

Medicinal Uses of Seaweeds

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INTRODUCTION

Seaweeds offer a wide range of therapeutic possibilities both internally and externally. The term Seaweeds in this case refers only to macrophytic marine algae, both wild and cultivated, growing in saltwater.

Botanically, seaweeds are classified as Green, Brown, or Red. A particular seaweed's placement in one of these groups is determined first by its photosynthetic pigments, then its reproductive mode, then its micro and macro morphologies, and finally by its phycopolymers. The obvious visual color of a particular seaweed species may not match its taxonomic color, which can be confusing to the beginner. Persevere.

Here I will discuss seaweed's primary and secondary metabolites and some of their respective peculiarities and therapeutic uses. References are provided for further information .

SEAWEED CONSUMPTION

Simply eating unprocessed dried seaweeds can yield many healing benefits. Many physical ailments in both humans and their companion animals can be regularly resolved with the simple addition of seaweeds to their respective diets. Although therapeutic seaweed constituents can be extracted singly or in clusters, in cases of chronic conditions, I usually recommend patients eat seaweeds, not extracts. I prefer the seaweeds to be eaten uncooked in most cases. The digestive flora in a particular person may take up to 4 months to agree to produce dedicated enzymes to thoroughly digest dietary seaweeds. Oftimes the individual's enteroflora must commit resources to recognizing the molecular structures on and in seaweeds and subsequently use them as food. This is the basis for the recommendation that it is far more productive to eat a small amount of seaweed daily rather than larger amounts occasionally. The key to bacterial dietary adaptation is continual exposure to the new food material. Consequently, positive therapeutic changes caused by eating seaweeds regularly may take several weeks to several months to become obvious.

RESISTANCE TO EATING SEaweEDS

When patients are oral adverse to the tastes, smells, and/or textures of seaweeds, I urge them to add seaweeds as small pieces or powder(s) to foods strongly flavoured with spices such as: cayenne, fried onions, raw garlic, chili powder, curry, or vinegar.

SEaweEDS AS MEDICINE

Seaweeds as the Best Dietary Sources of Essential Minerals

All essential minerals are provided by dietary seaweeds. No land plant even remotely approaches seaweeds as sources of metabolically-required minerals (See Bergner1997). Seaweeds can provide minerals often absent from freshwater and food crops grown on mineral-depleted soils. In addition to eating seaweeds regularly, those gardening for food can use copious amounts of seaweeds for mulch and fertilizer(Traditional Irish fertilizer, see: Man of Aran, and The Field), add seaweeds abundantly to compost, and even make seaweed tea sprayed directly onto leaves for foliar feeding through the stomates , as ways to therapeutically get trace elements into patients a trifle covertly.

Leon Uris in his novel, Trinity, delightfully describes the social scene accompanying "kelping" by the Irish.

Seaweeds are 20-50% dry weight mineral(Kazutosi, 2002). This figure is obtained by burning off seaweed's organic material and weighing the remaining ash. The elements abundant in seaweeds include: potassium, sodium, calcium, magnesium, zinc, copper, chloride, sulfur, phosphorous, vanadium, cobalt, manganese, selenium, bromine, iodine, arsenic, iron, and fluorine.

The large Brown seaweeds (Laminaria species (known collectively as Kombu), various kelps(Icelandic kelp, Norwegian kelp, Bullwhip kelp,Sugar kelp,Giant Pacific kelp, and Hijiki), Bladderwrack, Rockweed, Sargassum, Wakame, and Sea Palm, tend to contain more minerals per unit weight than the Red seaweeds (Nori, Irish Moss, Dulse, Grapestone, and Euchemia).

Many human body substances require particular mineral elements as part(s) of their respective structure. Examples are iron for hemoglobin and iodine for thyroxine.

For our bodies to function, we use proteins called enzymes. Most enzymes require one or more coenzymatic factors; these coenzymatic factors are usually one or more metals. cations. Chronic dietary shortages or disease-

related mineral depletions can produce both specific and general disease conditions: Iodine shortage results in varying degrees of thyroid dysfunction; poor absorption of dietary calcium can result in osteoporosis. Adequate residential body mineral supplies are critical for optimal body system functioning. My personal observations support the notion that non-specific disease categories such as Chronic Fatigue, lack of energy, subclinical depression and depressed immunity are probably due to inadequate minerals either in the diet and /or in the body. Many times I have seen chronically exhausted patients exhibit complete symptom resolution after several weeks of adding 5-10 grams of seaweeds to their daily diets.

In the hydrated seaweeds, raw or cooked, minerals are mostly in aqueous solution and readily available for intestinal absorption in humans. These accumulated minerals can be loosely considered primary metabolites. Even though they are not manufactured by the seaweeds, they are concentrated against the osmotic gradient to cause a much higher concentration of each mineral inside seaweed cells and intercellular spaces than in the surrounding seawater. This enables seaweeds to use water equilibrium mechanics to move materials in and out of their cells. It is no accident that seaweeds concentrate metal cations and other elements many times their respective concentrations in seawater. They have almost unlimited access to mineral resources unavailable to most land plants and animals.

CAUTION: Celtic Sea Salt and other designer so-called natural or raw, evaporated seawater sea salt products are not good sources of some trace elements, particularly iodine, iron, copper, and selenium. This is unfortunate since just plain sea salt is basically healthier than the modified commercial table salts.

IODINE

The single most important element provided by seaweeds, is Iodine. It is more abundant in seaweeds, any seaweed, than any plants or animals. Land plants, vascular plants in particular, seem to have no detectable iodine requirement.

ALL vertebrate animals REQUIRE IODINE. This iodine is used in thyroid hormones, T4, thyroxine, and T3, tri-iodothyronine to control all fetal development, postnatal growth, and ongoing daily body metabolism. No iodine, no vertebrate life. The choice of iodine seems to have been its isotopic stability: there is only one known natural iodine isotope, iodine 127. It is reliable, not subject to radioactive decay.

When vertebrates lived in the sea, even at about 60ppb, there was a constant reliable source of iodine. Since some vertebrates left the sea,

obtaining enough iodine has been a challenge to their descendants, including ourselves.

Since no land plants have a need for iodine, their taking it in from roots or leaves may be just incidental. That has meant that few land plants are reliable or even adequate iodine sources unless consumed in large quantities as by large herbivores. Plants grown proximal to the marine environment and those deliberately fertilized with seaweeds can accumulate enough iodine to provide adequate dietary supplies for herbivores and humans. Potatoes, garlic and other root crops are the best accumulators and dietary sources of plant-based iodine supplies.

