buffer soluble proteins were determined (Basha et al., 1976).

Preliminary phytochemical screening

20 g of powdered was successively extracted in 100 mL of methanol using the Soxhlet extractor for 8-10 h (Gafner, 1998). The extract was filtered through Whatmann No.1 filter paper to remove all undissolved matter including cellular materials and other constitutions that are insoluble in the extraction solvent. The extract was subjected to preliminary phytochemical tests to determine the secondary metabolites present in the tubers. Condensed extracts were used for screening of phytochemicals such as alkaloids, steroids and tannins (Ciulci, 1994), glycoside (Gokhale et al., 2008), flavonoids (Sofowora, 1993), phenols (Krishnamurthy, 1998), terpenoids (Salkowski and Ross, 1991), saponins (Brain and Turner, 1975) and Reducing sugar (Hulme and Narain, 1931).

Results

Yam is composed mainly of starch, with some proteins, lipids, vitamins and minerals. The present study

is based on the nutritional analysis of tubers of *D. pentaphylla* and *D. oppositifolia*, which has been estimated and presented in (Table 1). The highest percentage of moisture content was observed in *D. oppositifolia* (9.8%) followed by *D. pentaphylla* (4.1%). The percentage of crude protein observed (10.28%) in *D. pentaphylla* and (10.06%) in *D. oppositifolia*, respectively. Nitrogen content was analyzed in these two tubers and the best nitrogen source were in *D. pentaphylla* (1.64%) followed by *D. oppositifolia* (1.61%). The percentage of crude fiber (1.6%) was observed in *D. oppositifolia* followed by *D. pentaphylla* (1.03%). Estimation of ash in *D. oppositifolia* (5%) is more than that in *D. pentaphylla* (4.85%). The amount of fat (1.2%) in *D. pentaphylla* and *D. oppositifolia* was (1.0%) observed. Amino acids, the building blocks of protein, was recorded more in *D. pentaphylla* (4.4%) as compared to that in *D. oppositifolia* (4%). Estimation of buffer soluble protein in *D. oppositifolia* showed (5.52%) followed by (5.4%) in *D. pentaphylla*. The maximum sugars were observed in *D. oppositifolia* (19%) and *D. pentaphylla* (16%).

The caloric value shows the energy content of the tubers. The carbohydrate value in *D. pentaphylla* was recorded more (82.86%) than in *D. oppositifolia* (82.14%). The calorific value were also calculated and found that *D. pentaphylla* shows the higher calorific value (383.28 kcal) than in *D. oppositifolia* (378 kcal). The present study also reveals the presence of secondary metabolites through preliminary phytochemical analysis and represented in (Table 2) shows the presence of alkaloids, flavonoids, glycosides, phenol, reducing sugars, saponins, steroids, tannins and triterpinoids.

Table1. Nutritional analysis of *D. pentaphylla* and *D. oppositifolia*.

	Components	<i>D. pentaphylla</i> (%)	<i>D. oppositifolia</i> (%)
1	Moisture content	4.1	9.8
2	Crude protein	10.28	10.06
3	Nitrogen(kjeldhal method)	1.64	1.61
4	Crude fiber	1.03	1.6
5	Ash content	4.85	5
6	Fat content	1.2	1.0
7	NFE(Carbohydrate)	82.86	82.14
8	Calorific value	383.28	378
Estimation of Amino acids, free sugars and buffer proteins			
9	Amino acid	4.4	4
10	Free sugars	16.0	19.0
11	Buffer protein	5.4	5.52

Table2. Preliminary phytochemical analysis of *D. pentaphylla* and *D. oppositifolia*.

	Secondary metabolites	Methanolic extracts	
		<i>D. pentaphylla</i>	<i>D. oppositifolia</i>
1	Alkaloids	+	+
2	Flavonoids	+	+
3	Glycosides	+	+
4	Phenol	+	+
5	Reducing sugars	+	+
6	Saponins	+	+
7	Steroid	-	+
8	Tannins	+	+
9	Triterpinoids	+	+

+ Present; - Absent.

Discussion

This study has revealed the highest nutrients composition in *D. Pentaphylla* and *D. oppositifolia* in the species of *Dioscorea* tubers. Compared with *D. alata* two varieties of *D. pentaphylla* and *D. oppositifolia* tuber contain cruder proteins (Arinathan et al., 2009). The content of crude lipids in the tubers of *Dioscorea* species exhibited cruder lipid content than the earlier reports in the tubers of *D. alata* (Udensi et al., 2008) and *D. hispida* (Rajyalakshmi and Geervani, 1994). The crude fiber content in the presently investigated tubers of *D. oppositifolia*, *D. Pentaphylla* were found to be more than that in the earlier reports in *D. bulbifera* and *D. alata*

(Pramila and Raghuvanshi, 1991). The nitrogen free extractives (NFE) in the tubers of *D. pentaphylla*, *D. oppositifolia* were higher (above 80%). In the present study reports the phytochemicals in investigated tubers showed the presence of alkaloids, saponins, tannins, triterpinoids, steroids, phenols, flavonoids, glycosides, and reducing sugars. Similarly, in previous studies it was reported that ethanolic extract of *Dioscorea villosa* showed presence of proteins, flavonoids tannins, alkaloids, phenolic compounds saponins and glycosides (Roy and Geetha, 2013) *Dioscorea bulbifera* containing carbohydrates, flavonoids, alkaloids, steroids, glycosides, phenols, and fatty acids (Ravichandran and Magesh, 2015).

The bioactivity compounds of plant extracts are attributed to its phytochemicals constituent. For instance; flavonoids rich plants are reported to have a major group of phenolic compounds responsible for their antiviral properties (Mehrangiaz et al., 2001) and antimicrobial properties (Bastos et al., 2009). Saponin shows significant activity against the carcinosarcoma in rat (WenChih Liu et al., 1972). The methanolic extracts of *Dioscorea alata* contain different chemical compounds such as alkaloid, phenol, steroid (Abdussalam 2016).

Conclusion

Based on the nutritive evaluation studies, wild yams can be recommended as a good source of protein, lipid, crude fibre, starch, vitamins and minerals. Present study might be useful to supplement scientific information to establish wild yams for the presence of nutrients and phytocompounds. The result of our report shows the presence of potential bioactive compounds in yams and also suggests that the traditionally medicinal practices based on the ethnobotany will definitely pave way for effective medicinal formulation.

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Conflicts of interest

The authors declare that have no conflict of interests.

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