



DIVERSITY OF SUBAERIAL COCCOID CYANOBACTERIA FROM SIRSI TALUK, KARNATAKA, INDIA.

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ABSTRACT

Cyanobacteria, also known as Blue green algae, are the major photoautotrophic prokaryotes which are present in almost all the habitats. In this survey, species composition and occurrence of subaerial form of coccoid (non-filamentous and non-heterocytous) cyanobacteria have been studied. Around 150 algal samples were collected from various natural and artificial substrata of different habitats of Sirsi taluk (known as Heart of Western Ghats). On the basis of morpho-taxonomic observation, a total of 40 coccoid cyanobacteria have been documented which belonged to 6 families namely: Synechococcaceae (10taxa), Merismopediaceae (3taxa), Microcystaceae (13taxa), Chroococcaceae (9taxa), Xenococcaceae (3taxa) and Hyellaceae (2taxa). *Cyanobacterium* and *Myxosarcina* were least diverse represented by only one species while *Gloeocapsa* showed maximum diversity represented by 13 species. Tropical climate of Western Ghats provide favorable conditions for the luxuriant growth of these algal forms (and that is why, Western Ghats are known as one the major biodiversity hotspot worldwide). Despite of being the most important organisms in the ecosystem, as they are capable of photosynthesis and are the excellent source of tremendous secondary metabolites, unfortunately, no or less literature is available on coccoid cyanobacteria from tropical climate especially, in India. Most of the research has been done only in European countries which are the temperate regions. Hence, the aim of the present study is to explore the wealth of diversity of cyanobacteria in Sirsi Taluk. Taxa have been described along with camera lucida drawings.

KEYWORDS: *Aerophytic, Cyanoprokaryotes, Western Ghats, Tropical climate.*



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INTRODUCTION

Western Ghats are crucial geological terrain of Indian subcontinent and possess many unparalleled habitats where dwells variety of endemic flora and fauna and thus, are the treasure trove of biodiversity. Tropical climate (especially low light intensity and high humidity¹) of Western Ghats is responsible for profuse growth and diverse species composition of subaerial (aerophytic terrestrial algae but only after intermittent water supply) cyanobacteria². Coccoid cyanobacteria are the “simplest” cyanobacteria³ and include both unicellular and colonial forms. Traditionally, coccoid cyanobacteria were classified (Botanical Classification) in one order “Chroococcales”⁴ but later classified (Bacteriological Classification) in two orders: Chroococcales, where reproduction by binary fission in one, two or three planes or by budding and Pleurocapsales, where mode of reproduction is multiple fission, or combination of multiple fission and binary fission⁵. Modern polyphasic approach shows at least two main phylogenetic clades of coccoid genera resulting to filamentous cyanobacteria (Synechococcales → Pseudanabaenales; Chroococcales → Oscillatoriales)⁶. Unfortunately, subaerial cyanobacteria are the most overlooked organisms and lag behind aquatic environment⁷. Hence it is indispensable to document the subaerial cyanoprokaryotic community. Recent, literature available on cyanobacterial diversity in India⁸⁻⁹ and other countries¹⁰⁻¹³ are few. Although these forms are cosmopolitan, research specifically on coccoid cyanobacterial diversity¹⁴ is scarce in the tropical region (especially Sirsi taluk of Western Ghats). But because of deforestation (5.8 million hectares per year), tropical forests are continuously degrading¹⁵. Moreover, mostly available literature is from European countries where the climate is temperate. Hence, it's a dire need to record the diversity and occurrence of algae from Indian Western Ghats before they become extinct. Hence, in this study, an attempt has been made to explore the wealth of coccoid cyanobacterial diversity.

MATERIAL AND METHODS

Study area

Sirsi taluk, Heart of Western Ghats of Karnataka state, has a geographical extent of 1322 sq km in which 78.11% is occupied by forest land. It lies between 14° 28' and 14° 51' N latitudes and 74° 34' and 75 ° 04' E longitudes and at an elevation of 600 m above mean sea level. Climate of Sirsi taluk is tropical which has average temperature 27 °C, average rainfall 3878.35 mm and humidity up to 100%.

Sample collection

Samples were collected in the pre-monsoon and monsoon season in the month of April and June in the year 2015 and 2016, respectively. Habitats were selected geographically including forest area; near waterfalls and streams; rocks; from areca nut and teak plantation; botanical garden and urban areas. Subaerial algal samples were scrapped and collected with the help of knife in air tight sterile plastic bags from different natural (bark, stem and rocks) and artificial substratum (cemented walls, pots, pipes).

Identification of Cyanobacteria

After collection, samples were taken to the laboratory and immediately transferred into vials and preserved in 4% formalin solution for further observation and identification was done with the help of light microscope and camera lucida sketches were drawn using Rotring Isograph. Monographs used for identification of taxa are: Desikachary (1959)¹⁶, Komárek and Anagnostidis (1999)². Classification system by Komárek and Anagnostidis (1999)² has been followed in the present study, according to which all coccoid cyanobacteria are classified in 11 families namely: Gloeobacteraceae, Synechococcaceae, Merismopediaceae, Microcystaceae, Chroococcaceae, Entophysalidaceae, Hydrococcaceae, Chamaesiphonaceae, Dermocarpellaceae, Xenococcaceae and Hyellaceae.

