Pakistan Journal of Marine Sciences, Vol. 25(1&2), 15-25, 2016.

EXTRACTION AND ESTIMATION OF IODINE FROM BROWN SEAWEEDS, OF KARACHI COAST, PAKISTAN

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ABSTRACT: Iodine is not only essential for thyroid function, but it is also beneficial for other organs of the body for example, prostate gland tissue, pancreas, gall bladder, kidneys, adrenals and even the liver. Brown seaweeds extracts are very rich in sea minerals with the supreme amount of iodine. In the present study, iodine was extracted from 6 different brown seaweeds representing three classes: *Colpomenia sinuosa* and *Iyengaria stellata* of class Laminarophyceae, *Sargassum spp.* of class Fucaceae, *Padina pavonica* and *Spatoglossum variabile* of class Dictyotaceae. The samples of Brown Seaweeds were collected from Buleji and Manora Rocky Ledges of Karachi coast. The level of iodine was measured in the range of 500ppm to 1000ppm by applying classical procedure. The maximum level was recorded in *Sargassum carpophyllum and S. tenerrimum* whereas the minimum was found in *Padina pavonica*.

KEYWORDS: Brown seaweeds, iodine, Fucaceae, extraction, Karachi coast, Pakistan.

INTRODUCTION

Phylum Phaeophycota members are generally known as Brown seaweeds. There are omit approximately 1500- 2000 species are found all over the world (Hoek *et al.*, 1995). Approximately, 29 genera and 90 species of brown seaweeds were identified along the coast of Pakistan (Shameel and Tanaka, 1992; Aisha and Shameel 2009, 2010, 2012 a,b,c, 2013). Numerous brown seaweeds are used on commercial scale throughout the world. Omit as food and as household products (McCoy, 1987). Most of the brown seaweeds are rich in proteins, iodine, carbohydrate, trace elements and amino acid (Waaland, 1981; Kaur, 1997). Iodine contents in seaweeds species depend on omit their different parts of thallus and is characteristically highest in fresh cut blades as compare to sun bleached blades (Teas *et al.*, 2004).

At least 13,000 years, seaweeds have been exploited for human as medicine and food. At late Pleistocene settlement in Chile (Rosen and Dillehay, 1997; Ugent and Tindall, 1997) discoveries based on seaweeds found at Monte Verde and Jomon period in Japan, an archeological inference from ancient sites (Arasaki and Arasaki , 1983) seaweeds utilize in three most important medical purpose: Ayurvedic medicine from 400 BC (Misra and Sinha, 1979), Traditional Chinese Medicine, reported by Shen-nung in the Chinese Materia Medica of 2700 BC outstanding medicinal qualities of seaweeds (Hoppe, 1979) and in the Ebers Papyrus, Egyptian used in medical treatment, in about 1550 BC (Loeser, 1956). Seaweeds uses as in medical treatment are enormous from goiter therapy to topical burn therapy to softening of tumors (Schwimmer and Schwimmer, 1955).

In Japan, about 20 different species of red, green and brown seaweeds integrated in meals. Three most renowned seaweeds products used as a meal in Japan are wakame (*Undaria*), nori (*Porphyra*) and Kombu (*Laminaria*). Kombu which made from (*Laminaria*) brown seaweeds iodine content in this seaweed throughout the world was examined to standard 1,542µg/g dried weight. In Japan, iodine contents in kombu and wakame were predictable 2353µg/g in kombu and 42µg/g in wakame respectively (Nagataki, 2008). Wakame and nori contains low amount of iodine contents as compared to kombu (Zava and Zava, 2011). Seaweeds put away as a flavor dishes or soup stock. Iodine is water soluble, when kombu boil in water for just 15 minutes it can misplace up to 99% of its iodine content, while iodine present in *Sargassum* another brown seaweed, loses approximately 40% when boil in water (Hou *et al.*, 1997 and Ishizuki *et al.*, 1989). Organic form of iodine occurs in high amount in many types of seaweed. Food materials which invent from marine have high content of iodine because marine plants and animals concentrate iodine from seawater (Zimmermann, 2009).