Eating 3-5 grams of most dried, unrinsed seaweeds will provide the RDA of 100-150 micrograms.

Lack of iodine can cause developmental structural and neural fetal abnormalities collectively called cretinism. This condition, directly as a result of low maternal iodine supplies, is difficult to correct postpartum, if at all. The treatment is adequate maternal iodine consumption from the mother's initial beginning as an egg in her maternal grandmother.

That means treating the problem 2 generations before a particular pregnancy. In the moment, maternal iodine supplies can be monitored by maternal urine testing and any deficiencies immediately corrected by adding dietary iodine. Mammalian fetal iodine need is about three times per unit body weight of the mother.

In adult humans, chronic low iodine consumption often results from iodine deficient soils and water, and consequently low iodine food. The human consequence is: first, goiter, an enlargement of the thyroid gland, deliberately generated by TSH (thyroid-stimulating Hormone) to increase thyroid gland cell surface area and more "iodine traps", and secondly, various manifestations of hypothyroidism.

The treatment is often simply more dietary iodine for both conditions And this can be easily accomplished with dietary seaweeds.

Chronic pernicious human iodine deficiency developed during 7000 of continuous extractive agriculture in the interior of China resulting in tens of millions of near-cretinous citizens by the mid-1900's. For treatment, the Chinese developed warm-water Laminaria kelp varieties which they now cultivate in great quantity with entire villages growing and processing up to 650,000 metric tons each year to provide more than enough dietary iodine for 1.5 billion Chinese (Druehl, 2000). This is a most curious successful

marvel; nearly 5000 years ago, in an herbal attributed to the Emperor Shen Nung, goiter was described, and the treatment was seaweed, apparently Fucus. Nori seaweed was also touted as the most wonderful elixir (Katzutosi).

CAUTION: Some individuals are extremely sensitive to iodine. A little bit too much in their diets and they begin to exhibit hyperthyroid signs and symptoms: nervousness, heart palpitations, sleeplessness, irritability and even iodine-induced goiter. If these symptoms appear, first inquire about seaweed/iodine consumption (from any source, including dairy and baked goods). Individuals with "seafood allergy" seem especially sensitive to iodine. Contrary to some practitioners and their believing patients, nobody has "iodine allergy". No iodine, no life.

SEAWEED IODINE CONTENT

Icelandic kelp, 8000ppm, Norwegian kelp 4000ppm, Atlantic kelp 1500-2000ppm, Pacific kelps 500-1200ppm, Fucus spp. 200-500ppm, Wakame 50-150ppm, Sargassum 35ppm, and Nori 15 ppm. These are all approximate and will vary considerably by season, location, age, and harvest practices.

The Japanese and other Asians apparently usually soak their Kombu and other seaweeds in freshwater for 10-30 minutes prior to using in miso broth and other cooking, which removes about 60% of the iodine (Hazutosi). Curiously, I was told by Japanese nationals that the kombu was left in the miso broth for 10-20 minutes and then discarded.

The soaking or prolonged rinsing of high-iodine content seaweeds may reduce the risks for excess iodine-induced disease.

For some interesting views on iodine and health, please see Guy Abraham MD's website, www.optimox.com

IODINE PROTECTION

The iodine story as related to human health took an interesting turn when Uranium was used to cause nuclear fission: one of the decay products of nuclear explosions is Iodine 131. That means not only nuclear weapons, bombs, but also, all of the controlled nuclear events in Nuclear reactor fuel rods. *ALL NUCLEAR FACILITIES* release radioactive Iodine 131 into the atmosphere. Hundreds of them are licensed to do so. This means that we are all continually and erratically dusted with Iodine 131 every day of every year. As shown by reliable research for over 50 years, nuclear power plant stack gases circle the earth in 3-5 days, continuously dusting us all until all settled. Additionally, there are nuclear disasters, such as Three-mile Island

in USA and Chernobyl in Ukraine. The Chernobyl disaster on 26 April 1986 released enormous quantities of Iodine 131 into the atmosphere. Since then, millions of iodine-131-induced thyroid disease patients have been reported worldwide starting shortly after the event and continuing today. Relatively rare 20 years ago and unknown prior to 1945, thyroid cancer is now the number one cancer in children in USA. Thyroid cancer is one of the fastest increasing cancers in both adult men and women.

Iodine 131 is hazardous because our bodies will happily take it in if we need iodine. Since prior to the human atomic age there was no iodine 131, we have no defense against it if we need iodine, and no way to selectively excrete it. If we have sufficient iodine in our bodies, Iodine 127, the only natural iodine isotope, our bodies will not take in the heavier iodine 131. How the weighing is done is an interesting question to be considered elsewhere. The critical information is: if we continually take in 150 micrograms of iodine 127 daily, we will most likely be protected from iodine-deficiency "iodine aggressive uptake". We can do this by eating 5-10 grams of seaweeds daily. If we are worried about iodine 131 which reasonably might be expected in the seaweed, we can let the seaweed iodine 131 if any, decay for 8 weeks. How do we know and expect this seaweed iodine to be protective against iodine 131 fallout and decay? The Polish example. Within hours after the onset of the Chernobyl disaster, Polish authorities acted to get iodine solutions, potassium and sodium iodide tablets, even seaweed tablets and capsules into as many of their citizens as possible to protect them from the nearby huge amounts of iodine 131 coming their way. Over the intervening 20 years, the Polish people treated with iodine 127 have almost 1000 times less thyroid disease than neighboring countries even further than Poland from the Chernobyl disaster site.

Unfortunately, ALL Nuclear Power Plants are nuclear disasters waiting to happen. Not because of evil intent (we hope) but because of mechanical and materials deterioration and human error. Hundreds more nuclear power plants are planned, especially by developing countries anxious to reduce their energy dependencies on fossil fuels. Of course, that will mean increasingly huge amounts of radioactive iodine 131 into the atmosphere and huge quantities of nuclear waste begging for safe disposal. Simpler of course, would be to boil water with solar mirrors. All nuclear power plants so far are just fancy water boilers. Strange.

Eat your seaweeds.

Iodine passes readily through the epidermis, and alveolar cell walls into the body in addition to intestinal absorption. This means that any iodine 131 we

breath or get on our skins is likely to be absorbed if we are the least bit iodine 127 deficient.

