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Evaluation of phytochemicals and antioxidant activities of *Remusatia vivipara* (Roxb.) Schott., an edible genus of Araceae

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ABSTRACT

The present investigation deals with the evaluation of phytochemicals, total phenolic content, antioxidant activity and total carbohydrates in plant parts of Remusatia vivipara, an edible member of araceae collected from the natural forests of Western Ghats, southern India. Kupchan partition method was used for the extraction of the plant materials in hexane, chloroform and methanol. Phytochemicals were tested for the presence or absence of tannins, saponins¸ flavonoids, terpenoids, steroids, anthraquinones, phlobatannins, glycosides, reducing sugars and alkaloids in solvent fractions. Total phenolic content was determined by Folin-Ciocalteu (FC) method employing Gallic acid as standard. Total carbohydrates were determined by phenol sulphuric acid method. Radical scavenging was determined by 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay. Phytochemical screening of plant parts revealed the presence of flavonoids, terpenoids, reducing sugars and alkaloids in polar solvents viz., water and methanol. Hexane extract showed the presence of reducing sugars and chloroform revealed the presence of flavonoids and reducing sugars. High phenolic contents were detected in leaf and root (42-44 µg/mL GAE), while in tuber the phenolic content was 12 µg/mLGAE. High carbohydrate content was estimated in tuber compared to leaf. The antioxidant potentials of plant parts ranged from 73 to 78%. The IC_{50} values for leaves and root extracts were 1.71 µg/mL. Although, tuber extracts exhibited low phenolic content, the IC_{50} value was 7 µg/mL. Results indicate the presence of potential phytochemicals in the aqueous extracts of R. vivipara plant parts, which in turn endorses its edible value as food source among the communities residing in Western Ghats.

Keywords: *Remusatia vivipara*, araceae, Western Ghats, phytochemicals, total phenolic content, antioxidant activity.

INTRODUCTION

Medicinal plants constitute main source of new pharmaceuticals and healthcare products. The family Araceae, commonly known as aroids consists of 105 genera and more than 3300 species [1] and is distributed worldwide. It is commonly found growing in the Subtropical forests of Asia such as South West China, Sri Lanka, Nepal, India, Myanmar, Thailand, Vietnam, Indonesia and common in West Africa[2]. *R. vivipara* (Roxb.) Schott. an epiphytic species in the family is also known as 'Hitchhiker Elephant Ear'. In India, it is distributed in the Himalayan region and Western Ghats of central South India and Maharastra region. In South India, it is commonly found in states of Kerala and Karnataka. In vernacular language it is known as "Mara Kesa". The leaves and tubers are extensively used in folk medicine for the treatment of inflammation, arthritis, analgesic, on the wound to dispel any worms and germs, for disinfecting genitourinary tract and for promoting conception, whooping cough and for the treatment of reddish boils [1]. The tubers are strongly poisonous but used externally to treat breast mastitis, abscesses and ascariasis [2].

This plant grows luxuriantly in the crevices and on tree tops during monsoon season (June to September), it is consumed by the inhabitants of Kodagu, a district of natural forests and coffee plantations situated in the Western ghats as a source of food and on the belief that it helps to fight cold and in the maintenance of body temperature during rainy season. Studies of *R. vivipara* sampled from Maharastra on the basis of preliminary chemical evaluation anti-inflammatory and analgesic activity of *R. vivipara* has been reported [1,3].

Various medicinal properties have been attributed to natural herbs. Medicinal plants constitute the main source of new pharmaceuticals and healthcare products [4]. As a part of normal metabolic action going on, active oxygen and free radicals are constantly formed in human body. At higher levels, as a result of oxidative stress, a variety of biochemical and physiological lesions often results in metabolic impairment and cell death [5]. An antioxidant is a molecule capable of inhibiting the oxidation of other molecules. Therefore, antioxidants with free radical scavenging activities have great relevance as prophylactic and therapeutic agents in diseases in which oxidants or free radicals are implicated [6,7].