Seaweeds have exclusive potential to concentrate iodine from the ocean and with numerous types of brown seaweeds accumulating over 30,000 times the iodine absorption of sea water (Kupper *et al.*, 1998). In United States chief sources of iodine are bread and milk (Pearce *et al.*, 2004). In Switzerland, frequent intake of dietary iodine is just about 140µg/d, mostly from bread and dairy products (Haldimann *et al.*, 2005). In Pakistan, a number of work have been done on the taxonomy, distribution (Anand, 1940, 1943; Nizamuddin 1964; Afaq-Hussain and Shameel, 1991; Shameel, 2000; Saifullah, 1973; Shameel *et al.*, 1996, Hameed *et al.*, 2001; Aisha and Shameel, 2012) phycochemistry (Shameel, 1990; Usmanghani and Shameel, 1996) and biological and elemental constituents (Usmani *et al.*, 1991; Siddiqui *et al.*, 1993; Rizvi and Shameel, 2001, 2005).

In this context the present work designed to determine the iodine level in three different classes of brown seaweeds available at two rocky ledges of Buleji and Manora located in Karachi coast.

MATERIALS AND METHOD

Samples were collected from Buleji (24^{O} 50´N, 66^{O}48´ E) and Manora (24^{O} 48´ N 66^{O} 58´ E) located southwest of Karachi facing open Arabian sea in (Fig.1).

Sample collection:

The fresh thalli of brown seaweeds were collected during the winter season from inter tidal rocky ledges of two different sites Buleji and Manora. Fresh thallus of these seaweeds were handpicked from hold fast, together in polythene bags and brought to the laboratory where they were refrigerate at 4^{o}C overnight.

Sampling protocol:

On next morning fresh thallus of these seaweeds were washed thoroughly with tape water to remove debris and soil particulates attached to the thallus. All the samples were dispersed individually on blotting paper and left next to 2 – 3 days for air dried. All dried samples were kept in separate plastic bags to use for iodine extraction and stock for further analysis and so on.

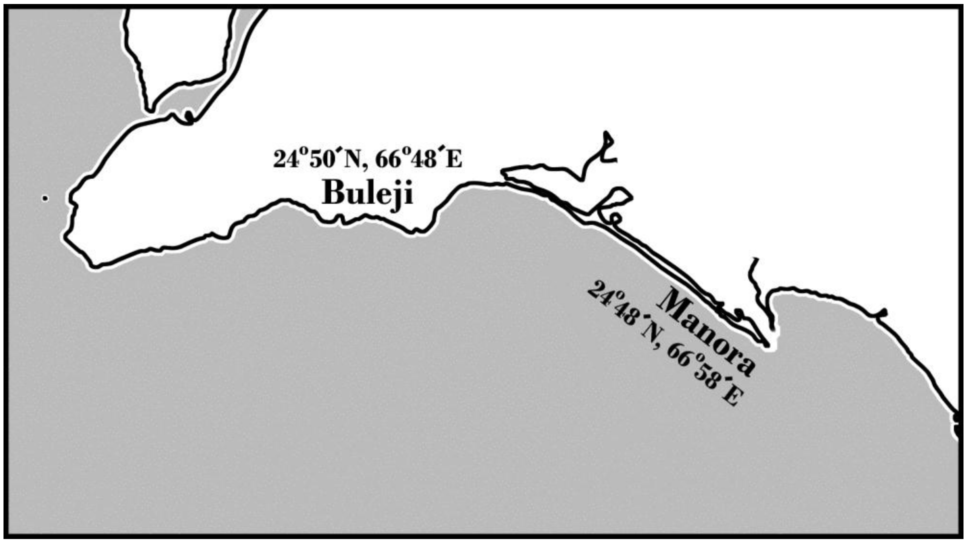

Fig.1. Map showing the location of sampling sites.