How is iodine 131 hazardous? It radioactively decays with a half life of about 8 days. This means in 8 weeks, there is probably not much left in a particular sample, and not enough to cause radiation damage. Iodine 131 decays with the release of a high energy Beta particle, which crashes ionizingly through adjacent tissues, and ionizing high energy gamma radiation. There is no safe exposure to radioactive-decay sourced ionizing radiation (Shannon, 1995)

POTASSIUM

All living cells, and that means all of our cells, need potassium all of the time to function and stay alive. There are no exceptions. Our bodies have no innate potassium conservation mechanisms. The human evolutionary assumption seems to be that we will always have plenty of potassium available in our wild and live food diets, since all living cells require potassium. This is in contrast to sodium, also an essential element, for which we have a very rigorous sodium conservation mechanism.

The human tongue, just as the average beginning analytical chemistry student, seems to have difficulty distinguishing potassium from sodium: both taste salty. In equal amounts, potassium is up to 8 times saltier than sodium.

Often, overwrought patients will complain of constant "salt cravings" even though they eat a lot of salty foods. "I just can't seem to get enough salt" is a common statement. These people are often overweight, puffy (edemic), and complain of exhaustion. I suggest high-potassium powdered seaweed (almost any seaweed, although the kelps tend to have more potassium than other seaweeds) up to 10 grams daily until symptoms resolve. So far, I have not encountered any indications of potassium toxicity which might have been caused by excessive consumption of hi-potassium seaweeds, although such poisoning may be possible. If practitioners are concerned, prescribe less seaweed consumption at any one time.

I believe that almost any craving for salt in our dietary times of heavily salted, with sodium chloride, home-cooking, restaurant meals, and preserved foods is a strong indication of potassium deficiency, especially in pregnancy.

Potassium is essential for even minimal nerve and muscle functioning, and as a cross-membrane transporter ion for neurotransmitters and hormones. I have observed that adding high-potassium foods, especially seaweeds, to

the diets of ADD children (instead of Ritalin) and adults can significantly improve behavior and mental functioning.

Similarly, fibromyalgia patients, the exhausted, the forgetful, the moody, the agitated, anxiety disorders, and depression are all favorably improved with high-potassium diets and seaweeds.

YES! Before grabbing the herbal nerviness and muscle analgesics, try feeding the nerves and muscles their essential mineral foods: potassium, sodium, calcium and magnesium. The last three, are all abundant in all seaweeds: sodium, 2-4%, calcium 0.5-1.0%, magnesium 0.2-1.0%. In addition to optimal nerve and muscle functioning, these four elements are important in transporting many substances along the intercellular integrin network.

Many women patients eating seaweeds to reduce PMS symptom severity report a distinct cyclical waxing and waning of seaweed cravings.

SELENIUM

Selenium is present in all seaweeds in physiologically significant amounts.

Selenium is, like its partner in thyroid hormone metabolism, apparently not required by any land plants although some do concentrate it (Brazil nuts are the usual culprit). No selenium, no thyroid hormone production and conversion of T4 to T3.

Selenium is present in all edible animals, and is easily absorbed from eggs in the diet. Selenium is required for many critical metabolic actions besides the selenodeiodinases.

Men usually have a much higher selenium demand than women because, like zinc, it is secreted in the male reproductive ejaculate, and must be replaced to maintain ejaculate production and sperm fertility. Check for selenium deficiency in males with fertility issues.

PHYCOPOLYMERS

All seaweeds contain a large proportion (25-40%) of mucopolysaccharides, collectively referred to as Phycopolymers.

The brown algal phycopolymers are algin and fucoidan, both sulfated galactans.

ALGIN

Algin has great therapeutic value as a heavy metal detoxifying agent. When added to the diet as a component of edible brown seaweed, algin powder, or

sodium alginate, it can bind heavy metals present in the food stream and carry them out with the stool, since algin is generally not digestible (Schechter, 1997).

Excretory algin tends to bind metal ions presented in the small intestine from distal body locations. A complex diffusion gradient transport system will move poisonous metal atoms a few at a time to the intestine for probable binding to insoluble dietary fiber. Apparently this is a way of removing hazardous metals in a way which avoids damaging the kidneys. Regular eating of even small amounts of brown algae can be an ongoing metal detoxification practice which can reduce the quenching of enzymes by heavy metals.

Hair analysis can be a better predictor of excess metal poisoning than blood or urine analysis because the body seems to use the sulfhydryl groups in hair proteins as an excretory mechanism which also protects the kidneys. If a patient presents with relatively high levels of toxic metals in hair, blood, or urine, the addition of 3-5 grams brown seaweed to the daily diet will help remove those metals from the body, but not the hair, of course.

Using brown algae as part of an aggressive metal removal treatment plan is recommended for both acute and chronic exposures and actual poisoning. Reducing further exposure to heavy metals is of course essential for a metal removal plan to succeed. I usually recommend a lot of rolled oats in the diet (every morning) to aid the seaweeds in metal removal. For some persons, adding the seaweed to the oatmeal seems to hasten metal removal. This combination will tend to bulk the stool and reduce transit time. I also encourage at least 2L of water (just water, not drinks) intake daily; as well as frequent hot baths and saunas with vigorous dry skin brushing before and after each bath or sauna.

Chronic Passive Metal Poisoning

Industrial activities, mining, and nuclear power activities release relatively large amounts of usually unseen toxic metals into our air, water, and unfortunately onto our food crops. We are all being continually poisoned.

From nuclear facilities (radioactive medical wastes are increasingly a source of radioactive metal poisoning) we are exposed to radioactive isotopes released into the air by way of gaseous emissions and radioactive substances released into cooling water.

Since most of these exposures are probably going to continue for the foreseeable future, we are advised to do what we can to reduce their negative health effects. The best action may be to eat a diet that is

continually detoxifying our bodies. Regular seaweed consumption should be a part of that diet.

I predict that age-related dementia and perhaps Alzheimer's can be prevented or suppressed by regular consumption of algin-rich brown seaweeds, to slow the bioaccumulation of neurotoxic metals. The kelps and popular dietary brown seaweeds can do this.

Some of the salts of alginic acid present in aqueous solutions in ingested brown algae, such as potassium and sodium alginates, are digestible by intestinal flora. The metals they contain are released into the food stream and tend to be bound up by the undigested algal fibers.

FUCOIDAN

Fucoidan can be easily cooked out of most edible brown algae by simmering 20-40 minutes in water (alone or in food). When consumed, it seems to reduce the intensity of the inflammatory response and promote more rapid tissue healing after wound trauma and surgical trauma. This means that brown seaweed broth is recommended after auto collision, sports injuries, bruising falls, muscle and joint damage, and deep tissue cuts, including voluntary surgery.

Surgery

I recommend patients anticipating surgery eat 3-5 grams brown seaweed cooked as a vegetable broth daily for a week or two prior to surgery. Fucoidan in the pre-surgical patient diet seems to reduce the intensity of blood loss and vascular bed collapse shock during and after surgery. The mechanism for this positive effect is unclear.