Phytochemicals are bioactive substances of plants that have been associated in the protection of human health against chronic degenerative diseases [8]. Among the phytochemicals, the phenolics are one of the largest and most ubiquitous groups of plant metabolites [9]. A number of studies have been focused on the biological activities of phenolic compounds which are potential antioxidants and free radical-scavengers with disease-preventive properties [10-14]. Natural antioxidants are mainly derived from plants in the form of phenolic compounds such as flavonoids, phenolic acids, tocopherol etc. [15]. Many reports suggest that plants with greater phenolic content show good antioxidant activity and a direct correlation exists between total phenolic content and antioxidant activity [16].

Synthetic antioxidants such as butylated hydroxyanisol (BHA) and butylated hydroxytoluene (BHT) due to their high volatility and instability at elevated temperature, carcinogenic nature and consumer preferences have shifted the attention of manufacturers from synthetic to natural antioxidants [17, 18]. Therefore, the development and isolation of natural antioxidants from natural plant has been become the theme of antioxidant research, and many studies have suggested that consumption of certain natural antioxidants helps to reduce oxidative stress and prevent human diseases [19].

Phenolic compounds with strong antioxidant activity have been identified in edible members of Araceae family [20-22], and are of interest to food manufacturers as consumers move towards functional foods with specific health effects. Therefore, the present investigation is aimed at the evaluation of phytochemicals and antioxidant activity of *R. vivipara* plant parts collected from the natural location of Kodagu, Western Ghats.

MATERIALS AND METHODS

Study Site and Plant Material:
The plant *R. vivipara* (Araceae) was collected from the natural forests of Nelaji village, located in the Talacauvery sub cluster of Western Ghats ($12^{o}17'$ to $12^{o}27'$N & $75^{o}26'$ to $75^{o}33'$E), Kodagu District, Karnataka. The plant was photographed and the plant parts such as leaves, tuber and roots were washed thoroughly with water. The excess soil adhering to the tubers and roots were removed and washed thoroughly and separated. The parts *viz*., leaves, tubers and roots were separated and shade dried. The plant specimen was identified with the help of Flora [23] and herbarium specimen was prepared and submitted to the herbarium collection of the department.

Source of Chemicals: 1, 1-diphenyl-1-picrylhydrazyl (DPPH) was purchased from M/s Sigma–Aldrich Chemicals Pvt., Ltd., Bangalore, Folin–Ciocalteau reagent, ascorbic acid and phytochemical reagents used were of analytical grade.

Extraction of plant materials
The fresh leaves, roots and corm of *R. vivipara* were dried under shade and powdered in a mixer grinder. The powdered leaves, roots and tuber (100gm each) were packed in polythene bags and their weight was determined and stored in an air tight container until use. The Kupchan partition method was used for the extraction of the plant materials with particular solvent chosen according to the increase in polarity. 100gm of dried powder of plant materials such as leaf, tuber and root was soaked in methanol over night and filtered through Whatman filter paper no.1. The fraction was then concentrated by using a rotary evaporator. A portion of the concentrated methanol extract was fractionated by the modified Kupchan partitioning method [24] into *n*-hexane, chloroform and aqueous soluble fractions. The dried extracts were scraped, weighed in pre-weighed dry Eppendorf tubes, sealed and preserved for further use. Qualitative phytochemical analysis was carried out in crude dry powder of solvent extracts. The aqueous extract was prepared from powdered plant parts by boiling one gram in 10ml of distilled water. The extract was filtered and the filtrate was termed as aqueous extract. Similarly other dried extracts were

subjected to phytochemical analysis by weighing one mg of dry powder and dissolving them in one ml of respective solvents.