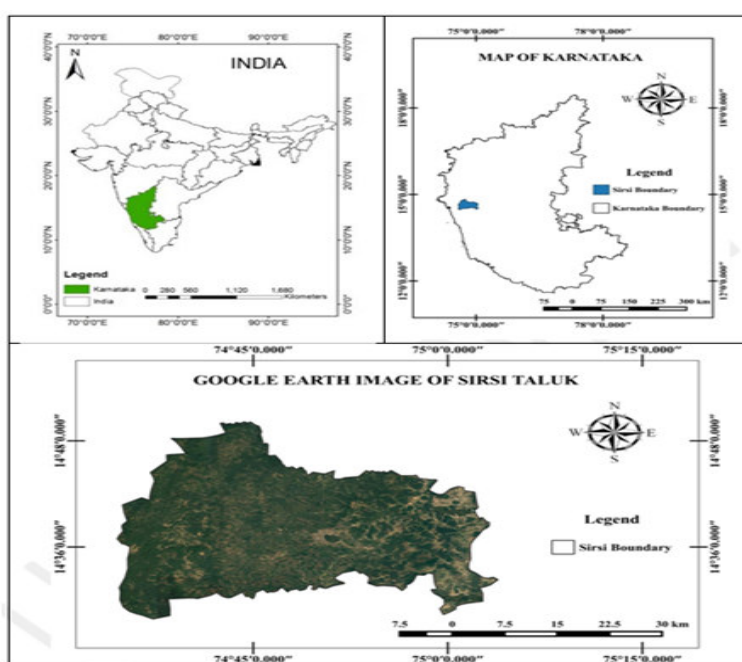


Figure 1
Map and Google earth image showing study area, Sirsi Taluk, Karnataka.

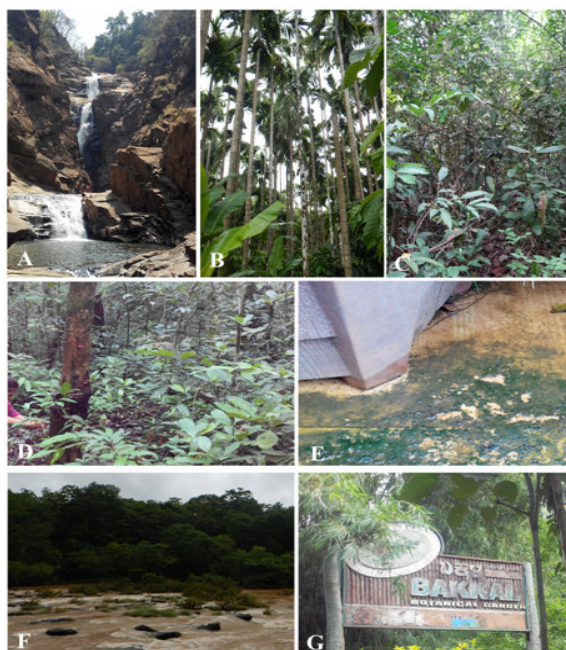


Figure 2

Some of various habitats from where samples were collected including A. Waterfall (Shiv ganga); B. Areca nut plantation (Karasulli, Amballike); C & D. Forested area (Mattigatta); E. Artificial substratum (Sirsi city); F. Forested area near water body (Sahasralinga); G. Botanical garden (Bakkal)

RESULT

Following taxa have been documented in the study

Family Synechococcaceae

*Cyanobacterium cedrorum*² (Sauvageau) Komárek et al.

Cells solitary; cell with very thin, colorless sheath, or may be without sheath, hardly visible; cell dull blue green, oval or ellipsoidal to cylindrical, cell content homogenous, $6.24\mu \times 3.9-4.7\mu$.

[Occurrence: on tree bark and cemented wall; (Sample no. 29 on 26/06/2015 from forested area of Sahasralinga)]

*Aphanothece castagnei*² (Brébisson) Rabenhorst (Pl. 1, Figure. 5)

Colony irregular, mucilaginous, amorphous; common envelope colorless or slightly yellowish; cells densely and irregularly arranged, oval to cylindrical, in center of colony cells with no individual sheath but at the margin yellowish with lamellation, dull blue green with granular content, oval with widely rounded ends, $5.4-7\mu \times 3.1-4.6\mu$

[Occurrence: on bark, cemented wall or pot and rock; Sample no. 5, 6, 19, 25 (on 26/06/2015 from forested area of Sahasralinga); 127 (on 01/07/2015 from Botanical Garden, Bakkal); 54 (on 28/06/2015 from Yadalli); 80 (on 29/06/2015 from Shiv Ganga waterfalls); 69 (on 17/04/2016 from Sahasralinga); 56 (on 18/04/2016 from MM Arts & Science College, Sirsi city)]