We can all statistically expect major surgery sometime in our individual lives. We are the only animal that voluntarily submits to surgery. I believe this may cause some body integrity sanctity problems internally which may negatively effect the wound response and subsequent healing. Fucoidan may help the body decide to heal after voluntary surgery and other wounding such as radiation and chemotherapy.

Patients undergoing radiation or chemotherapy seem to benefit from regular fucoidan consumption via brown seaweed broth before, during, and after treatments. They report fewer and less intense adverse reactions, better recovery and sense of well-being.

Antiviral Action

Fucoidan interferes with every stage of viral attack, cell attachment, cell penetration, and intracellular virion production by stimulating the production

of antiviral cytokines. There may be some viral suppression in virus-infested patients but results are difficult to verify or measure. Research continues into using fucoidan or its derivatives to combat common viral infestations: HIV, HPV, and Herpes.

A fucoidan curiosity is that its terminal sugar is Fucose. All human cells studied have very precise Fucose receptor sites on their surfaces. Perhaps this results in stronger therapeutic responses.

RED ALGAL POLYMERS

The main red algal polymers are agar and carrageenan, and mainly porphyran in nori. All of these polymers are sulfated galactans. They are modestly water-soluble, partially digestible and easily extracted from red seaweeds by boiling .

Carrageenan

Carrageenan was originally isolated by simply boiling red seaweeds for an hour or more , discarding the seaweed mass, and saving the usually thick mucilaginous liquid. It was used for soups, hot gruels when mixed with grains, seafood, and peas. It was drunk as a soothing treatment for sore mouths and throats and for constipation relief.

It was used by the poor starving Irish during the oppressive British occupation of Ireland for 800 years as an emergency food, filling if not totally nutritious.

Today, carrageenan is used in over ten thousand proprietary industrial, food, and health and beauty products as a thickener, gelling agent, meat and sugar extender, medicines, and paints. Red seaweeds containing carrageenan have been overharvested in many places, including the intertidal zones of the Canadian Maritime Provinces and many of the Caribbean Islands. Now, to meet demand, the world's largest aquaculture farms are located in Malaysia, Indonesia, and the Philippines, where the red alga *Eucheimia* is grown on nets. Historically, it has been used as a sexual lubricant in China, Korea, and Japan for millennia.

Carrageenan eaten as red seaweeds such as dulse, Irish moss, and *Eucheimia*, is partially digested and absorbed as small globular gel masses into the lymph and blood stream. It can provide sugar molecules for glycoproteins secreted by mucous membranes and for cell surface aminoglycan labeling.

Medicinal Uses

RESPIRATORY TREATMENT

Until 1935, pneumonia was the leading recorded cause human death in the USA. 100 years ago, five of the top ten causes of death in men were respiratory diseases.

Today, asthma is the leading cause of juvenile school absenteeism and is increasingly an affliction of adults.

Red algae containing carrageenan have been used for millennia as treatments for respiratory ailments, especially intractable sinus infections and lingering pneumonias. Asthma was not separated out as such in the old literature.

I use plain boiled-out carrageenan singly or in combination with strong antimicrobial herbs for all respiratory ailments. The process is simple:

- Place an ounce of carrageenan-containing red seaweed in a food-grade mesh bag
- Place the bag in a stainless steel boiler or ceramic "Crockpot" containing up to 1l of water.
- Bring to a boil and simmer for ½-4 hours. The bag of seaweed can be left in the crockpot, setting at LOW, for 8-12 hours, which means overnight for breakfast readiness.
- Stir or otherwise pump the gel out of the mesh bag while simmering; this will move the dissolved gel out of the bag and allow more extraction. If this step is omitted, the gel may just thicken, clog the mesh pores, and remain a mess in the mesh bag
- Pour off the fluid gel, while hot
- If only one extraction is enough, hang the bag from something over a container and let more gel drip out
- The red seaweed mass remaining in the mesh bag can be simmered and the gel fluid poured off again and again, up to 4-5 times with more gel extracted each time

The gel can be consumed as soon as cool. It can be flavoured with anything suitable from honey, fruit juice, cinnamon, cayenne, vanilla, maple syrup, cocoa powder, to various distilled spirits, herbal tinctures and milk.

The extracted gel will keep cold without spoiling for only about two days. It is an excellent growth medium for microbes. Do not leave gel unused for more than two days in a refrigerator with out boiling again briefly to sterilize it.

I recommend consuming at least a pint a day for children and a quart or more per day for adults up to a week or until respiratory symptoms resolve.

In cases of obvious microbial infection, add strong herbs such as elecampagne, osha, Lomatium, even garlic in the extraction bag, or as a separately-prepared tea mixture; tinctures can also be added to the gel after removing from boiler.

The herbal-enhanced gels are usually good expectorants and can improve cough productivity.

The first gel extracted is often very strongly seaweed- flavoured and unpalatable to children and those with a resistant sensitive nature. The flavourings listed above can mask the strong seaweed flavours.

Those flavours are usually not present in the gel produced in second and more extraction episodes of the same bag of red seaweed.

I think that cases of respiratory mycoplasma (often presenting as adult-onset asthma in people over 35) are helped by the gel with the addition of strong herbs, especially elecampagne.

A soothing carrageenan gel variant is to use 5 parts red seaweed, and one part each : Usnea lichen, fennel seeds, marshmallow root (powdered) and hawthorn berries. This is very helpful for throats sore from excessive coughing.

CAUTIONS for Red Seaweed Gel Use: Small amounts of carrageenan gel can help heal ulcers including ulcerative colitis. Large amounts may worsen alimentary ulcers and erosive bowel diseases, especially in the bowel if carrageenan successfully competes with the bowel membranes for water from the stool.

ANTIVIRAL RED SEaweEDS

In vitro tests in the 1950's and 1960's showed that some red algae are strongly antiviral. The ideas were developed by Robert Ellis and Natasha Calvin, who used scuba gear in SE Alaska to harvest three species of subtidal red algae to produce a mixture called Alaska Dulse. This was taken internally as a very effective treatment for SHINGLES.

Natasha has passed and Robert is no longer providing the Alaska Dulse. From Blue Moon Marine, Kim and Mark Donovan are test-marketing antiherpetic crèmes and lotions for cold sores, shingles and hopefully genital herpes. I have tried their products on recurring shingles with some lessening

of lesion severity but not a great improvement. Clinical trials are underway in cooperation with the Bastyr University Clinic.