Methodology:

Approximately take 4gm dried seaweeds in an evaporating dish, burn them towards ash in a fume cupboard. When seaweeds convert to ash form shift the ash in to a small beaker and boil with 30ml deionized water for about 05 minutes. After that, filter it into a boiling tube, then add dilute sulphuric acid 5mlafterward add 10ml hydrogen peroxide. Removal the mixture into a separating funnel and then last add 10ml of petroleum ether. Cork the funnel and inverting the funnel quite a lot of times until the contents mix well. Pressure built up inside the funnel, eliminate pressure by removing the cork. Run the (super latent layer) upper organic layer into a test tube labelled as Iodine extract from seaweed. At final stage iodine extract from petroleum ether and conclude the mass of iodine achieved.

Table 1. Iodine concentration (mg/g ± SD) in individual seaweed samples.

Seaweeds Name	Concentration of iodine in an individual sample (mg/g ± SD)	Range of Concentration of iodine in Classes (mg/g)
Colpomenia sinuosa	22.5 ± 9.50	2.5 – 37.5mg/g
Iyengaria stellata	16.5 ± 5.00	
Padina pavonica	5.83 ± 2.30	2.5 – 15mg/g
Spatoglossum variabile	8.75 ± 3.50	
Sargassum carpophyllum	82.5 ± 30.22	7.5 – 152.5mg/g
Sargassum tenerrimum	35 ± 18.60	

RESULTS AND DISCUSSION

In this study level of iodine with standard deviation extracted from dried forms of different brown seaweeds belongs to three classes, Laminarophyceae, Dictytaceae, Fucaceae depicted in Table 1. The brown seaweed *Colpomenia sinuosa* and *Iyengaria stellata* belongs to class Laminarophyceae while *Padina pavonica* and *Spatoglossum varibile* belongs to Dictyotaceae and *Sargassum carpophyllum* and *S. tenerrimum* belongs to Fucaceae. The highest percentage of iodine measured in class Fucaceae i.e. 68% (Fig. 2) and the peak level was recorded in *Saragassum carpophyllum* and the second highest value shown by *S. tenerrimum*. Eventually, the lowest percentage (10 %) of iodine in class Dictyotaceae while the least concentration of iodine observed in *Padina pavonica.* In contrast, the moderate percentage of iodine showed in class Laminariohyceae i.e. (22%) among this class *Iyengaria stellata* depicted with lowest value in Table 1.

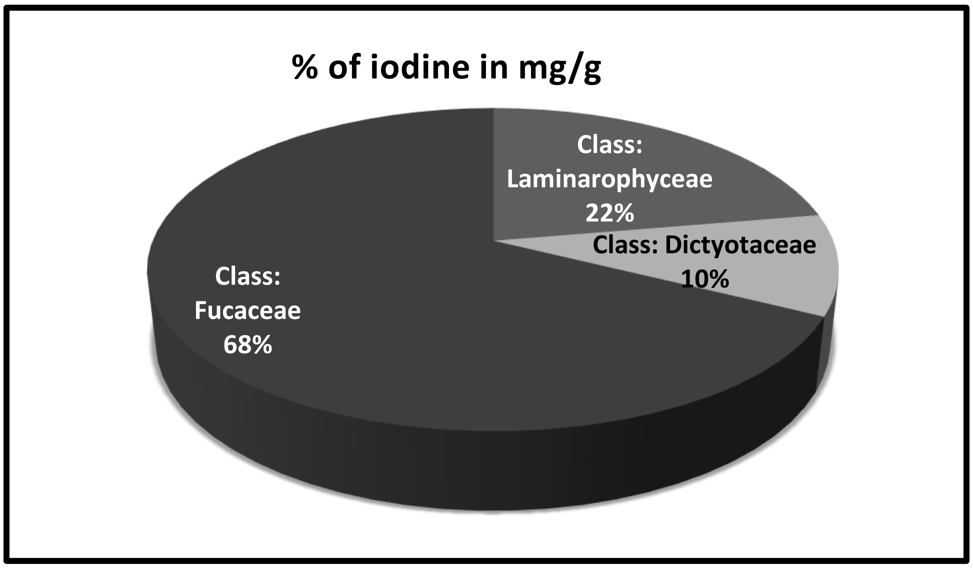

Fig. 2. Comparative percentage of iodine in three classes of brown seaweeds.