*Aphanothece pallida*² (Kützing) Rabenhorst (Pl. 1, Figure. 2)

Colony amorphous; envelope colorless; cells oval to cylindrical, densely arranged in the center but loose at the margins sometimes, individual sheath lamellated, intensely yellow, thick; cell content granular, $7.8-10.9\mu \times$

4.6μ . [Occurrence: on rocks; Sample no. 114 (on 30/06/2015 from Forested area of Mattigatta); 72 (on 17/04/2016 from Sahasralinga)]

*Aphanothece saxicola*² Nägeli (Pl.1, Figure. 4)

Colony micro- or macroscopic, spherical, cells more or less densely arranged; envelope colorless; cells blue green with homogenous or granular content, $2.4\mu \times 1.5\mu$ [Occurrence: on bark; (Sample no. 119 on 30/06/2015 from forested area of Mattigatta)]

*Gloeothece samoensis*² Wille (Pl.1, Figure. 3 & 7)

Colony with up to 8 or more cells; sheath colorless, wide, distinctly or concentrically lamellated; cells dull blue green, $4.6-7.8\mu \times 3.1-3.9\mu$.

[Occurrence: blackish or dark green mat on cemented wall of house; (Sample no. 43, 46 on 28/06/2015 from Yadalli); 127 (on 01/07/2015 from Botanical Garden, Bakkal)]

*Gloeothece palea*² (Kützing) Rabenhorst (Pl.1, Figure. 8)

Colony spherical, gelatinous; envelope colorless, delimited; cells densely and irregularly arranged, individual sheath colorless, not or only 1-2 lamellation, bright blue green with homogenous or granular content, $-5.9\mu \times 3.1-3.9\mu$

[Occurrence: on rock, bark and cemented wall; Sample no. 39 (on 27/06/2015 from Karasulli); 122 (on 01/07/2015 from Botanical Garden, Bakkal); 134 (on 30/06/2015 from forested area of Mattigatta); 33 (on 27/06/2015 from Karasulli)]

*Gloeothece rupestris*² (Lyngbye) Bornet in Wittrock & Nordstedt (Pl.1, Figure. 6)

Colony large; small subcolonies numerous with colorless to yellow envelope; cells oval-cylindrical with rounded ends, sheath colorless, unlamellated to yellow

and distinctly lamellated, blue green with granular content, 7.8-10.1 μ x 3.9-5.46 μ .

[Occurrence: smooth blackish green jelly on cemented wall; Sample no. 27 (on 26/06/2015 from forested area of Sahasralinga); 37 (on 18/04/2016 from MM Arts & Science College, Sirsi city)]

***Gloeotheca confluens*² Nägeli (Pl.2, Figure. 9)**

Cells solitary or in pairs or colonial, in irregular, amorphous, yellowish, micro- or macroscopic aggregates; envelope more or less wide, colorless or yellow, unlamellated, diffluent; cells short cylindrical with rounded ends, pale blue green with homogenous content; 5.46 μ x 2.3-3.9 μ

[Occurrence: dark blackish green mat on tree bark; Sample no. 72 (on 29/06/2015 from MM Arts and Science College, Sirsi city)]

***Gloeotheca tepidariorum*² (A. Braun) Lagerheim (Pl.2, Figure. 10)**

Colony small; cell olive green, oval or ellipsoidal; individual sheath colorless or slightly yellowish, cell content granular, 9.3 μ x 5.4 μ .

[Occurrence: on rocks near waterfalls; Sample no. 110 (on 17/04/2016 from forested area of Mattigatta)]

***Gloeotheca fusco-lutea*² Nägeli (Pl.2, Figure. 11)**

Colony spherical or irregular; envelope yellow or colorless, unlamellated; cells oval with round ends, spherical after division, with granular content, green, individual sheath slightly lamellated, colorless, 7.8 μ x 4.5 μ

[Occurrence: blackish green thallus on tree bark; Sample no. 129 (on 01/07/2015 from MM Arts and Science College, Sirsi city)]

Family Merismopediaceae

***Aphanocapsa muscicola*² (Meneghini) Wille (Pl.2, Figure. 12)**

Colony colorless, amorphous; cells bright blue green, 2.3-3.1 μ diameter, more or less densely and irregularly arranged, spherical or hemispherical after division, with or without more or less widened, diffluent, colorless sheath.

[Occurrence: brownish gelatinous and brownish matlike on cemented wall; Sample no. 60 (on 16/04/2016 from Bislakoppa); 1, 12, 22 (on 26/06/2015 from forested area of Sahasralinga); 129 (on 01/07/2015 from Botanical Garden, Bakkal); 86 (on 28/06/2015 from forested area near Shiv Ganga waterfalls); 90 (on 29/06/2015 from MM Arts & Science College, Sirsi city)]

***Aphanocapsa fusco-lutea*² Hansgirg (Pl.2, Figure. 13)**

Colony spherical or formless, envelope yellowish; cells densely and irregularly arranged, 1-1.5 μ diameter, spherical, blue green or dull blue green, with own sheath.