Strong antiviral activity has been observed in a variety of heavily modified carrageenans and research continues on how to use this in commercial medications. I do not know if occasional consumption of red seaweed gels will be antiviral.

One carrageenan derivative showed strong anti-HIV activity when delivered as a contraceptive vaginal foam.

ERECTILE DYSFUNCTION

On a very memorable visit to Caye Caulker in the Belizian Caribbean, I had an interesting seaweed encounter. Whilst strolling along the unpaved path of the merchantile zone, we came upon a little juice stand where fresh tropical juices were made and sold. The children were thirsty as usual and so we got some watermelon banana pineapple slurries for them. I noticed a couple of recycled whiskey bottles with hand-printed tape labels that read "SEAWEED DRINK". I inquired about it. It was the most expensive item on display. The young woman in charge said she did not know much about its manufacture, but I could talk with the owner tomorrow at a time designated. I bought a bottle and she recommended that I flavour it with rum or whiskey, since it did not have any alcohol in it and it would spoil quickly in the tropical heat. "It make you strong, mon!" she assured me with a BIG smile.

I did not add any alcohol and drank it over an hour or two. It tasted just like red seaweed gel at home onisland. It took several days before I was able to meet with the owner and seaweed drink maker. He was extremely reluctant to talk about the product. Eventually I told him about my own production of seaweed drinks back in Washington State and he eased up a bit.

He told me that the process had been the same for thousands of years, used by the Ancient Maya and the Arawaks and Caribs. Using stone-weighted poles with hooks, the seaweed was spun off the seafloor and loaded into canoes or now small sailboats and brought to shore where it was laid out in the sun to be washed by rains and bleached by sun until a yellowishwhite colour and no seaweedy flavours remained. The mass looked like distressed pasta noodles when he gave me a big handful of dried seaweed. He told me that just like grapestone, it could be boiled many times and thick gel came out each time, up to 12 times. Impressive. He was especially reluctant to take me out to witness the harvest or do some myself. The Rastafarians had the Seaweed Drink monopoly and perhaps he feared my setting up a little drink stand.

I bought several bottles of it during three weeks on Caye Caulker. Eventually the salespeople asked "How you doin, mon?" I had to be educated as to the intended purpose of the Seaweed Drink. It was a renowned local treatment for erectile dysfunction and my otherwise recreational excessive purchases and assumed consumption was cause for much laughter and smirking stares.

I really could not detect any positive therapeutic effect or behavioural changes.

Eight years later I get an inquiry from some patients who are looking for Sea Moss. I checked in with some of my phycological colleagues, notably Dr. Mel Goldstein of U. Victoria in BC.

He had been in charge of the Sea Moss recovery program in Santa Lucia, Virgin Islands. The popularity of Sea Moss as a virility drink had led to its extermination from all of the larger Carribean islands and locals were continually asking him during his research years there, where he had seen any Sea Moss It was very rare and occurred only on tiny dangerous uninhabited rocky islands He decided to try and use basic seaweed mariculture techniques to grow Sea Moss using starts from wild patches. It worked eventually and many bays on the Virgin Islands, Jamaica, Barbados, Trinidad, and other islands have ropes and poles growing Sea Moss to meet an expanding market demand. The red seaweeds , species of Eucheimia, Gracillaria and Hydroputia were originally harvested to make a traditional pre-contact breakfast gruel, and to thicken jellies as well as make soothing drinks. Now, Sea Moss is sold in tourist shops , featured in local jams and jellies, and served as a special ethnic gruel to tourists.

The Maya apparently used the gel with ground cacao, vanilla bean, and honey to make a treat.

I have no information about erectile dysfunction amongst the ancient Maya.

I make the assumption that the Sea Moss drink must have had some positive effects on male libido or erectile dysfunction. What the actual effects in terms of tissue changes might be, I can only speculate that circulation may be improved and mucous membranes more productive. There are many causes of erectile dysfunction and most of these are behavioral, such as smoking, alcohol consumption, chronic dehydration, obesity, medications, sociology. I doubt if seaweed drink alone will overcome these causes. We will keep trying, however.

HORMONES IN SEaweEDS

Melatonin

Melatonin is abundant in many seaweeds, up to 1000 times the amounts found in land plants such as Feverfew and St. John's Wort. This may explain some of the calming effects of eating seaweeds. Night-time harvested seaweed has much more melatonin content than daytime-harvested seaweed of the same species. There may be some useful therapeutic opportunities using seaweed-sourced melatonin.

Thyroid Hormones in Seaweeds

Brown seaweeds are the only known non-animal sources of thyroid hormones.

The presence of organically-bound iodine in brown seaweeds as thyroid hormones may explain some of the effects of eating some brown seaweeds.

DI-IODOTHYRONINE (DIT)

Fucus spp of brown seaweeds have been used as treatment for thyroid disorders . The thyroid hormone present in Fucus is Di-Iodothyronine (DIT); it is weakly active if at all as a thyroid hormone in the mammalian body. Two DIT molecules are condensed in an elegant esterification reaction to produce tetraiodotyrosine(T4, Thyroxine). The organically bound iodine in Fucus may enhance T4 production by providing some prefabricated portions of T4. I have not seen any studies tracing Fucus-sourced DIT to either the thyroid gland or circulating T4.

The therapeutic effects of using powdered Fucus, 3-5 grams daily resemble the therapeutic effects of thyroxine medications: shrinking of goiters, weight loss, resolution of symptomatic non-autoimmune hypothyroidism, return of vim and vigor, lessening of psychiatric disruptions, and resolution of eczemas. This is especially true of women enduring postpartum physiological depression after several years of being pregnant and nursing one or more children.

I have seen no reports of thyrotoxicity from Fucus consumption.

Women with low thyroid function, according to thyroid panel blood tests report improved test results.

Any similar results from using Fucus teas will be due to inorganic iodine supply increase and probably not from DIT. DIT is not very water soluble.

Fucus is used to wean mildly hypothyroid patients off thyroid hormone medication.

This can work only if the patient has a thyroid gland mass capable of making T4 and T3 in sufficient quantities to supply body needs. Those without a thyroid gland may be helped by the iodine from Fucus, alleviating the need to mine thyroid medications for iodine. This may also explain in part the alleged weight loss results from ingesting Fucus; to wit, upregulation of basal body metabolic rate from iodine alone.

Thyroxine and Tri-iodothyronine in Brown Seaweeds

T4 and T3 have been found as the main organically bound iodine compounds in several brown seaweeds, notably Laminaria sp. and Sargassum sp. Up to 10% of Lamiarian iodine may be in MIT, DIT, T3, or T4. Even more in the less commonly available Sargassum (less commercially available; it is a rapidly expanding invasive of all temperate coasts; this may be good news for thyroid sufferers.) (Kazutosi 2002).