Phytochemical screening: Phytochemical screening for solvent extracts was done according to the procedure of Harborne [25]. The following tests were conducted:

Tannins*:* Small quantity (1mg) was mixed with one ml of water and heated on water bath. The mixture was filtered and two drops of ferric chloride ($FeCl_3$) was added to the filtrate. A green solution indicated the presence of tannins.
Saponins: One ml of aqueous extract of the plant parts were taken and 2.0ml of distilled water and shaken vigorously, a stable persistent froth indicated the presence of saponins.

Flavonoids: A few drops of 1% ammonia solution were added to the aqueous extract of plant parts and concentrated sulphuric acid was also added, a yellow colouration indicated the presence of flavonoids.

Terpenoids*:* One ml of aqueous extract of plant parts were taken separately and mixed with 2.0ml of chloroform, to this mixture 3.0ml of concentrated sulphuric acid was added carefully. The appearance of reddish brown layer indicated the presence of terpenoids.

Steroids: 10.0ml of chloroform was added to the 20mg of plant parts and then filtered. 2.0ml of acetic anhydride was added to this extract and then concentrated sodium hydroxide was added. A green ring indicated the presence of steroids.

Anthraquinones: 0.5gm of dried plant parts was boiled with 10% HCl for few minutes in a water bath, the contents were filtered cooled. To this filtrate equal amount of chloroform was added and a few drops of 10% NH_3 were also added to the mixture and heat. Formation of rose pink colour indicated the presence of anthraquinones.

Phlobatannins: One ml of aqueous extract of plant parts were taken and boiled with 2% HCl solution which gives red precipitate, this indicated the presence of phlobatannins.

Glycosides: Two ml of aqueous extract of plant parts were taken to this 1.0 ml of glacial acetic acid and $FeCl_3$ and concentrated sulphuric acid was added carefully which gives reddish blue colouration at the junction of two layer of solution and formation of the bluish green colour at the upper layer, which indicates the presence of glycosides.

Reducing sugars*:* One ml of aqueous extract of plant parts was boiled with few drops of Fehling's solution A and B for a minute. An orange red precipitate indicated the presence of reducing sugars.

Alkaloids*:* About 0.2gm of material was warmed with 2% H_2SO_4 solution for a two minute and filtered. To this filtrate a few drops of Dragendorff's reagent was added. An orange red precipitate indicates the presence of alkaloids.

Evaluation of antioxidant activity: The antioxidant activities of the extracts were evaluated by two methods:

Estimation of total phenolic content (TPC): Total phenolic content of plant parts *viz.*, of leaves, tuber and root were performed by Folin-Ciocalteau (FC) method employing Gallic acid as standard (1mg/ml) as per the procedure of Volluri *et al*. [26] with some modifications. Different concentrations of standard (5-25µg/ml) as well as the extracts (50-250µg/ml) were taken in test tubes and one ml of FC reagent (1:1 dilution) was added, 3-5 min later 2.0ml of sodium carbonate (20% w/v) was added and the mixture was allowed to stand for 45 min under dark condition. After the specified incubation period, the absorbance of standard and samples were read at 765 nm using UV-VIS spectrophotometer (ModelT-60). The concentration of total phenolics was expressed in terms of Gallic acid equivalence (µg/ml GAE).

DPPH radical scavenging assay
Different aliquots of standard (1mg/ml) and aqueous extracts of plant sources (5 – 25 µg/ml) were taken and the total volume was made up to 250µl with water/ methanol respectively. To this one ml of DPPH (4mg/100ml) was added and the tubes were kept in dark for incubation at room temperature for 20 min. The absorbance was checked against the blank at 517 nm. Per cent free radical scavenging was calculated based on the extent of reduction in the colour [27].

The percentage of radical scavenging was calculated as follows:

$$\% \text{ radical scavenging activity} = \frac{A_c - A_s}{A_c} \times 100$$

Where A_c= absorbance of control and A_s= absorbance of test sample. The IC_{50} values were calculated and represented.

