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ALGAE FROM THE INLAND SALT PANS

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The western region of Rajasthan contains several inland salt producing centres. The algae from the Sambhar lake have been described by Ruinen (1938) and Subbaramaiah (1972). The algal taxa collected from the inland salt pans at Pachpadra (Barmer district) are being described in this paper.

Key words Inland salt pans; algal taxonomy; Cyanophyta; Volvocales; Ecology.

Salt production from the inland brine is an important industry of the Rajasthan State. The Sambhar lake is well known centre for it but many other salt producing areas are present specially in the Barmer district such as Pachpadra and Phalodi salt basin. In the present communication algal taxa collected in 1987, 1988 on monthly intervals are being recorded. Ghose and Singh (1968) concluded that Pachpadra is a natural depression which developed due to leaching of salts of different solubility during past humid phases and their precipitation according to solubility. Salt production at Pachpadra basin is carried out by constructing large rectangular pits three to five meters in depth water about a meter deep is obtained by seepage from below. These are left to dry in sun, water evaporates leaving behind thick crusts of salts, these are recrystallised for purification. It was found that in these salt pans normally beneath the salt crusts profuse growth of a number of species of *Chlamydomonas* occur in the peripheral region. In the older pans some taxa belonging to Cyanphyceae namely species of *Synechococcus, Oscillatoria* and *Spirulina* were also collected. *Chlamydomonas* with 23 species, *Polyblepharides* and *Dunaliella,* one species each, *Synechococcus* and *Oscillateria* with two species each and a single species of *Spirulina* are described in this communication.

MATERIAL AND METHODS

The algae and the water samples were collected in glass stoppered bottles and polythene containers and brought to the laboratory. Initial studies of pH were made at the site with B.D.H. indicator solutions and then confirmed in the laboratory with glass electrode pH meters. The water samples were analysed by standard methods based on APHA (1980). The morphological studies were made with the living materials, with light and phase-contrast microscopes The identification of the taxa have been done on the bases of Cyanophyta (1959) by Desikachary and Volvocales (1981) by Iyengar and Desikachary.

SYSTEMATIC ENUMERATION OF SPECIES

Polyblepharides singularis Dangeard 1888 (Fig. 1): Cells pyriform to ovoid with thin periplast, posterior end rounded, the anterior end truncated with 8 equal apical flagella, chloroplast cup shaped, single pyrenoid present, eye spot indistinct. Cells 8.0 - 8.5 μm broad 10.0-11.2 μm long, flagella 8.0-10.5 μm long. Collected from old salt pans, Pachpadra.

Dunaliella solina Teod. 1905 (Fig. 2) : Cells ellipsoidal to ovoid, anterior end tapering acutely at the apex with rounded posterior end, 2 equal anterior flagella present, chloroplast cup shaped, a single basal pyrenoid present, eye spot indistinct, contractile vacuole not observed. Cells 6-0-6.8 μm broad, 9.0-10.2 μm long, flagella 8.0-10.2 μm long. Collected from old salt pans, Pachpadra.

Chlamydomonas pseudoepiphytica Iyengar (Fig. 3): Cells broadly ovate to spherical, chloroplast cup-shaped with single pyrenoid at the base, contractile vacuoles 2, present on the anterior end, eye spot indistinct, two equal anterior flagella present, anterior end conical and the posterior end rounded. Cells 8.0-8.5 μm broad, 11.0-11.9 μm long and flagella 10.0-11.2 μm long. Collected from fresh salt pans, Pachpadra.