In facts the highest level shown by *Sargassum carpophyllum* due to the large size of seaweeds and our study also supported by (Ar Gall *et al.*, 2004).

Nevertheless, iodine intake from seaweeds eating in high amount can cause surprising health problems like pre-existing thyroid disorders in an individual. Even though, previous work stated that thyroid antibody positivity does not cause by excessive iodine but in comparison of high amount of iodine consumed can cause in people with earlier thyroid issues (Nagata *et al.*, 1998). In Japan, transient hypothyroidism and iodine induced goiter is common by intake of restricted seaweeds (Nishiyama *et al.*, 2004; Ishizuki *et al.*, 1989; Tajiri *et al.*, 1986; Kasagi *et al.*, 2003). Foods containing goitrogens such as broccoli, cabbage, bokchoi and soy, phytochemicals in these foods competitively inhibit iodine uptake by thyroid gland i.e., isothiocyanates from cruciferous vegetables (Greer and Astwood, 1948; Zimmermann, 2009).

According to Hou *et al.* (1997) iodine existed in seaweeds primarily I^- as shown by 88% in kelp (*Laminaria*) and 66% in (*Sargassum*). However, 10% Kelp and 29% *Sargassum* contained organic iodine, on the other hand Iodate (IO_3^-) ranged from 1.4% in kelp and 4.5% in *Sargassum*.

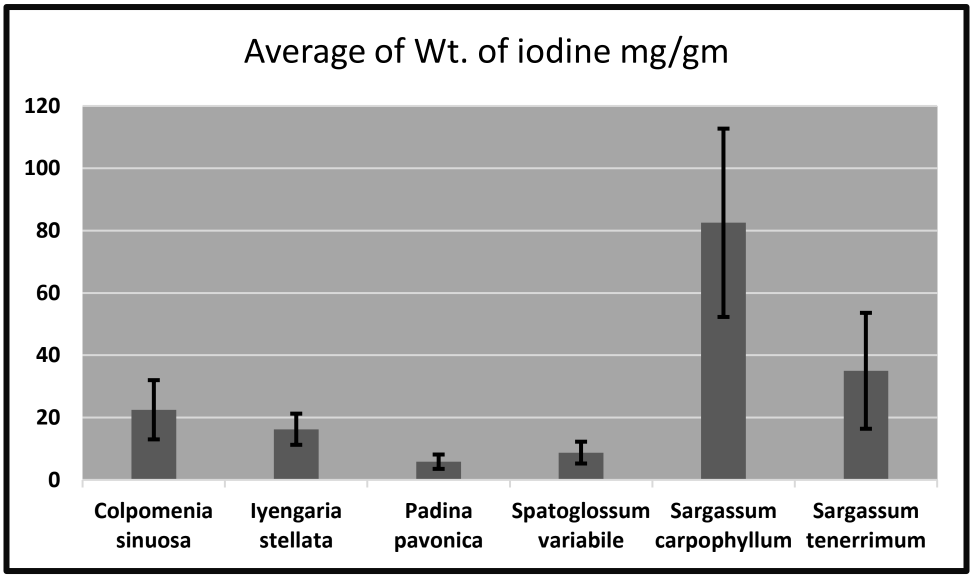

Fig. 3. Comparative levels of iodine in six brown seaweeds samples.

Food Standard Australia New Zealand (FSANZ, 2008a) inspected numerous forms of edible seaweeds (e.g. dried, cooked or component in soup) and reported that dried seaweed showed maximum range of level of iodine (9.4mg/kg to 4300mg/kg). In contrast, cooked seaweeds and products contained lower iodine level (0.01mg/kg to 110mg/kg).