Kombu is one of the top 5 most consumed seaweeds in Japan and USA. The physiological effects of regular kombu consumption can be: resolution of coronary artery disease, healthier liver function, higher metabolic rate, faster food transit time, lower LDL cholesterol,, higher HDL cholesterol blood levels. If the thyroid hormones in kombu and Sargassum are available from food, this could turn out to be an effective treatment to replace both synthetic thyroxines and animal-thyroid medications.

I assume at least some T4 and T3 get into the human body from dietary Kombu and stimulate more rapid clearing of fatty wastes from the liver, enabling more rapid removal of blood borne fatty wastes.

T4 and T3 are biphenols and are not water soluble. Oil extractions of Kombu may provide T4 and T3 as well as DIT and MIT(Mono-iodotyrosine) and be an effective thyrosupportive medicine.

Powdered Fucus is mixed with olive oil as a vegan replacement for cod liver oil and seems to work as well or better than cod liver oil

ESSENTIAL FAT AND VITAMINS IN SEaweeds

Most seaweeds are rich in vitamins, especially the B vitamins, including B12.

They also have significant amounts (1-3%) of Omega-3 fatty acids. Nori, in particular has 3% omega-3 fatty acids and large amounts of vitamins A and C. Interestingly, eating lots of nori is the Japanese prescription for boys who may have inherited male pattern baldness. In Scandinavia, the eating of refined sugars is discouraged for the same condition. Perhaps a combination

could treat both hair loss and slow the progression of pattern baldness in both men and women?

BROWN SEAWEED- ENHANCED EXCRETION OF DIOXINS AND PCBs

Very exciting and encouraging research by Morita and Nakano (2) using seaweeds for Dioxin and PCB (polychlorinated biphenyl) excretion demonstrates clearly that the brown seaweeds Hiziki, Wakame, and Kombu speed body clearing of dioxins and PCBs.

Dioxins and PCBs are extremely toxic. They are lipophilic and are not water-soluble; they are readily absorbed from the digestive tract and stored in adipose tissue and the liver in abundance. Once stored, their eventual excretion tends to be very slow. Studies on Vietnam veterans and herbicide-spraying personnel showed dioxin body half-lives of 11.3-19.6 years.

In the excretory process, dioxins are shed from the GI walls into the food stream and expelled via the feces; but, only if they are not reabsorbed from the colon prior to actual excretion. It is this reabsorption that causes the prolonged body retention of Dioxins and PCBs.

The authors used rats in their initial seaweed experiments and monotypic encapsulated dried seaweed powders. Their results showed conclusively that:

- 1 Dietary seaweeds effectively inhibit reabsorption of Dioxin mixture congeners excreted into the gut from the GI walls and promote their fecal excretion.
- 2 The seaweeds inhibited the initial uptake of dietary-sourced Dioxins and PCBs from food, binding them for fecal elimination. Foods are the primary sources of Dioxins and PCBs for most of us.
- 3 Seaweeds accelerated whole body elimination of Dioxins and their metabolites.
- 4 Body processing of stored Dioxins before metabolite excretion was assumed to be hastened.

Although rat and human digestive physiologies differ, Morita and Nakano's work strongly suggests that in humans regular dietary consumption of commercially available brown seaweeds will likely reduce Dioxin and PCB uptake and speed the fecal elimination of body-accumulated Dioxins and PCBs. The authors intend to use human subjects for equivalent research to demonstrate seaweed-enhanced dioxin and PCB excretion.

In the work cited, the most effective brown seaweed was Wakame, followed closely by both Hiziki and Kombu.

Dioxins, PCBs, and PBDEs (polybromated diethyl ethers) are found in all humans tested (100%)! This means that all of us can likely begin to benefit immediately from regular eating of 5-10 gm/daily of brown seaweed which can serve as toxic Dioxin, PCB, and PBDE exit vectors.

POST TRAUMATIC STRESS SYNDROME

I wonder about the probable relation of brain-loaded Dioxin and PCBs to psychiatric symptoms of Post Traumatic Stress Syndrome, especially considering the long body half-lives of these substances in adipose tissues. Since the brain is nearly 50% fat, it can be considered an adipose tissue.

In practice I would definitely recommend daily consumption of 4-10 gm Wakame and other dietary brown seaweeds for prevention of Dioxin and PCB uptake and their continual removal, bound to seaweed fiber, and excreted in the stool.

This work adds to the knowledge that regular consumption of brown seaweeds facilitates and hastens the removal of toxic heavy metals from both the human body and our ingested food. In addition to providing most of our essential mineral cations, brown seaweeds also rid us of dangerous health-negative substances.

THYROID HEALTH

PCBs and PBDEs are known endocrine and thyroid disrupters. In light of the toxin-removal results reported by Morita and Nakano, part of the thyrosupportive action of dietary brown seaweeds probably results from reducing PCB and PBDE uptake from food and their concomitant accelerated fecal excretion. This is in addition to providing thyroessential iodine (I) and thyroid hormone homologs (T4, T3, DIT & MIT), (I0).

WEIGHT LOSS

Those dieting for weight loss release adipose-sequestered PCBs, Dioxins, and PBDEs into their blood and lymph. Ingesting brown seaweeds may mitigate the negative consequences caused by weight loss toxin releases.

CARRAGEENAN INHIBITION OF PAPILLOMA VIRUS INFECTION

Papilloma viruses infect vertebrate skin and mucosal tissues. Human infection with genital HPV (human papilloma virus) is very common with an estimated lifetime risk of infection at about 75%. Most genital HPV infections are sub-clinical and self-limiting, but some persistently infected individuals have lesions that progress to cancer. Certain sexually transmitted HPV are allegedly responsible for most, if not all, cases of uterine cervical cancer, benign genital warts (condyloma accuminata), and a large portion of ano-

genital cancer, and head and neck cancers. HPV-initiated cervical cancer is allegedly the #1 lethal cancer amongst women worldwide.

In 2007, the first prophylactic HPV vaccines were released. Their protection timeline for a vaccinated individual is unknown. The vaccines are recommended only for young women, 11-25 and are intended to be effective against only 2 of the at least 33 forms of genital HPV. They are expensive. Why are young men not being vaccinated, since they can carry the two suspected carcinogenic HPV strains? Will the next vaccine(s) protect against HPV-induced penile cancers?