Chlamydomonas globosa Snow (Fig. 4) : Cells nearly spherical, two equal anterior flagella longer than the cell present, chloroplast cup-shaped with a single basal pyrenoid, cell wall distinct and separated

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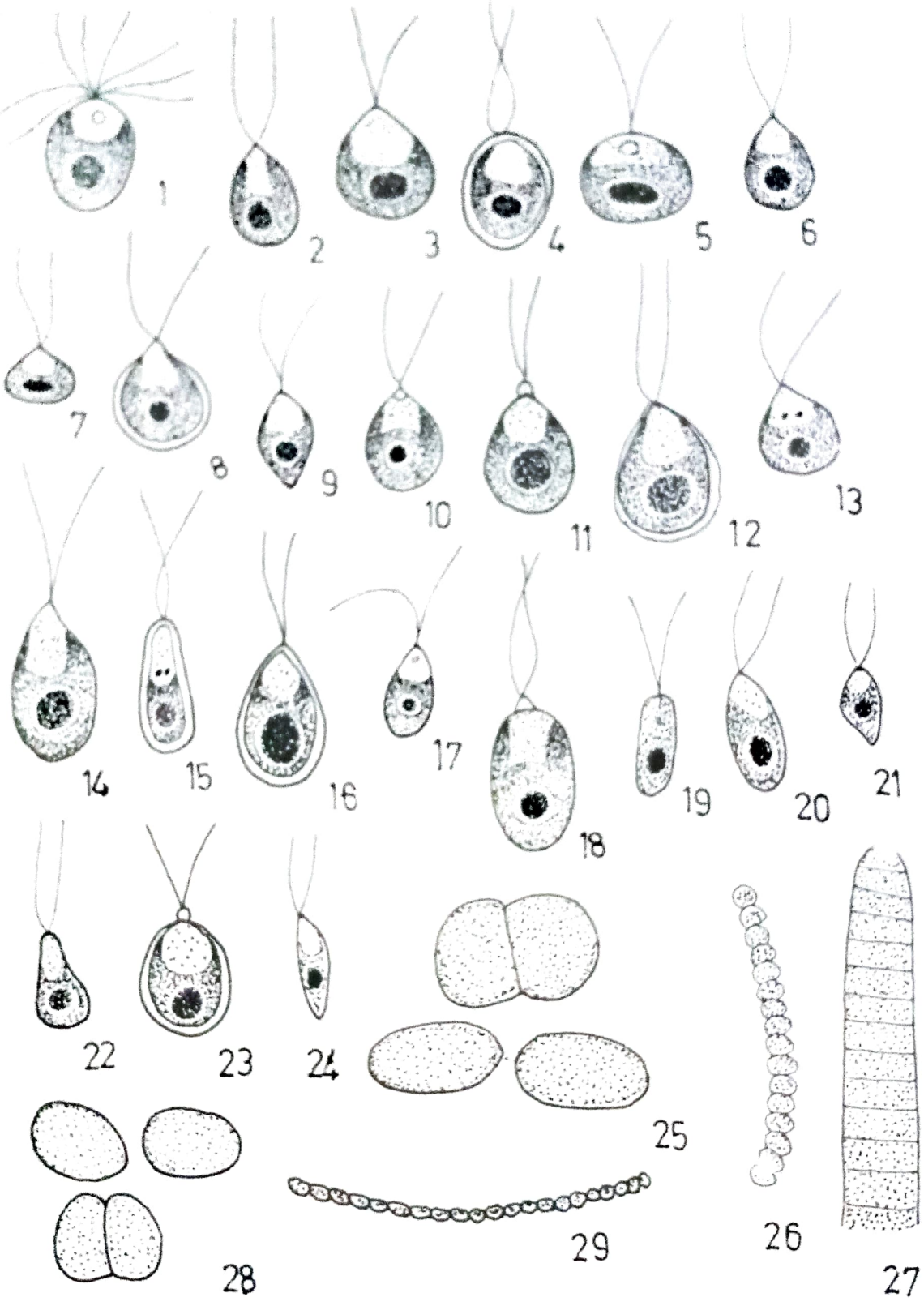