The determined average content of iodine expressed with standard errors in Table 1. *Sargassum carpophyllum* exposed the peak content of iodine with an average of82.5 ± 30.22, whereas *S. tenerrimum* showed second highest level (35 ± 18.60). On the other hand, *Colpomenia sinuosa* with (22.5 ± 9.50), *Iyengaria stellata* (16.5 ± 5.00), *Spatoglossum varibile* with an average of 8.75 ± 3.50 and in *Padina pavonica* we examined the lowest level of iodine with (5.83 ± 2.30).

Two well distinct lines (1 and 2) identified by Dendrogram derived from Ward's cluster analysis in Fig.4. Line 01 comparatively comprised of the highest levels of iodine (37.5, 30, 152.5, 62.5 mg/g) in all selected brown seaweed species (*Colpomenia sinuosa*, *Iyengaria stellata*, *Sargassum carpophyllum* and *S. tenerrimum*). Whereas, line 2 characterized by the lower most levels of iodine (7.5, 2.5, 5, 5, 7.5, 15, 2.5, 12.5, 7.5 mg/g) from all species as exposed in Fig.4.

Variations occurs in iodine concentration of seaweeds due to geographical distribution (Table 2). Maximum concentration of iodine recorded in kelp granules from U.S., Canada,

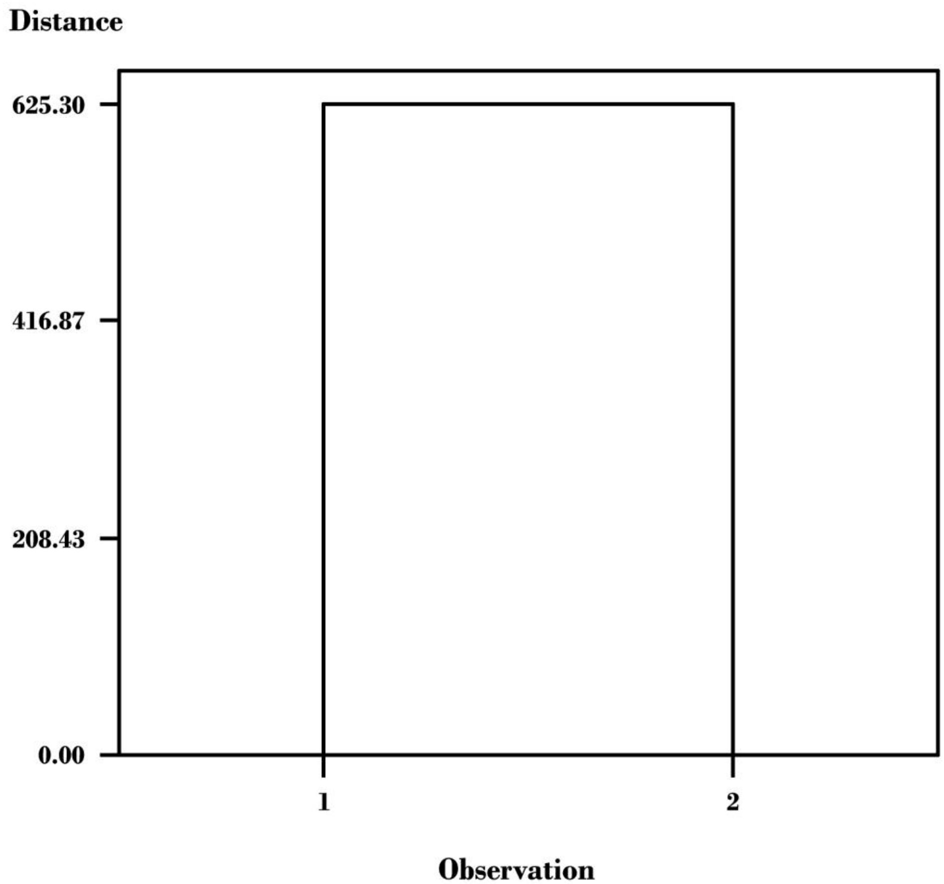

Fig. 4. Dendrogram derived from Ward's cluster analysis of values of iodine levels in three class of brown seaweeds samples.