In a bizarre instance of medical tyranny, the governor of Texas decreed that all young women, 11-25 were required to be vaccinated with the new HPV vaccines. Although described as a public health gesture, I suspect the real reason was to help the marketers recover their development costs at the possible expense of the young women being vaccinated. I applaud the sagacity of the Texas lawmakers who overwhelmingly voted out the decree.

In a rigorous study (3), Buck and colleagues, brilliantly demonstrate that carrageenan extracted from red seaweed inhibits HPV infection. The modified carrageenan (C-iota) acts primarily by preventing binding of HPV virions to cell surfaces; carrageenan also exhibits a post-attachment inhibitory effect on virions, quenching infectivity.

The research used tissue cultures and tissue models to test the carrageenan.

Carrageenan is an easily extracted, sulfated unbranched polygalactose red algal polymer. It is used in thousands of patented applications in food and cosmetic products and in sexual lubricants.

Carrageenan-containing sexual lubricants and condoms lubricated with gel containing carrageenan were extremely effective at blocking HPV infectivity, even when the condom gel was diluted one million times. The authors tested several condoms and sexual lubricants for HPV infectivity inhibition. Only products containing Carrageenan were HPV inhibitive.

Lubricants containing other seaweed gels, agar and algin, were much less effective HPV inhibitors. Non-carrageenan-coated condoms are, at best, only marginally effective for preventing sexual transmission of HPV.

Carrageenan in condom gels seems well tolerated by the human vagina. The pH of the human vagina is typically below 4.5. Carrageenan extracts maintain anti-HPV infectivity at pH 4.5.

I believe that carrageenan red seaweed extract gels are effective, relatively inexpensive protection against the spread/acquisition of genital HPV. There are no data yet about the real or potential treatment with carrageenan of existing HPV lesions. Seaweed gels have been used as sexual lubricants for 5000 years (5,11). Perhaps the antiviral prophylactic action of red seaweed gel as a microbicide was recognized then. Carrageenan gel as a sexual lubricant is completely edible and a tissue stimulant. I suggest it should be investigated as a replacement for topical estradiol vaginal creams.

JORRP

A rare (1/25,000 births) HPV condition is JORRP (Juvenile Onset Recurrent Respiratory Papillomatosis), in which HPV-induced large benign tumors develop on airway surfaces. The main treatment is surgical removal of recurring obstructive masses. JORRP is thought to be vertically transmitted HPV types 6 or 11 from genital warts during birth. Pharmaceutical grade carrageenan gels could become a safe perinatal cervicovaginal preventative for JORRP and asymptomatic vertically transmitted HPV by adding the gels to the perinatal birth canal in women known to carry HPV types 6 & 11.

SEAWEEDS AND SOY

A recent paper by Jane Teas and colleagues⁽⁵⁾ ambitiously attempts to elucidate what if any, effects dietary seaweed (dried, powdered, encapsulated Alaria, American Wakame), and a soya protein isolate, singly and together, have on thyroid function. I applaud their use of a simple seaweed, rather than a processed seaweed extract. I am suspicious of the soya extract, but agree that use of an industrial product as opposed to real, unrefined food is appropriate, since American women consume thousands of tons of soya protein isolate yearly.

The results demonstrated markedly increased seaweed-sourced iodine uptake and small measurable changes in thyroid function with the seaweed powder. Soya isolate did not seem to alter thyroid function. The seaweed with soya produced the same increased iodine uptake and up-regulated thyroid function.

My complaints about the study are: too small a sample (25), possibly due to severely exclusionary criteria for study eligibility; the very short study time (7 weeks); the limited (1 week) ingestion of soya protein isolate; the use of soya protein isolate rather than real food; and the high probability that ingested American Wakame, Alaria, does not induce the same human physiological responses as Japanese Wakame, Undaria.

The minimal results produced a long narrative in which the two lead authors ranted and repeated their long-standing iodophobia (fear of dietary iodine).

The authors did concede their work to be "... supportive of the idea that seaweed, possibly via iodine, could be involved in breast cancer prevention". Their comparative discussion of thyroid disease and breast cancer between American and Asian women is very conservative, intriguing, and well referenced. I do not believe that Asian women traditionally ate either encapsulated Alaria seaweed powder or soya protein isolate. This distinct factor probably invalidates rigorous ethnic comparisons of diets and subjects' responses.

The small database in this study seems to provide minimal therapeutic direction.

The authors do not cite a previous study by Yamori et al on Okinawan Japanese immigrant descendents in Brazil, using powdered Wakame and Soya isoflavone powder, published in 2001.

TERTIARY SEAWEED THERAPY

Meat cattle fed fungal-infected fescue hay typically display a lethargy, which impedes growth and weight gain. The disease is called "Fescue Toxicosis". Grass fertilized with Rockweed seaweed, *Ascophyllum nodosum*, suction-harvested by the ton for Acadian Sea Plants, Dartmouth, Nova Scotia, did not stimulate fungal-infected fescue lethargy.⁽¹¹⁾ The seaweed provided ample copper and other trace nutrients via the Tall Fescue grass fed to the animals. The authors conclude that the animals' basic health and immunity were greatly enhanced.

This work, over several years and hundreds of animals, demonstrates the probable positive effects on humans from eating produce from seaweed-fertilized plants.

Superior health was observed in Irish populations who had access to abundant seaweeds for fertilizer for their crops. (See ref. 12 for a graphic account of Irish kelping.)

SEAWEED ARSENIC SCARE

In April 2007, Amster et al published a diatribe against herbal supplements and kelp tablets in particular⁽⁸⁾, Case Report: Potential Arsenic Toxicosis Secondary to Herbal Kelp Supplement. I think calling kelp tablets an "herbal supplement" in the paper's title seems deliberately hostile and knowingly erroneous. Few of us would label kelp tablets an herbal supplement; kelp is not an herb. Unfortunately, the authors in their haste to publication and sloppy peer-review spelled *Laminaria* incorrectly (their spelling: *Limnaria*).

The article was remarkably similar to the guilt-by-association attacks on comfrey nearly 20 years ago. In this case, it is the assumption that kelp-sourced arsenic produced the patient's overt symptoms. That the article was generated by the Veterinary School at UC Davis is telling.

The article reports on one patient who allegedly took 3x the recommended daily dosage of kelp tablets for a year and presented subsequently with elevated arsenic levels and alleged symptoms of chronic arsenic poisoning. After stopping the kelp tablets, her symptoms and arsenic levels improved to near normal levels.

The authors claim that this case demonstrates the toxic heavy metal contamination problems of unregulated herbs and other health supplements.

No.

Their database is inadequate to make any certain conclusion.