Figures 1–29. Habit diagrams. Fig. 1. *Polyblepharides singularis* Dang., 2 *Dunaliella salina* (Dun.) Toed., 3. *Chlamydomonas pseudoepiphytica* Iyengar, 4. *C. globosa* Snow., 5. *C. orbicularis* E.G. Pring., 6. *C. conoides* Iyengar, 7. *C. coniformis* Pascher, 8. *C. reinhardi* Dang., 9. *C. subcaudata* Wille, 10, *Cumbonata* Pascher, 11. *C. iyengari* Mitrra, 12. *C. conferta* Kors., 13. *C. microsphaera* Pascher & Jahoda, 14. *C. franki* pascher, 15. *C. snowiae* Printz., 16. *C. gracilis* Snow., 17. *C. atactogama* Kirs., 18. *C. cylindrocystiformis* Iyengar, 19. *C. terrestris* Petersen, 20. *C. badensis* Moewus, 21 & 24 *C. acuta* Kors., 22. *C. grandistigma* Mitra, 23. *C. mucicola* Schmidle, 25. *Synechcoccus aeruginosus* Naeg., 26. *Spirulina major* Kutz. ex Gomont., 27. *Oscillatoria subbrevis* Schmidle, 28. *Synechococcus cedrorum* Sauvageau, 29. *Oscillatoria limnetica* Lemm.

from the protoplast, eye spot indistinct. Cells 6.0-6.8 μm broad and 12.0-13.6 μm long, flagella 13.0-15.3 μm long. Collected from old salt pans, Pachpadra.

Chlamydomonas orbicularis E.G. Pring (Fig. 5): Cells spherical, chloroplast cup-shaped, cell wall distinct, two equal anterior flagella longer than the cell present, two contractile vacuoles present at the base of flagella, single basal pyrenoid present, apapillate. Cells 8.0-8.5 μm across and flagella 11.0-13.6 μm long. Collected from old salt pans, Pachpadra.

Chlamydomonas conoides Iyengar (Fig. 6): Cells pyriform, Chlorplast cup-shaped, contractile vacuoles two present at the anterior end, cell wall distinct slightly separated from the protoplast, single basal pyrenoid present, eye spot indistinct, two equal anterior flagella longer than the cell present on the anterior end, anterior end tapering and the posterior end rounded. Cells 4.0-5.1 μm broad and 10.0-10.5 μm long. Collected from old salt pans, Pachpadra.

Chlamydomonas coniformis Pascher (Fig. 7) : Cells conical with a rounded posterior end, chloroplast cup-shaped with a single basal pyrenoid, eye spot indistinct, two equal apical flagella longer than the cell present. Cells 5.0-5.8 μm broad and 5.0-6.8 μm long, flagella 10.0 11.9 μm long. Collected from old salt pans, Pachpadra.

Chlamydomonas reinhardi Dang (Fig. 8) : Cells nearly spherical, cell wall distinct; removed from the protoplast, a small anterior plasma papilla present, chloroplast cup-shaped with a single basal pyrenoid; flagella two; equal apical and longer than the cell. Cells 8.0-10.2 μm broad and 13.0-15.3 μm long. Flagella 15.0-17.0 μm long. Collected from old salt pans, Pachpadra.

Chlamydomonas subcaudata Wille (Fig. 9): Cells ellipsoidal to slightly elongated, cell wall distinct, anterior end broader with a small papilla while the posterior end is pointed, eye spot indistinct, chloroplast cup shaped with a single basal pyrenoid, two equal anterior flagella, slightly longer than the cell, present. Cells 6.0-8.6 μm broad and 10.0-11.9 μm long, flagella 10.0-13.6 μm long. Collected from fresh salt pan, Pachpadra.

Chlamydomonas umbonata Pascher (Fig. 10) : Cells spherical or slightly elongated, posterior end rounded, anterior end conical with a pointed papilla, chloroplast thick and cup shaped with a basal pyrenoid, eye spot indistinct, flagella two; equal and anterior, slightly longer than the body. Cells 6.0-6.8 μm broad and 11.0-11.9 μm long, flagella 12.0-13.6 μm long. Collected from old salt pans, Pachpadra.

Chlamydomonas iyengari Mitra (Fig. 11) : Cells subspherical, chloroplast cup-shaped with single rounded basal pyrenoid, two median eye spots present, posterior end rounded, anterior end tapering to a truncated hyaline papilla, cell wall distinct and removed from protoplast, flagella two; equal and anterior, as long as the body arising from the hyaline papilla. Cells 6.0-8.8 μm broad and 11.0-11.9 μm long, flagella 12.2-13.6 μm long. Collected from old salt pan, Pachpadra.