Estimation of total carbohydrate content

Total soluble carbohydrate in the aqueous extracts of tuber and leaves of *R. vivipara* was determined using phenol sulphuric acid method [28] with some modifications. Glucose was used as standard (1mg/ml). Aqueous extracts were obtained by boiling one g of plant material in 10.0ml of distilled water for 20min and filtered. The filtrate was used for estimation of total carbohydrates. Working solution of standard was prepared using different concentrations of glucose (1mg/ml) in the range of 5-25µg and samples (50-250µg/ml). Solution was made up to the final volume 500µl in each test tube with distilled water. 1.0 ml of 5% phenol solution was added to all test tubes; 2.0ml of concentrated sulphuric acid was released immediately from the sides and shaken well. The reaction mixture was incubated for 30min in dark. The absorbance of standard and the solution was read at 490 nm by using UV-visible Spectrophotometer. The standard graph was plotted. The amount of total carbohydrate in the different samples was calculated and represented.

Data Analysis/ Statistical Data Analysis

Statistical evaluation was done with the Statistical Programme for Social Sciences 16.0 (SPSS 16.0 version). Analysis for all assays was performed in triplicates, and the mean for all parameters were analysed for significance ($P \leq 0.05$) by analysis of variance (ANOVA). Tukey's B test was conducted to determine the significance between treatments and between plant parts.

RESULTS

Extraction of sample by Kupchan fractionation method: The Kupchan fractionation method was used for solvent extraction using solvents such as polar, semi-polar and non-polar. The yield of extracts differed in each solvents. In methanolic extracts, yield was comparatively high (Table 1).

Table 1: Yield of solvent extracts obtained for *R. vivipara* plant parts by Kupchan fractionation method

Solvents	Yield of extracts (mg/g* dry weight)		
	Leaves	Root	Tuber
Methanol	45 mg	45 mg	60 mg
Chloroform	30 mg	6.25 mg	10 mg
Hexane	15 mg	25 mg	6 mg

**100 g of dried plant parts were used for fractionation*

Table 2: Phytochemical tests for the solvent extracts of *R. vivipara* plant parts.

Phytochemical tests	Aqueous			Methanol			Hexane			Chloroform		
	L	T	R	L	T	R	L	T	R	L	T	R
Tannins	-	-	-	-	-	-	-	-	-	-	-	-
Saponins	-	-	-	-	-	-	-	-	-	-	-	-
Flavonoids	+	-	-	-	+	-	-	-	-	-	-	-
Steroids	-	-	-	-	-	-	-	-	-	-	-	-
Terpenoids	+	-	-	+	+	-	-	-	-	+	-	-
Anthraquinones	-	-	-	-	-	-	-	-	-	-	-	-
Phlobatannins	-	-	-	-	-	-	-	-	-	-	-	-
Glycosides	-	-	-	-	-	-	-	-	-	-	-	-
Reducing sugars	+	+	+	+	+	+	+	+	+	+	+	+
Alkaloids	+	-	-	-	-	-	-	-	-	-	-	-

" + " = Positive for the test and " - " = Negative for the test; L = leaf; T = tuber; R = root.

Phytochemical screening: The phytochemical screening was conducted for all plant parts such as leaves, tuber and roots, which yielded variable results for solvent extracts. The aqueous extracts showed the presence of reducing sugars in leaves, tuber and root. Flavonoids, alkaloids and terpenoids were present in aqueous extract of leaf. The aqueous extracts of root and tuber showed positive results for reducing sugars. The methanol extracts of leaf and tuber showed positive for terpenoids and reducing sugars, but the root showed positive for reducing sugars (Table

2). The chloroform and hexane extracts of all plant parts showed positive for reducing sugars but terpenoids were detected in the chloroform extract of tuber.

Evaluation of antioxidant activity: The antioxidant activity of *R. vivipara* plant parts were evaluated by two methods.