Seaweeds are not "contaminated" with arsenic. All seaweeds contain arsenic; they deliberately accumulate arsenic up to 10,000 times the concentrations of arsenic in the seawater in which they are growing. Seaweeds contain an average of 30 parts per million arsenic, dry weight⁽⁹⁾.

Japanese scientists are quick to point out that "if seaweed-sourced arsenic were a real problem, most Japanese would present with either chronic or acute arsenic poisoning very early in life" and would display foreshortened life spans (4,10). Instead, Japanese enjoy the longest human health spans, longest human life spans, and eat the most seaweeds per capita.

Arsenic comes in all seafood.

Arsenic is deliberately added to the diets of most commercially grown so-called "broiler chickens". The arsenic acts as a growth accelerant and remains in the tissues. It is cheap and effective. Chickens normally require 5-8 months to reach maturity and adult size. Factory meat chickens reach market size in 6-7 weeks. They are bloated sham chickens.

Arsenic pesticides are still used abundantly. Millions of outdoor decks and wooden playground structures are impregnated with Paris Green, Copper Arsenate to retard decay. Paris Green is a better wood preservative alternative than Penta-Chloro-Phenol, a known vicious endocrine disruptor. Arsenic is readily absorbed through the human epidermis upon contact.

Rice grown in Arkansas and Louisiana has 30 ppm arsenic; California rice has 15ppm.

To ban arsenic is to ban food.

EXTERNAL SEAWEED TREATMENTS

Ireland , the Mediterranean, the Pacific Northwest, and other coastal areas have long histories of using seaweed baths for relief from muscle and joint pains, eczema, ectoparasites,, and prostatic swelling.

A CASE OF THE KNEES

A 50-year old woman presented with terribly painful knees. She was told her cartilage had severely deteriorated. She was using a cane or walker all of the time and was expecting the wheelchair soon. She had been a very active herb grower and weekend clown for over 20 years. The combination of working on her knees and clowning around had been very bad for her knees. I told her I could fix her knees if she was completely compliant. Here was the treatment:

I told her she would need to soak her legs in a hot Fucus (Bladderwrack) bath for four hours each day for up to a year. When she categorically refused, I could only remind her of the painful alternatives.

We agreed on a compromise: tall (16 inches) rubber boots, several sizes too large. Hot Fucus slurry, made from DRIED FUCUS, was poured into the boots and her feet placed in them, with about 2 inches between the top of the Fucus slurry and the top of the boot. That way she could sit at her shop, walk around, and keep the boots on for four hours. Heat was a problem=keeping the boots and slurries warm. A hotpad applied external to the boots worked well. I provided both the boots and all of the Fucus she would use without charge. All she had to do was comply And that included no more clowning around, at work or home.

She did and after almost a year, all symptoms were resolved, she could walk without either pain or cane. I checked her every year for a decade and no return of symptoms

Now, 15 years later she is still symptom free.

I had perhaps excessive confidence in the treatment based on local and traditional First Nations folklore about the use of prolonged hot Fucus mush soaking by mostly elderly women to relieve aching leg and foot joints.

THE INVADER GETS SOAKED

Traditionally, long weekends to many weeks' holidays were taken by English Victorians to the impoverished West Coast of Ireland. There they steamed and soaked luxuriously in very hot baths filled with seawater and at least 10

gallons of fresh *Fucus serratus*, a particularly mucoidal brown seaweed. This treatment performed very thorough exfoliation of old dead skin squamous debris, stimulated peripheral circulation, and imparted comfort to many aches and pains. Swollen prostate glands seemed to shrink.

The most exciting part was the amazing increase in skin sensitivity and touchability. Seaweed bathing became a must for newlyweds and those seeking romantic revivals in fading libido relationships. Nearly 100 years ago, scores of seaweed bath houses existed. Only a handful survive from those times. Dozens of new seaweed baths have been built in the past decade in response to both renewed interest in the healthy effects of seaweed bathing, and the entry of the Irish Republic into the European Union and a great influx of European immigrants and tourists.

OTHER

My favorite therapeutic traditional use of seaweed is as a parlor floor shock absorber. In Hildene, the palatial home of Robert Todd Lincoln in Manchester, Vermont, a thick layer of dried seaweed, (probably stiff fronds of *Chondrus crispus*) is underneath the parlor dance floor to reduce impact trauma to dancing couples' feet. I was not able to obtain a sample.

BOOKS FOR GENERAL SEAWEED INFORMATION

Arasaki, S. and T. Vegetables From The Sea. 1983. Japan Publications, INC. ISBN 0-87040-475-X

Excellent review of traditional and contemporary Japanese uses of seaweeds. Includes many tables listing various nutritional components of seaweeds, including: minerals, amino acids, starches, polymers, fatty acids, vitamins and peptides.

Describes basic seaweed biology, many edible seaweeds, and a bunch of traditional sea vegetable recipes. Industrial uses and seaweed mariculture are described. Some of the authors' original seaweed researches are included. A well-translated and organized text makes this a relatively easy read of some highly technical aspects of seaweed biology, particularly metabolic physiology and ecology.

Cooksley, Valerie. Seaweed. 2007. Stewart, Tabore, & Chang. ISBN 10:1-58479-538-7

Best all-round, thorough, very readable comprehensive text emphasizing health and nutritional seaweed topics. Excellent introductory survey useful for healers, beauticians, and the general public. Well-documented, conveniently organized, good index, and contains current resource lists for seaweeds and seaweed products.

BEST SEA VEGETABLE COOKBOOK

Erhart, Shep and Cerier, Leslie. Sea Vegetable Celebration. 2001. Book Publishing Co. ISBN 1-57067-123-0

Shep presents an excellent brief discussion of seaweed biology followed by wonderful sea vegetable recipes from Leslie.

Shep, like myself, likes a lot of sea vegetable and some other food to dilute the sea vegetable. Leslie takes a less sea vegetable-dominant approach and offers foods with sea vegetables. Some very appealing color photos of delicious food.

Further sea vegetable recipes are in Leslie's most recent book, *Going Wild in the Kitchen*.

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BC Kelp. POB 274, Prince Rupert, BC V8J 3P3, Canada. 250-622-7085

Island Herbs, POB 25, Waldron, WA 98297

Maine Seaweed Co. POB 57, Steuben, Maine 04680

Maine Coast Sea Vegetables. 3 Georges Pond RD., Franklin, Maine 04634
207-565-2907

Mendocino Sea Vegetables. POB 455, Philo, CA 95466. 707-895-2996

Nature Spirit Herbs. POB 150, Williams, OR 97544. 541-846-7995

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