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Seaweeds are being used as source of food, fertilizer, feed, chemicals, medicine etc. Nutritional value of various edible and non-edible seaweeds have been investigated by Chapman and Chapman (1980), Ito and Hori (1980), Fujiwara-Arasaki et al., (1984), Fleurence (1999), Sánchez-Machado et al., (2004), Philpott and Bradford (2006), MacArtain et al., (2007), Kim et al., (2008), Matanjun et al., (2009) and Holdt and Kraan (2011) where they have discussed about application of seaweeds as food and their role in combating various ailments. Mendis and Kim (2011) examined scope of seaweeds as a functional food to fulfill present and future food demand. Although several reports are available on different aspects of some important commercial seaweeds like Ulva, Enteromorpha, Monostroma, Laminaria, Undaria, Hizikia, Porphyra, Gelidium, Kappaphycus etc. Only a few reports are available focusing nutritional value of Sargassum and Gracilaria (Chan et al., 1997; Norziah and Ching, 2000; McDermid and Stuercke, 2003; Haque et al., 2009). Many reports suggest that seaweeds are quite rich in various types of micro and macro nutrient such as calcium, sodium, magnesium, iron etc. (Rupérez, 2002; Almela et al., 2006; Dawczynski et al., 2007a and 2007b). The mineral content of seaweeds is highly significant and is probably responsible for many health benefits such as treating goiter (Burtin, 2003; Mendis and Kim, 2011). Ramlov et al., (2011) discussed the effects of the interaction of irradiance and nutrient level on growth and nutritional properties of seaweeds. Pillai (1956, 1957a and 1957b) studied the mineral constituent of many Indian seaweeds.

Seasonal studies were considered as an important parameter from an industrial and nutritional point of view, by many phycologists. However, only a few studies have highlighted the influence of certain environmental factors on the biology of seaweeds (El-Naggar, 1994). Abdel-Fattah and Hussein (1970) studied seasonal changes in biochemical properties of Cystoseira and Sargassum which is one of the first reports of its kind. Seasonal biochemical changes for various seaweeds were studied in Macrocystis pyrifera (Brown et al., 1997), Ecklonia cava (Iwao et al., 2008) and Catenella repens (Banerjee et al., 2009). Variations in biochemical composition during summer to winter in tropical Australian marine seaweeds were
studied by Renaud and Luong-Van (2006). Seasonal changes in carbon, nitrogen and major organic compounds and their significance to morpho-functional processes in brown seaweed was investigated by Gómez and Wiencke (1998). Some reports are also available on seasonality in biochemical composition of Sargassum and Gracilaria species such as Gorham and Lewey, 1984 (S. muticum); Prasad, 1986 (Jamaican species of Gracilaria); Dawes, 1987 (Caribbean species of Sargassum); Stiger and Payri, 1999, Zubia et al., 2003 (S. mangarevense); Marinho-Soriano et al., 2006 (G. cervicornis and S. vulgare) and Murakami et al., 2011 (S. horneri). Nutritional properties of seaweeds changes in different parts of the same thallus. Prince and Daly (1981) and Dawes (1987) studied the seasonal biochemical changes in different parts of the same thallus in Sargassum filipendula and S. pteropleuron. Givernaud et al., (1999) described seasonal variations on growth, ash and agar composition of Gracilaria multipartita. Devi et al., (2009) focused their study on element composition of various seaweeds from Gulf of Mannar. There are limited reports available on biochemical analysis of Sargassum and Gracilaria species from Southeast coast of India (Kalesh, 2003; Manivannan et al., 2008 and 2009).

Alginate, agar and carrageenan are major soluble polysaccharides in seaweeds and various reports are available on their structure, biosynthesis and function (Bird and Haas 1931; Mateus et al., 1977; Percival, 1979). Worldwide main source of alginates are members of Laminariales and Fucales out of which species of Sargassum and Turbinaria play a major role in India and Philippines. Various reports have been published on different methods of extraction and properties of alginates such as Hernández-Carmona et al., (1999); Horn et al., (1999); McHugh et al., (2001); Usov et al., (2001) and Vauchel et al., (2008). Zubia et al., (2008) compared alginic acid and mannitol content of Sargassum mangarevense and Turbinaria ornata with other species of Sargassum and Turbinaria reported by that time. Cheshire and Hallam (1985) studied the correlation of dry weight of lamina and stipe region of Durvillaea potatorum with alginic acid yield. Effects of formalin and different acids on alginate yield from Macrocystis pyrifera was studied by Hernández-Carmona et al., (1999). Effect of temperature and time on alginate extraction from Sargassum species was examined by Torres et al., (2007). Seasonality in alginate content has also been investigated in various brown seaweeds such as Ecklonia radiata.
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(Stewart et al., 1961), Undaria pinnatifida (Skripsova et al., 2004), Macrocystis pyrïfera (McKee et al., 1992). Variations in average yield and viscosity of alginate and mannitol content during different periods of the year was investigated by Rodríguez-Montesinos et al., (2008). Ganesan et al., (2001) studied the effect of different storage methods of Sargassum wightii and Turbinaria conoides on alginate yield. Sobha et al., (2009) discussed the seasonal variation of alginic acid content in various parts of S. wightii and Padina tetrastromatica. Seasonal study on the alginate content and biochemical composition of Sargassum species from Indian coast was studied by Saraswathi et al., (2003). Very few reports are available on seasonal variation in biochemical constituents of S. wightii with reference to alginic acid yield (Jayashankar, 1993; Rao, 1994).


The conversion of marine algal biomass into energy was first investigated in USA and Japan as an alternative source of energy during 1970’s after the oil crisis. However, these studies discontinued due to stabilization of oil prices in the global market (Bird and Benson, 1987; Chynoweth et al., 2001; Yokoyama et al., 2007). With the resurgence of interests in algal biofuels, attention has again turned to macroalgae as a possible feedstock for the production of bioethanol. Moen et al., (1997a and 1997b); Horn (2000); Horn et al., (2000a and 2000b); Horn and Østgaard (2001) stated the possibilities of bioethanol production from Laminaria and Ascophyllum.

Mitsubishi Research Institute Japan, has emerged as a leading industry-academia consortium for research on bioethanol production from seaweeds (Roesijadi et al., 2010). Some reports are also available on biofuel factory concept near Exclusive Economic Zone (EEZ) (Notoya, 2010). Several European institutions are currently investigating the production of macroalgae for conversion to methane and ethanol as part of this program. Prototypes for offshore growth of the kelp *Laminaria*
have been successfully tested in the North Sea (Buck and Buchholz, 2004; Roesijadi et al., 2010). However, limited reports have been published on algal biorefinery concept (Goh and Lee, 2010; Subhadra and Grinson-George, 2010; Singh and Gu, 2010; Singh and Olsen, 2011). But, very few reports are available on use of remaining pulp or waste of seaweeds based industry such as Fleury and Lahaye (1993a and 1993b). Ge et al., (2011) used floating residue, a surplus byproduct from alginate extraction process, to produce ethanol. Recently Sahoo et al., (2012) discussed the potential of leftover seaweed pulp as a feedstock for bioethanol production in a biorefinery approach. Therefore, using total biomass of any feedstock for integrated production of food, energy and other useful products based on zero waste concept is a relatively new and novel idea where much literature is not available.