Chlamydomonas conferta Kors (Fig. 12) : Cells subspherical, posterior end broadly roun-ded, anterior end narrowing with small pointed papilla, cellwall thick and slightly removed from the protoplast, chloroplast cup shaped, a single rounded median pyrenoid present, eye spot and contractile vacuole indistinct, two equall anterior flagella arising from the papilla, slightly longer than the body. Cells 10.2-13.8 μm across and flagella 13.0-15.3 μm long. Collected from old salt pan, Pachpadra.

Chlamydomonas microsphaera Pascher and Jahoda (Fig. 13) : Cells spherical, chloroplast cup shaped with a basal pyrenoid, two eye spots present in the middle of the cell, anterior end tapering with a small hyaline papilla, cell wall distinct, flagella two, equal or slightly longer than the body. Cells 8.0-8.5 μm across and flagella 8.0-9.5 μm long. Collected from old salt pan, Pachpadra.

Chlamyodomonas frankii Pascher (Fig. 14) : Cells long and ovate, both ends narrowing with a small anterior papilla, chloroplast cup-shaped with a single median pyrenodi, eye spots two, flagella two equal and longer than the cell. Cells 3.0-3.6 μm broad and 5.1-6.5 μm long, flagella 6.0-6.8 μm long. Collected from old salt pan, Pachpadra.

Chlamydomonas snowiae Printz (Fig. 15) : Cells ellipsoidal with cup shaped chloroplast, a single rounded basal pyrenoid, flagella two as long as the cell, posterior end rounded and anterior end slightly tapering with small hyaline papilla, cell wall distinct, contractile vacuole indistinct, eye spot non-discernible. Cells 8.0-8.8 μm broad and 11.9-12.6 μm long, flagella 12.0-13.6 μm long. Collected from old salt pan, Pachpadra.

Chlamydomonas gracilis Snow (Fig. 16) : Cells ellipsoidal to oblong, cells wall thick, removed from the protoplast, contractile vacuoles two, chloroplast cup-shaped, posterior end rounded and the anterior end slightly tapering with small hyaline papilla, eye spots two and median, two equal flagella arising from the base of the papilla, flagella as long as the body. Cells 5.0-5.6 μm broad and 15.0-17.0 μm long. Flagella 17.0-18.7 μm long. Collected from old Salt pan, Pachpadra.

Chlamydomonas atactogama Kors (Fig. 17) : Cells subspherical and slightly ellipsoidal, chloroplast cup-shaped with median pyrenoid, eye spots two, contractile vacuole indistinct, posterior end rounded, the anterior end with small hemispherical papilla, cell wall distinct and removed from the protoplast, two equal flagella as long as the body present. Cells 8.5-9.0 μm broad and 13.0-13.6 μm long. Flagella 13.0-14.6 μm long. Collected from old salt pan, Pachpadra.

Chlamydomonas cylindrocystiformis Iyengar (Fig. 18) : Cells ellipsoidal, posterior end rounded, anterior end with small papilla, chloroplast cup-shaped, lateral with basal rounded pyrenoid, eye spot indistinct, two equal anterior flagella as long as the body present, cell wall distinct. Cells 3.4-4.5 μm broad and 8.0-10.2 μm long, flagella 10.5-11.2 μm long. Collected from old salt pan, Pachpadra.

Chlamydomonas terrestris Petersen (Fig. 19) : Cells elongate to ellipsoidal, chloroplast lateral, a single rounded lateral pyrenoid present, eye spot indistinct, flagella two, equal and as long as the body, cell wall distinct. Cells 3.4-4.5 μm broad and 8.0-10.2 μm long, Flagella 14.5-16.5 μm long. Collected from old salt pan, Pachpadra.