Estimation of total phenolic content (TPC): Total Phenolic content of plant parts were compared and expressed as Gallic acid equivalents (µg/mL GAE). Total phenolic content was detected at 44µg/ml GAE in leaves and 42µg/ml GAE in roots. However, the concentration of phenolics in tuber was 12µg/ml (Fig. 1) and was 3.6 fold less than the concentration in leaves.

DPPH radical scavenging activity: All plant parts exhibited radical scavenging potentials in the range of 73 to 78% (Fig. 2). The IC_{50} values for leaves and root extracts were 1.71µg/ml. Although tuber extracts exhibited low phenolic content (Fig) the IC_{50} value was 7µg/ml, demonstrating a four-fold increase in antioxidant activity than roots and leaves.

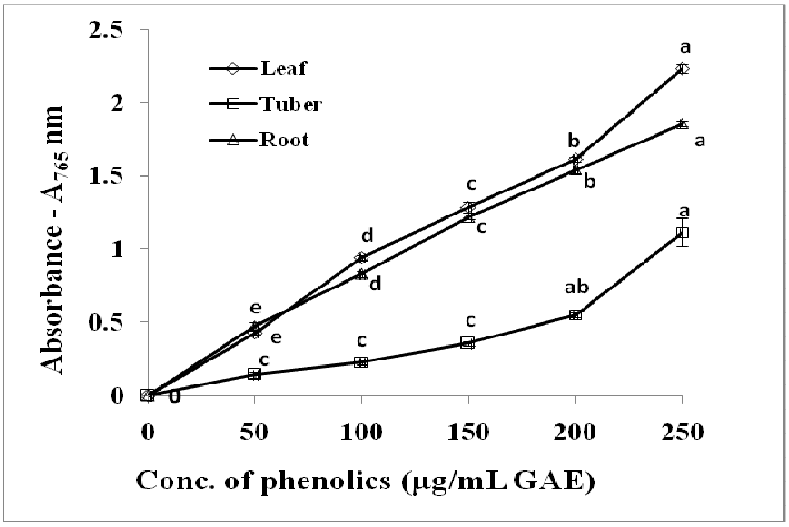

Fig. 1: Determination of total phenolic content in plant parts of *R. vivipara*

Aqueous extracts of *R. vivipara* plant parts were prepared. Concentrations ranging 50-250 µg/mL were tested for total phenolic content by Folin-Ciocalteu method using gallic acid as standard. The absorbance of the samples was read at 765 nm and the values of the samples were calculated from the standard graph and represented in terms of µg/mL GAE. Values are means of triplicate experiments and expressed as mean±SE. Letters a,b,c,d,e differ significantly ($P \leq 0.05$).

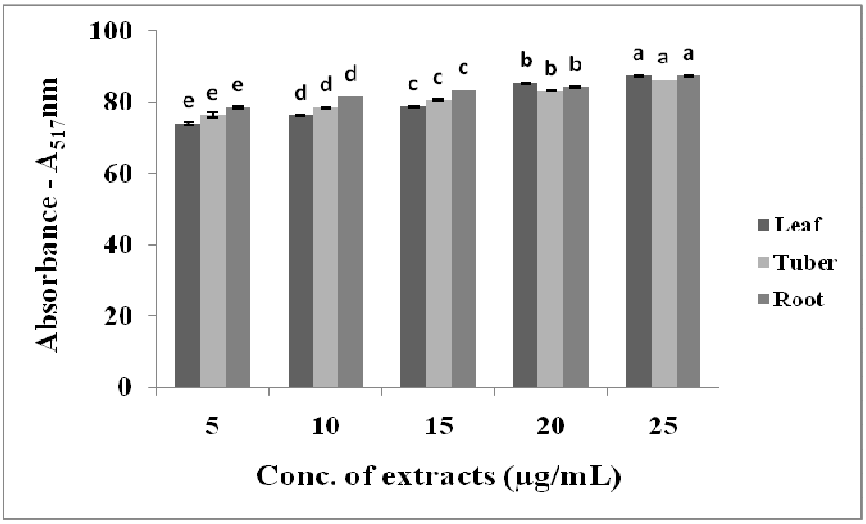

Fig. 2: Comparison of free radical scavenging potentials in plant parts of *R. vivipara*