[Occurrence: rough, blue green thallus among other algae on tree bark; Sample no. 68 (on 17/04/2016 from forested area of Sahasralinga); 72 (on 29/06/2015 from MM Arts & Science College, Sirsi city); 113 (on 30/06/2015 from Forested area of Mattigatta); 45 (on 28/06/2015 from Yadalli)]

***Aphanocapsa parietina*² Nägeli (Pl.2, Figure. 15)**

Colony greenish yellow; envelope gelatinous; cells spherical, blue green, homogenous or slightly granular content, densely arranged in center of colony, \pm 4.6 μ diameter.

[Occurrence: on rock; Sample no. 87 (on 29/06/2015 from MM Arts and Science College, Sirsi city)]

Family Microcystaceae

***Gloeocapsa rupicola*² Kützing (Pl.2, Figure. 16)**

Colony small, reddish, with numerous irregular cells, cells densely and irregularly arranged; envelope thick; mucilaginous envelopes enclose the group of cells, individual sheath thin, red, outer sheath not so red or colorless; cells blue green, with granular content, 3.12-4.5 μ diameter.

[Occurrence: from cemented wall of water tank; Sample no. 49 (on 18/04/2016 from Botanical Garden, Bakkal); 143 (on 01/07/2015 from Amballike); 45 (on 28/06/2015 from Yadalli); 93 (on 29/06/2015 from forested area near Shiv Ganga waterfalls)]

***Gloeocapsa atrata*² Kützing (Pl.2, Figure. 17)**

Colony macroscopic, colony diameter 12 μ -24 μ , with colorless envelope, subcolonies with 2-4 cells; cells spherical, slightly elongated before division, individual sheath indistinctly lamellated, 3.9 μ diameter.

[Occurrence: on bark; Sample no. S9 (on 17/04/2016 from forested area of Sahasralinga)]

***Gloeocapsa punctata*² Nägeli (Pl.2, Figure. 14)**

Colonial envelope wide, colony diameter 12.4 μ ; cells bright blue green, spherical, individual sheath colorless, unlamellated or hardly lamellated, 1.5-2.4 μ diameter.

[Occurrence: on rocks ; Sample no. 37 (on 27/06/2015 from plantations in Karasulli)]

***Gloeocapsa biformis*² Ercegović (Pl.2, Figure. 18)**

Colony micro- or macroscopic, irregular, slight yellow, composed of subcolonies; mucilaginous envelope colorless or yellow, hyaline, not lamellated; cell spherical, blue green, 1.5 μ diameter.

[Occurrence: light green rough and thin surface on tree bark, cemented wall, PVC pipe and rock; Sample no. 40 (on 16/04/2016 from Botanical Garden, Bakkal); 46 (on 16/04/2016 from Bislakoppa); 61 (on 18/04/2016 from MM Arts & Science College, Sirsi city); 5 (on 26/06/2015 from Sahasralinga); 106 (on 30/06/2015 from forested area of Mattigatta)]

***Gloeocapsa keutzingianum*² Nägeli (Pl.2, Figure. 19)**

Colony micro or macroscopic, irregular, composed of more or less spherical or ellipsoidal subcolonies; subcolonies enveloped by wide outer firm, delimited, not or indistinctly lamellated, mucilaginous sheath, outer envelope slight yellow or colorless; cells spherical, blue green, 3.1 μ diameter.

[Occurrence: dark green thallus on tree bark; Sample no. 142 (on 01/07/2015 from Amballike); 127 (on 01/07/2015 from Botanical Garden, Bakkal)]

***Gloeocapsa compacta*² Nägeli (Pl.2, Figure. 20)**

Colony micro- or macroscopic, spherical; envelope colorless, delimited; subcolonies having 2-4 cells; with violet (sometimes violet colour more intense on one side than the other one), wide, unlamellated or indistinctly

lamellated; cells blue green, densely arranged, with or sometimes without their own violet, unlamellated sheath; cell spherical, 2.3 – 3.1µ diameter.

[Occurrence: dark green soft velvety thallus on bark; Sample no. 127 (on 01/07/2015 from Sahasralinga); 119 (on 30/06/2015 from forested area of Mattigatta)]

***Gloeocapsa aeruginosa*² Kützing (Pl.3, Figure. 21)**

Colony crusty, granular, amorphous; envelope colorless, slightly lamellated (?) (Because of encrustation lamellation was not clear); subcolonies spherical with colorless sheath; cell blue green, spherical, 3.4µ diameter.