Namibia, Tasmania, Japan i.e. 8.165mg/g (Teas J *et al.*, 2004). In our studied highest iodine concentration found in *Sargassum carpophyllum* and *S. tenerrimum* (82.5, 35mg/g) as shown in Fig.2 & (Table 1) for the reason is that at our coast it grows throughout the year as compare to some other seaweeds that grows in specific season such as some members of class Laminarophyceae, grows in winter season. Whereas, *Sargassum* spp. from Gujarat coast contained minimum level of iodine 0.2 – 0.5mg/g (Ahmad *et al.*, 1989). In *Padina pavonica*, (5.83mg/g) lower most iodine concentration examined in our studied. Factors like salinity, season, depth of the seaweed, coldness of water, postharvest storage conditions, distance from the equator and some other factor also involves (Kravtsova and Saenko 1979). Other factors like method of cooking or food preparation also demonstrating final iodine content of food and this iodine is richly water soluble (Ishizuki *et al.*, 1989), reported that when kelp boiling in water, after 15 – 20 minutes 99% iodine is found in the cooked water.

Table 2. Variation in iodine level (mg/g) reported in species of seaweeds from different coastal regions of the world.

Species	Locality	Concentration (mg/g) of iodine	References
Ulva lactuca	Abu-Qir Bay, Egypt	0.03	EL-Tawil and Khalil, 1983
Caulerpa prolifera	Abu-Qir Bay, Egypt	0.09	EL-Tawil and Khalil, 1983
Cystoseira fimbriata	Abu-Qir Bay, Egypt	0.22	EL-Tawil and Khalil, 1983
C. barbata	Black Sea	0.367	Güven and Bergisadi, 1973
C. barbata	Black Sea	0.1	Dalev *et al*., 1957
C. myrica	Red Sea	0.17	Khalil and EL-Tawil, 1982
Petrocladia capillacea	Abu-Qir Bay, Egypt	0.67	EL-Tawil and Khalil, 1983
Laminaria (kelp)	U.S., Canada, Namibia, Tasmania, Japan	1.542	Teas *et al*., 2004
	UK	2.650	Lee *et al*., 1994
	China	3.040	Hou and Yan, 1998
	France	5.307	Aquaron *et al*., 2002
	British Columbia	2.110	Van Netten *et al*., 2000
Kelp granules	U.S., Canada, Namibia, Tasmania, Japan	8.165	Teas *et al*., 2004
	UK	0.067	Lee *et al*., 1994
	British Columbia	0.815	Van Netten *et al*., 2000
Undaria (wakame)	U.S., Canada, Namibia, Tasmania, Japan	0.066	Teas *et al*., 2004
	UK	0.161	Lee *et al*., 1994
	China	1.571	Hou and Yan, 1998
	British Columbia	0.06	Van Netten *et al*., 2000
	British Columbia	0.102	Van Netten *et al*., 2000
Alaria	British Columbia	0.151	Van Netten *et al*., 2000

Continued……

Porphyra (nori)	U.S., Canada, Namibia, Tasmania, Japan	0.016	Teas *et al*., 2004
	UK	0.043	Lee *et al*., 1994
	China	0.036	Hou and Yan, 1998
	British Columbia	0.017	Van Netten *et al*., 2000
Hincikia fusiforme	U.S., Canada, Namibia, Tasmania, Japan	0.629	Teas *et al*., 2004
	UK	0.391	Lee *et al*., 1994
	British Columbia	0.436	Van Netten *et al*., 2000
Eisenia bicyclis	U.S., Canada, Namibia, Tasmania, Japan	0.586	Teas *et al*., 2004
	UK	0.714	Lee *et al*., 1994
	British Columbia	0.600	Van Netten *et al*., 2000
Palmaria palmata	U.S., Canada, Namibia, Tasmania, Japan	0.072	Teas *et al*., 2004
	UK	0.044	Lee *et al*., 1994
Sargassum spp.	Gujarat coast, India	0.2 – 0.5	Ahmad *et al*., 1989

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