Aqueous extracts of *R. vivipara* plant parts were prepared. Concentrations ranging 5-25 µg/mL were tested for radical scavenging potentials by DPPH method using ascorbic acid as standard. The absorbance of the samples was read at 517 nm and the values of the samples were calculated from the blank and represented in terms of µg/mL GAE. Values are means of triplicate experiments and expressed as mean±SE. Values are means of triplicate experiments and expressed as mean±SE. Letters a,b,c,d,e differ significantly (P≤0.05).

Determination of total soluble carbohydrate: Total soluble carbohydrate content of leaf and tuber tissues was determined by phenol sulphuric acid method employing glucose as standard. Total soluble carbohydrate detected in tuber was 38µg/ml, whereas in leaves, its concentration was 7µg/ml (Fig. 3). A ~5.4-fold increase was noted in the concentration in tuber when compared to leaves.

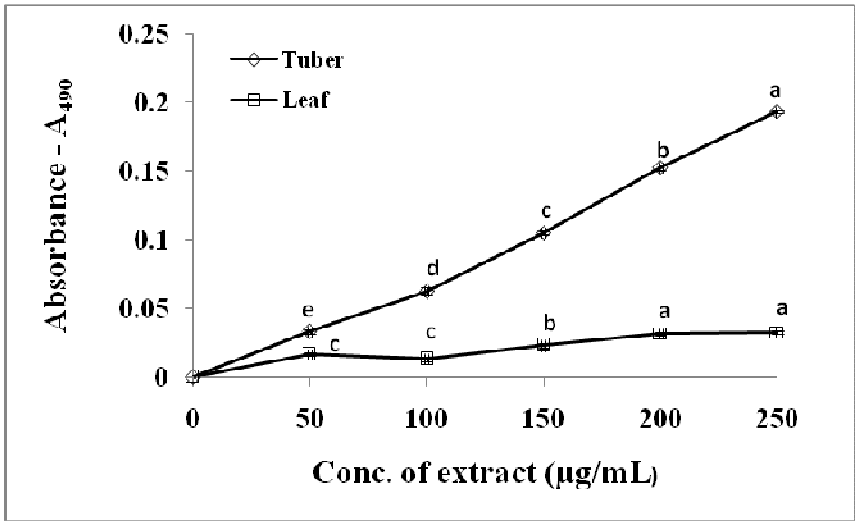

Fig. 3: Determination of total soluble carbohydrates in plant parts of *R. vivipara*

The total carbohydrate content of aqueous extracts of leaf and tuber were determined by phenol-sulphuric acid method using glucose as standard. Concentrations ranging 50-250 µg/mL were tested for carbohydrate content. The absorbance of the samples was read at 490 nm and the values of the samples were calculated from the standard graph and represented. Values are means of triplicate experiments and expressed as mean±SE. Values are means of triplicate experiments and expressed as mean±SE. Letters a,b,c,d,e differ significantly (P≤0.05).

Correlation between TPC and radical scavenging /Statistical analysis

The total phenolic content differed significantly ($P \leq 0.05$) between dose-dependent concentrations in aqueous extracts of leaf, root and tuber. High phenolic content was noted for concentrations of 250µg/ml. The radical scavenging potentials differed significantly ($P \leq 0.05$) for various concentrations of extracts, with high scavenging values for 25µg/ ml of extracts of all plant parts. The total carbohydrate content differed between leaves and tuber ($P \leq 0.05$), with significant values for tuber extracts.