[Occurrence: on bark, grayish green velvety, filamentous on cemented wall of water tank; (Sample no. 46 on 28/06/2015 from Yadalli)]

***Gloeocapsa fusco-lutea*² (Nägeli) Kützing (Pl.3, Figure. 22)**

Colony macroscopic, composed of many celled subcolonies; solitary or small group of cell with 4.6µ wide gelatinous sheath; envelope of subcolony mucilaginous, wide, slightly lamellated, colorless to yellow brown; cells spherical, oval, hemispherical, after division, 1.5–2.3µ diameter.

[Occurrence: dark green on cemented wall; (Sample no. 14 on 26/06/2015 from Forested area of Sahasralinga)]

***Gloeocapsa rupestris*² Kützing (Pl.3, Figure. 23)**

Colony gelatinous, spherical, with yellow envelope; composed of subcolonies with distinct yellow and distinctly lamellated and concentric envelope; cells bright blue green, 5.5-7.8µ diameter with homogenous or slightly granular content, slightly elongated before division.

[Occurrence: brownish matlike and also gelatinous on cemented wall, on bark; Sample no. 49 & 68 (on 28/06/2015 from Yadalli) and 103 (on 30/06/2015 from forested area of Mattigatta)]

***Gloeocapsa violascea*² (Corda) Rabenhorst (Pl.3, Figure. 24)**

Colony spherical; common envelope violet, rough and granular; small subcolonies with violet sheath, not much wide, not or indistinctly lamellated; cell spherical, blue green with granular content, 3.1-4.6µ diameter, irregularly and densely arranged.

[Occurrence: gelatinous on bark; Sample no. 140 (on 01/07/2015 from Amballike)]

***Gloeocapsa alpina*² (Nägeli) Brand (Pl.3, Figure. 28)**

Colony micro- or macroscopic, almost spherical with delimited, colorless or slightly violet, hyaline envelope; subcolonies with more than 2 cells with colorless or dark bluish violet, slightly or distinctly lamellated envelope; cells bright blue green, spherical, after division hemispherical, 4.6µ diameter, with or without individual sheath.

[Occurrence: on bark in forested area; Sample no. 40 (on 17/06/2016 from Botanical Garden, Bakkal)]

***Gloeocapsa sp*² Kützing (Pl.3, Figure. 25)**

Colony spherical; envelope gelatinous; cells spherical with granular content, blue green, sheath greyish blue with indistinct lamellation, diameter 4.6-5.4µ; reproduction by nanocytes.

[Occurrence: on bark (in the mucilaginous colony of *Aphanothece pallida*); Sample no. 114 (on 30/06/2015 from forested area in Mattigatta)]

***Gloeocapsa coracina*² Kützing (Pl.3, Figure. 26)**

Colonies not so large, envelope colorless, unlamellated; subcolonies with 2-4 or many cells, envelope colorless, unlamellated, wide; cells dull blue green, individual sheath indistinctly lamellated, 4-4.5µ diameter.

[Occurrence: on rock and tree bark; Sample no. 86 (on 29/06/2015 from forested area near Shiv Ganga waterfalls)]

Family Chroococcaceae

***Asterocapsa pulchra*² (Gardner) Komárek (Pl.3, Figure. 27)**

Cells solitary or in groups, spherical, with homogenous content, 3µ diameter, blue green; sheath thick, red colored, delimited, inner envelope having spine like ornamentation, lamellated, cell division in three perpendicular planes. [Occurrence: dark green thallus on tree bark; Sample no. 127 (on 01/07/2015 from Botanical garden, Bakkal)]

***Asterocapsa sp*² Chu (Pl.3, Figure. 29)**

Cell solitary, spherical; sheath delimited, colorless or slight yellow, cell content granular, on the surface spine like ornamentation, 3.1-3.9µ diameter.

[Occurrence: on bark; (Sample no. 142 (on 01/07/2015 from Amballike)]

***Gloeocapsopsis crepidinum*² (Thuret) Geitler ex Komárek (Pl.3, Figure. 30)**

Colony micro- or macroscopic; envelope yellow or yellow brown, colorless in young colony, unlamellated; subcolonies having yellow brown envelope; cells blue green, spherical, hemispherical and polygonal, individual sheath unlamellated, thin, ±3µ diameter.

[Occurrence: dark green rough surface on wet bark; Sample no. 41 (on 27/06/2015 from Areca nut plantation in Karasulli)]

***Gloeocapsopsis pleurocapsoides*² (Nováček) Komárek & Anagnostidis (Pl.3, Figure. 31)**

Colony micro- or macroscopic, ±31.2µ diameter; envelope yellow, thick, lamellated, not diffluent; outer envelope slightly yellow or almost colorless, inner or subcolonial sheath intense yellow; cell blue green with homogenous content, spherical, oval, ellipsoidal, subspherical, 9.3-10.9µ diameter. bark; Sample no. 39 (on 27/06/2015 from plantations in Karasulli); 98 (on 29/06/2016 from forested area near waterfalls); 49, 46 (on 28/06/2015 from Yadalli); 116 (on 30/06/2015 from forested area of Mattigatta)]

***Gloeocapsopsis dvorakii*² (Nováček) Komárek & Anagnostidis (Pl.3, Figure. 33)**

Colony micro- or macroscopic; envelope gelatinous; cells blue green, densely and irregularly packed, spherical, oval, or polygonal, with homogenous content, 3.9µ diameter; individual sheath orange red or yellow, unlamellated or indistinctly lamellated, not wide.

