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Cell Wall Composition of the Generic Phase of *Bangia atropurpurea* (Rhodophyta)

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Abstract

Mechanically isolated cell walls were prepared from the generic phase of *Bangia atropurpurea* and chemically characterized. Electron microscopic examination of cell wall preparations revealed them to be morphologically similar to walls of whole thalli and free from protoplasmic contamination. The chemical composition of over 92% of the total wall weight was determined and polysaccharides were the major wall components (72% of wall weight). Mannan (at least part of which is β -1,4-linked) and a water soluble galactan fraction consisting of both D- and L-galactose residues in a ratio of 1:1.1 represents a large proportion of the carbohydrate content of isolated cell walls. In addition, 3,6-anhydrogalactose is probably associated with the water-soluble galactoses. The presence of cellulose could not be demonstrated. Protein was a significant wall component (10.6% of total wall weight) and consisted of at least 16 amino-acids, including hydroxyproline (0.3% of wall weight). Walls also contained 8.4% lipid and 1.4% ash.

Introduction

Marine algae possess a wide variety of economically important polysaccharides. Polysaccharides of the Rhodophyta, in addition to their commercial value, also have been used in studies on the chemistry and structure of polymer gels (Rees 1969, Morris *et al.* 1980) and for assessment of taxonomic relationships (Stoloff and Silva 1957, Klein and Cronquist 1967, Parker 1970, Lewin 1974, Percival 1978, McCandless 1978). The most thoroughly studied of these polysaccharides are the galactans comprising the hot-water soluble portion of the cell wall. Less well-known red algal cell wall carbohydrates include various mannans, xylans, and glucans. The majority of polysaccharides characterized from red algae have been extracted from field-collected whole thalli by various chemical procedures. A complete analysis of cell wall preparations devoid of other cellular constituents has shown that noncarbohydrate components (e.g., lipid and protein) make up part of the cell wall of several green algae (Northcote *et al.* 1958, 1960, Punnett and Derrenbacker 1966, Burczyk 1973, Miller *et al.* 1974, Dodson and Aronson 1978). However, a complete accounting of major constituents of clean, mechanically isolated cell walls has, to our knowledge, rarely been successfully accomplished in the Rhodophyta, although mechanically isolated preparations of the cuticle of *Iridaea*, the septal plugs of *Griffithsia*, and the cell wall carbohydrate and protein content of *Porphyra tenera* have

been examined (Ramus 1971, Gerwick and Lang 1977, Mukai *et al.* 1981). In this paper we report the chemical composition of mechanically-isolated cell walls of the generic phase of the red alga *Bangia atropurpurea*.

Materials and Methods

Cultivation

Bangia atropurpurea (Roth) C. Ag. [= *B. fuscopurpurea* (Dillw.) Lyngb.] was isolated from an intertidal collection from south of Bald Head Cliff, York, Maine (Sommerfeld and Nichols 1973) and was cultured in one liter Erlenmeyer flasks containing 300 ml of sterile medium consisting of a 1:4 (v/v) mixture of artificial sea water (Jones *et al.* 1963) and von Stosch medium (Stosch 1964). Cultures were maintained at 15 °C on a 12/12 LD cycle for 21 days with cool white fluorescent illumination (approximately 2500 lux) during light periods. Prior to harvest, cultures were allowed to remain in the dark for seven days (at 15 °C) to deplete the floridean starch reserve, a potential source of polysaccharide contamination of isolated walls.

Cell wall isolation

Mechanically-isolated cell walls were obtained by a modification of the procedure of Bertke and Aronson (1980). During all steps in the isolation procedure,