DISCUSSION

There has been considerable interest in finding natural oxidants from plant materials to replace synthetic ones. Natural antioxidant substances are presumed to be safe since they occur in plant foods, and are seen as more durable than their synthetic counterparts. Plants contain a large variety of substances called 'plant chemicals' or 'phytochemicals' that possess antioxidant activity [29]. In view of the interest generated over the years to search antioxidants from food sources, many edible plant species have been screened for their antioxidant potentials [8, 30-32]. *R. vivipara*, an important edible plant with medicinal values. Many members of the family araceae do possess medicinal values. The plant is found growing in the hilly and tropical rain forest areas of Western Ghats at an elevation of 5000 ft above mean sea level. During summer the aerial and underground parts dry and growth resumes during the onset of continuous showers (June-September) as the tubers regenerate. So the plant *R. vivipara* is a perennial. The local inhabitants of Kodagu consume a dish prepared from the leaves, along with rice bread, which helps to maintain the body temperature during rainy season. Since the leaves contain raphides, in order to overcome throat irritation, the dish is neutralized with *Garcinia* extract, boiled and then consumed. Therefore, owing to the nutritive and edible value of this plant, the phytochemical and antioxidant evaluation was investigated.

The collected plant parts were dried, weighed and subjected to Kupchan fractionation method with solvents such as hexane, chloroform, methanol and water. The solvents represented differed in the order of polarity. The solvent extracts obtained by the Kupchan fraction method [24] is advantageous when small quantities of samples be extracted instead of Soxhlet extraction. Polar, non-polar as well as semi-polar solvents were used for the extraction process. Phytochemical studies of leaves have earlier reported the extraction of powdered material by defatting with petroleum ether and successively with chloroform and ethanol by using Soxhlet apparatus [3]. However the, extraction of tubers was done by pulverizing the material with chloroform for two weeks and later with 20% aqueous methanol [32]. These studies suggest the advantages of using an alternative to the Soxhlet extraction.

Our study indicates the yield of extracts in polar solvent system was high in comparison with the other solvents in various plant parts. In our study, phytochemical tests were done in all the plant parts such as leaves, tubers and roots with the different solvent extracts such as aqueous, methanol, chloroform and hexane. The aqueous extract of the plant parts such as leaves, tuber and root indicated the presence of reducing sugars. Flavonoids, terpenoids and alkaloids were present in the aqueous extract of leaves. The aqueous extract of root and leaves as well as tuber showed positive for reducing sugars only. The methanolic extracts of leaves and tuber were positive for the presence of terpenoids and reducing sugars. Terpenoids were present only in chloroform extract of leaves.

Phytochemical analysis conducted for the leaves of *R. vivipara* collected from the hilly region of Toranmal Region, Dhule District of Maharastra showed the presence of carbohydrates, alkaloids, tannins, saponins and flavonoids in ethanolic extracts [1], whereas the chloroform extract indicated the presence of carbohydrates, alkaloids and steroids. The petroleum ether extract was positive for carbohydrates, alkaloids, tannins and steroids. The results presented by the authors indicated that the phytochemical studies were conducted with solvents such as chloroform and hexane, and only ethanol was used as a polar solvent. Our phytochemical analysis, indicate the presence of flavonoids, terpenoids, alkaloids and reducing sugars in n-hexane and aqueous extracts. The chloroform extract of leaves indicated the presence of terpenoids only. There is considerable difference in the phytochemical profile of solvent extracts in both studies, and this could be attributed to the influence of agro-climatic factors as well as the host trees from which the epiphyte was sampled. Further insight into phytochemical profile of *R. vivipara* collected from various hosts may help to resolve the differences. The total carbohydrate content was detected high (5.4-fold increase) in tubers than leaves. So, it is evident from our investigations that leaves of *R. vivipara* are a source for the presence of important phytochemicals, which are implicated in various biological activities. Flavonoids are plant pigments that are synthesised from phenylalanine. They have health related properties, which are based in their antioxidant activity. Other related activates include anti-cancer, anti-viral, anti-inflammatory activities [33]. Terpenoids represent a diverse class of molecules that are related to therapeutic properties including anti-cancer, anti-parasitic, anti-microbial, anti-allergenic, anti-spasmodic, anti-hyperglycemic, anti-inflammatory and immunomodulatory properties [34]. Alkaloids have anti-cancer and anti-tumour property.