[Occurrence: dark green velvety soft thallus on bark; Sample no. 1 & 12 (on 26/06/2015 from Forested area of Sahasralinga)]

***Gloeocapsopsis polyedrica*² (Ercegović) Komárek & Anagnostidis (Pl.3, Figure. 32)**

Colony micro- or macroscopic, spherical; envelope delimited; subcolonies with two or more cells with wide, slightly or unlamellated bluish envelope; sheath thick, unlamellated, colorless or blue or bluish violet; cells spherical, spherical to oval, individual sheath wide, unlamellated or slightly lamellated, 3.9-6.2µ diameter.

[Occurrence: brownish green gelatinous on bark; Sample no. BGA6 (on 01/07/2015 from Botanical Garden, Bakkal)]

***Chroococcus cohaerens*² (Brébisson) Nägeli (Pl.4, Figure. 34)**

Colony micro- or macroscopic, amorphous, spherical; envelope colorless, unlamellated; subcolonies with colorless envelope having 2-4 cells but not fan like arrangement; cell spherical or hemispherical or irregular, blue green, 2.3-3.1µ diameter

[Occurrence: on bark; Sample no. 119 (on 30/06/2015 from forested area of Mattigatta)]

***Chroococcus sp*² Nägeli (Pl.4, Figure. 35)**

Colony microscopic, spherical or irregularly spherical, envelope yellow coloured, wide, rough surfaced; cells spherical or hemispherical or polygonal rounded; violet with homogenous content, 3.1-3.9µ diameter, individual sheath colorless, thin, unlamellated.

[Occurrence: on rock and tree bark; Sample no. 36 (on 27/06/2015 from Areca nut plantation in Karasulli)]

***Chroococcus minor*² (Kützing) Nägeli (Pl.4, Figure. 36)**

Colony spherical or almost spherical, envelope yellowish or colorless, hyaline; cells blue green, densely and irregularly arranged, cells or groups of cells covered by colorless, unlamellated envelope; cell spherical or polygonal rounded with homogenous content, 3.9µ diameter

[Occurrence: dark green patches on areca nut bark; Sample no. 42 (on 27/06/2015 from Areca nut plantation in Karasulli)]

Family Xenococcaceae

***Chroococidiopsis kashayii*² Friedmann (Pl.4, Figure. 37)**

Many colonies grouped together, each colony with 2 or

more cells; envelope colorless or slightly yellowish, unlamellated, delimited; cells bright blue green, hemispherical or polygonal rounded with homogenous content, diameter 3-4.6 µ, individual sheath yellowish, thin and unlamellated, reproduction by baeocytes.

[Occurrence: on bark; Sample no. 68 (on 28/06/2015 from Yadalli)]

***Chroococidiopsis sp*² Geitler (Pl.4, Figure. 40)**

Colony spherical, 15.6µ diameter; envelope gelatinous, colorless, unlamellated; cells dull green, 2.3-3µ diameter, irregularly and in the centre densely arranged, cell polygonal rounded, individual sheath colorless, thin.

[Occurrence: on bark; Sample no. 47 (on 27/06/2015 from areca nut plantations in Karasulli) and 113 (on 30/06/2015 from forested area of Mattigatta)]

***Myxosarcina sp*² Printz (Pl.4, Figure. 38)**

Colony irregular, almost spherical; envelope yellow, subcolonies densely arranged, with thin envelope; cells small, densely and packet like arranged, 2.3-3.1µ diameter, rounded or polygonal.

[Occurrence: dark green velvety on bark; Sample no. 12 (on 26/06/2015 from forested area of Sahasralinga) and 50 (on 28/06/2015 from Yadalli)]

Family Hyellaceae

***Pleurocapsa sp*² Thuret in Hauck (Pl.4, Figure. 39)**

Colony irregular or almost spherical, polar; envelope yellow, thick, delimited, with pseudofilamentous structure; sheath uncontracted; cells spherical, hemispherical or polygonal rounded, 3.1-5.46µ diameter, with granular content, individual sheath yellow, lamellated or unlamellated.

[Occurrence: dark green thick, filamentous velvety matlike thallus on tree bark; Sample no. 103, 133 (on 30/06/2015 from Forested area of Mattigatta)]

***Pleurocapsa aurantiaca*² Geitler (Pl.4, Figure. 41)**

Colony irregular or spherical, polarized, forming pseudofilamentous structure, envelope colorless or yellow and thin or thick, subcolonies with few cells; cells broadly oval, dull blue green, cell content granular, 7-9.3µ x 4.6-6.24µ.