Chlamydomonas badensis Moewus (Fig. 20) : Cells cylindrical, both ends rounded, eye spot indistinct, chloroplast lateral with a single pyrenoid, cells wall removed from the protoplast, flagella two slightly longer than the body. Cells 5.0-6.5 μm broad and 8.0-10.2 μm long, flagella 10.2-11.9 μm long. Collected from old salt pan, Pachpadra.

Chlamydomonas acuta Kors (Figs. 21, 24) : Cells short spindle shaped, both ends pointed, cell wall thin, chloroplast, cup-shaped with single basal pyrenoid, eye spot indistinct, a tiny papilla present at the anterior end, flagella two, equal as long the body. Cells 5.0-6.5 μm broad and 6.0-6.8 μm long, flagella 6.8-7.0 μm long. Collected from old salt pan, Pachpadra.

Chlamydomonas grandistigma Mitra (Fig. 22) : Cells elongated to ellipsoidal, asymmetrical, posterior end broadly rounded, anterior end gradually narrowed, chloroplast cup-shaped with a single basal pyrenoid, two equal and anterior flagella slightly longer than the body. Cells 3.4-5.1 μm broad and 7.0-8.6 μm long, flagella 8.0-10.2 μm long. Collected from fresh salt pan, Pachpadra.

Chlamydomonas mucicola Schmidle (Fig. 23) : Cells ellipsoidal to elongated, posterior end rounded and anterior end slightly narrowed and pointed, chloroplast cup shaped with single basal pyrenoid, eye spot indistinct, flagella two slightly longer than the body. Cells 3.4-4.0 μm broad and 6.0-8.5 μm long, flagella 8.0-10.2 μm long. Collected from fresh salt pan, Pachpadra.

Synechococcus aeruginosus Nag (Fig. 25) : Cells single or two together, cylindrical, granular and plae green in appearance. Cells 6.5-6.8 μm broad and 8.5-8.8 μm long. Colleceted from all salt pans Pacnpadra, growing with other species of *Chlamydomonas*, *Oscillatoria* and *Spirulina*.

Synechococcus cedrorum Saugeau (Fig. 28) : Cells single or in two, elongate or cylindrical, blue-green. Cells 3.2-3.5 μm broad and 13.2-13.8 μm long. Collected from several salt pans, Pachpadra, growing with other algae.

Spirulina major Kutz. ex Gomont (Fig. 26) : Trichomes single, regularly spirally coiled, blue-green. Trichome 1.7-2.0 μm broad, spirals 2.2-2.4 μm broad and 2.0-2.2 μm distant. Collected from old salt pans, Pachpadra, April to June collections, growing mixed with other algal species.

Oscillatoria subbrevis Schmidle (Fig. 27) : Trichomes single, straight, end cells rounded and without granulations. Trichomes 5.0-5.6 μm broad. Colleceted from several salt pans, Pachpadra, April to June, growing with other algae.

Oscillatoria limnetica Lemm (Fig. 29) : Trichomes straight, thallus amorphous, trichomes constricted at the cross walls, pale blue-green. Trichomes 1.5-1.7 μm broad. Collected from fresh salt pans, Pachpadra, June 1988, growing with other algae.

RESULTS AND DISCUSSION

The Pachpadra salt brine provides a hostile environment for the growth of normal algal flora and only those which can withstand the high salt contents thrive in it. The flora though rich in number shows, limited taxa in it. The physical and chemical parameters of the habitats have been studied and the water samples were analysed by standard methods (APHA 1980) 15 Ed.) The parameters studied with the mean ± standard deviation are pH 6.95 ± 0.32; salinity with 4630.0 ± 920.0; chloride 1810.0 ± 958.0; total hardness 1060.0±58.6; calcium hardness 21.5±10.79; magnesium hardness 31.41±23.41; calcium 8.66±00.53; magnesium 13.5±3.11; total alkalinity 2330.0±74.0; carbonate C.37±0.36; bicarbonate 3100.0±57.0; total carbon dioxide 82.08±0.86; free carbon di oxide 27.5±5.69; nitrate 3.00±1.91; nitrite 12.6±4.72; phosphate 5.59 +1.33 and total dissolved solids 2150.0±92.0 (All values in ppm except pH.)

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