Traditionally, medicinal plants are used for more than one disease and they may possess very high bioactivity against common targets. In this context, antioxidant property has significance as it can target reactive oxygen species (ROS) that are implicated in many disease conditions. Therefore, the present study has been carried out to explore the antioxidant potential in aqueous extract of *R. vivipara*, plant parts by the estimation of total phenolic content and radical scavenging potentials. The presence of high concentration of total phenolics (42-44 µg/ml) is the first study conducted in the aqueous leaf and root extracts. While the phenolic content of ethanolic extract of tubers (15 mg/g) has been earlier reported [32], our studies also indicated high phenolic concentration (12 µg/ml). Phenolic compounds perform a variety of functions in plants, including acting as antioxidants. The ability of phenolics to act as antioxidants depends on the redox potentials of their phenolic hydroxyl groups, which allow them to act as reducing agents, hydrogen-donating antioxidants or oxygen quenchers [35].

The plant parts of *R. vivipara* were also tested for the DPPH radical scavenging activity. Antioxidant activity was found to be high in leaves and root followed by tuber (~ 3.6 fold less activity). DPPH is a stable free radical which has maximum optical absorbance at 517 nm. The reaction of DPPH with free radicals scavengers causes a decline in the absorbance value. Free radical scavenging potential of the extracts was tested against a methanolic solution of DPPH. This reaction has been widely used to investigate the ability of plant extracts and fractions and/or pure compounds of those, to act as free radical-scavengers or hydrogen donors. All the aqueous extracts of plant parts examined at concentrations ranging from 5-25µg/mL indicated 73-78% of radical scavenging activity. Although tuber extracts exhibited low phenolic content, a four-fold increase in IC_{50} value was observed (1.7 µg/ml). Marwah et al. [32] while examining the antioxidant potential by total antioxidant capacity in ethanolic extracts of tuber found low phenolics (15mg/g) and radical scavenging activity (8.4%). However our studies indicate the potential of aqueous extracts of *R. vivipara* as indicated by the presence of total phenolics as well as radical scavenging activity.

The plant parts such as tuber and leaves are also tested for detection of total carbohydrate content by phenol sulphuric acid method using glucose as standard. Carbohydrates are found in storage organs, such as tubers, corms and roots. In members of the family Araceae corm or tubers are storage organs. In our study the aqueous extracts of tuber (1 mg/ml) showed high concentrations of carbohydrate (~5.4 fold increase) over the leaves. Bhurat et al. [1] examined the presence of carbohydrate by phytochemical analysis which indicated a positive reaction for the same; however, the estimation was not done on a quantitative basis. Carbohydrates are also present in some of the important members of Araceae such as *Colocasia esculenta* and *Xanthosoma sagittifolium* in the corms/tubers and are considered as food sources among the plant parts.

Herbaceous perennials of the family Araceae are good sources of antioxidants [36]. Species of *Xanthosoma, Colocasia, Amophophallus* etc. are consumed as dietary source which indicates the health benefits of the plants as source of food. *R.vivipara* is a member of Araceae, the leaves and tubers being edible parts are used in monsoon by local people and are believed to have medicinal values. Therefore the presence of phytochemicals may indicate the medicinal as well as edible value of this epiphytic plant.

CONCLUSION

Phytochemical study in different solvent extracts of *R. vivipara* indicated the presence of reducing sugars, flavonoids, terpenoids and alkaloids. The total phenolic content was high in leaves. Total carbohydrate of tuber and radical scavenging activity in leaves was detected high. On the basis of these findings, it may be inferred that plant parts of *R. vivipara* such as leaves and tuber are important sources of chemical constituents with health benefits. Further investigations could throw light on various biological mechanisms of the active constituents present in the plant parts of *R. vivipara* for its medicinal use.

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