[Occurrence: smooth blackish green jelly on wet cemented wall; Sample no. 27 (on 29/06/2015 from Forested area of Sahasralinga)]

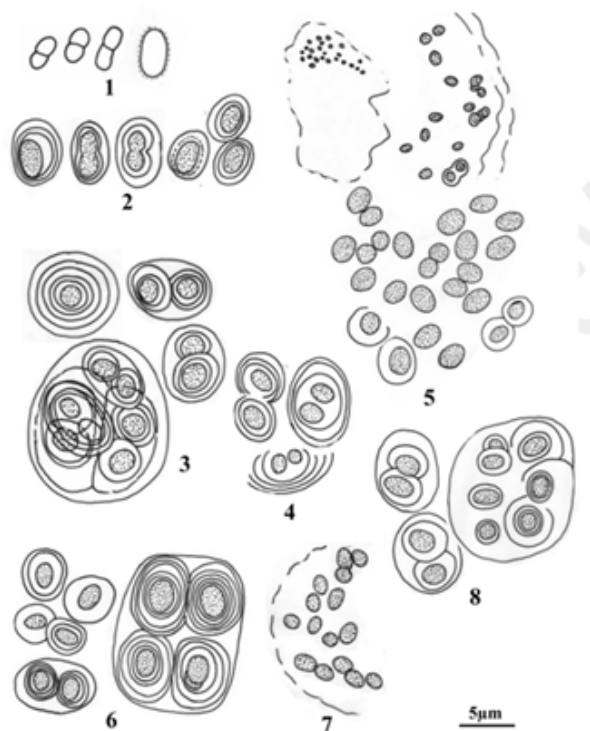


Plate1 (Figure1-8)

1. *Cyanobacterium cedrorum*, 2. *Aphanothece pallida*, 3&7. *Gloeothece samoensis*, 4. *Aphanothece saxicola*, 5. *A. castagnei*, 6. *Gloeothece rupestris*, 8. *G. palea*

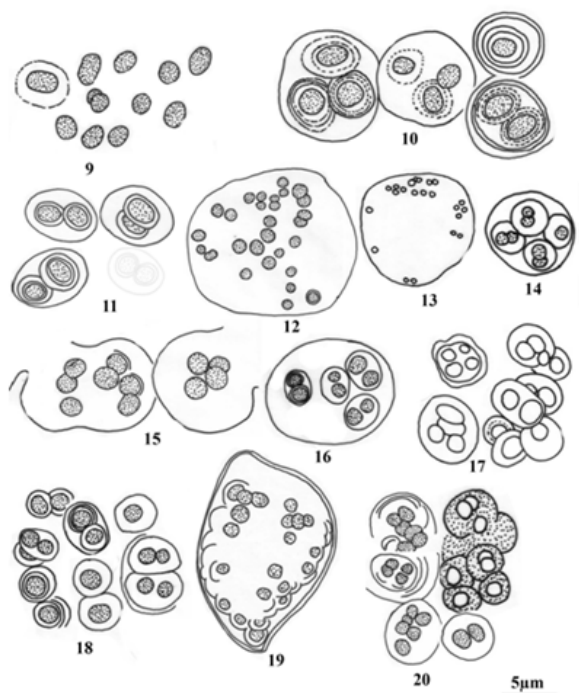


Plate 2 (Figure 9-20)

9. *Gloeothece confluens*, 10. *G. tepidariorum*, 11. *G. fusco-lutea*, 12. *Aphanocapsa muscicola*, 13. *A. fusco-lutea*, 14. *Gloeocapsa punctata*, 15. *A. parietina*, 16. *Gloeocapsa rupicola*, 17. *G. atrata*, 18. *G. biformis*, 19. *G. keutzingianum*, 20. *G. compacta*

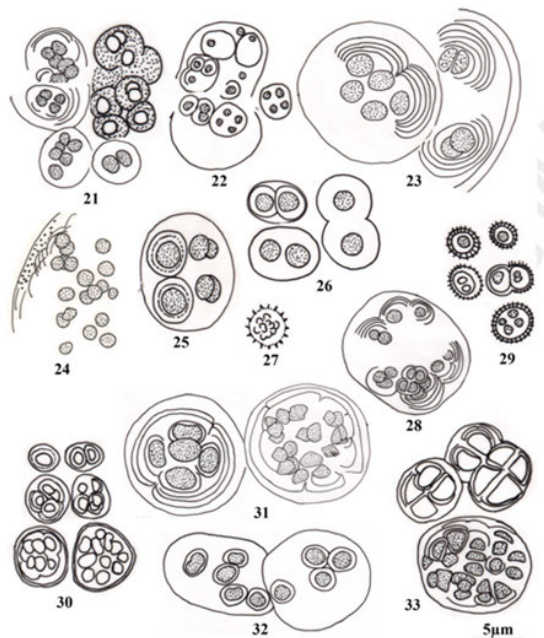


Plate 3 (Figure 21-33)

21. *Gloeocapsa aeruginosa*, 22. *G. fusco-lutea*, 23. *G. rupestris*, 24. *G. violascea*, 25. *Gloeocapsa* sp, 26. *G. coracina*, 27. *Asterocapsa pulchra*, 28. *Gloeocapsa alpina*, 29. *Asterocapsa* sp, 30. *Gloeocapsopsis crepidinum*, 31. *G. pleurocapsoides*, 32. *G. polyedrica*, 33. *G. dvorakii*

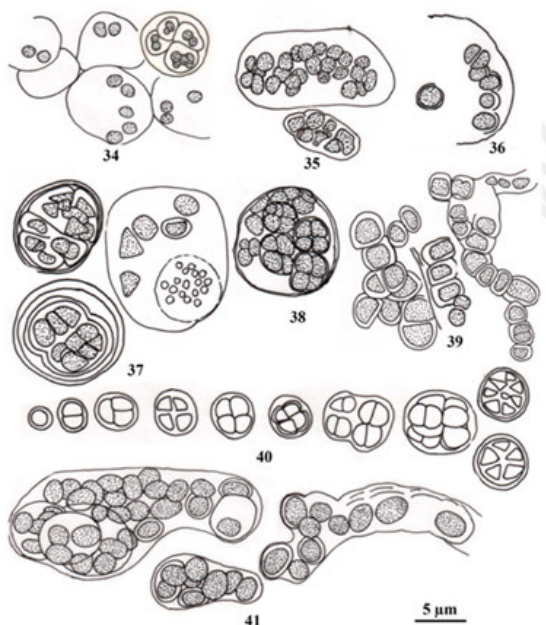


Plate 4 (Figure 34-41)

34. *Chroococcus coherens*, 35. *Chroococcus* sp, 36. *C. minor*, 37. *Chroococidiopsis kashayii*, 38. *Myxosarcina* sp, 39. *Pleurocapsa* sp, 40. *Chroococidiopsis* sp, 41. *Pleurocapsa aurantiaca*

DISCUSSION

Various habitats from Sirsi taluk were screened for the occurrence of coccoid cyanobacteria. Presence of algae was observed in the form of patches or gelatinous or matlike mass (maximum occurrence on bark and also on artificial substratum). A total of 40 coccoid cyanobacteria under 11 genera: *Cyanobacterium*[1], *Aphanothece*[3], *Gloeothece*[6], *Aphanocapsa*[3], *Gloeocapsa*[13], *Asterocapsa*[2], *Gloeocapsopsis*[4], *Chroococcus*[3], *Chroococidiopsis*[2], *Myxosarcina*[1]

and *Pleurocapsa*[2] have been documented in the present investigation. More abundance of cyanobacterial species was seen in comparison to other algal forms in the present study area. Around 60 years back, Desikacharya (1959)¹⁶ had recorded *Gloeothece samoensis* from Madras, with unlamellated sheath and cylindrical cells but Komárek and Anagnostidis (1999)² have described this taxa, (from European countries with temperate climate), with ellipsoidal cell shape and lamellated sheath. Both have described the colorless sheath but the sample collected from Sirsi taluk (with

tropical climate) showed morphology closer to definition given by Komárek and Anagnostidis (1999) but sometimes with slight yellow sheath. Moreover, earlier reports on similar work are evident with 28 coccoid forms from all possible habitats in Satara District (part of Western Ghats), Maharashtra¹⁷. And also Ambika and Krishnamurthy (2016)⁹ have recorded 4 genera *Chroococcus*, *Aphanothece*, *Gloeothece* and *Myxosarcina* with 4 species from bark samples of Kuvempu University campus, Shankaraghatta, Shimoga (average rainfall is 1400mm); whereas 40 coccoid cyanobacterial forms have been documented in the present survey. The result of the present study indicates that species composition and high abundance of subaerial coccoid cyanobacteria in Sirsi taluk basically depends on the ecological conditions, mainly high rainfall which leads to high humidity, one of the critical ecological parameter responsible for dominant cyanobacterial growth.

CONCLUSION

Apart from being one of the most important photosynthetic prokaryotic forms, coccoid cyanobacteria are excellent source of the secondary metabolites. Despite of the major ecological services in the ecosystem, unfortunately the subaerial forms of these

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organisms are the least explored and the most understudied. Literature reveals, publication on subaerial coccoid cyanobacteria from Sirsi taluk has yet, not been recorded. So, this paper may be considered as a pioneer contribution in the field of taxonomy of subaerial coccoid cyanobacteria, especially in Sirsi taluk (Western Ghats), Karnataka, India and may be proven as the fundamental work for future applied aspects. Hence, authors feel elevated in documenting diversity of these cyanobacterial forms which may contribute to the knowledge of diversity to the scientific community.

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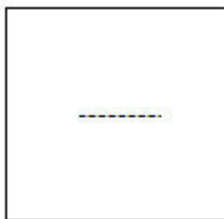
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CONFLICT OF INTEREST

Conflict of interest declared none.

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