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Medicinal & Therapeutic Interests along with the Seaweeds

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ABSTRACT

The global economic impact of the five leading chronic diseases-cancer, diabetes, mental illness, CVD, and respiratory disease — could reach $47 trillion over the next 20 years, according to a study by the World Economic Forum (WEF).According to the WHO, 80% of the world's population primarily those of developing countries rely on plant-derived medicines for the healthcare. The purported efficacies of seaweed derived phytochemical showing great potential in obesity, T2DM, metabolic syndrome, CVD, IBD, sexual dysfunction and some cancers. Therefore, WHO, UN-FAO, UNICEF and governments have shown a growing interest in this unconventional food with health-promoting effects. Edible marine macro-algae (seaweed) are of interest because of their value in nutrition and medicine. Seaweeds contain several bioactive substances like polysaccharides, proteins, lipids, polyphones, and pigments, all of which may have beneficial health properties. People consume seaweed as food in various forms: raw as salad and vegetable, pickle with sauce or with vinegar, relish or sweetened jellies and also cooked for vegetable soup. By cultivating seaweed, coastal people are getting an alternative livelihood as well as advancing their lives. In 2005, world seaweed production was totaled 14.7 million tons which more than double (30.4 million tons) in 2015. The present market value is nearly $6.5 billion and projected to reach some $9 billion seaweed global market by 2024. Aquaculture is recognized as the most sustainable means of seaweed production and accounts for approximately 27.3 million tons (more than 90%) of global seaweed production per annum. Asian countries produced 80% for world markets where China alone produces half of the total demand. The top six seaweed producing countries are China, Indonesia, Philippines, Korea, and Japan.

Keywords: *seaweeds; cancer prevention; hyperglycemia management; microalgae; neuro protection; alimentary disorders*

Figure1. Sea weeds Farming. According to FAO of the UN, a nearly 45% of the female workforce working in agriculture. Seaweed farming is surely a step toward gender equality (Source: SOFA Team and Cheryl Doss. The role of women in agriculture. ESA Working Paper No. 11-02, March 2011)

OBESITY, HYPERTENSION AND HYPERGLYCEMIA MANAGEMENT

According to the WHO, 2.3 billion adults are overweight and the prevalence is higher in females of childbearing age than males [1].In the US, the economic burden is estimated to be about $100 billion annually [2].Worldwide obesity causes 2.8 million deaths per year and 35.8 million disability-adjusted life-years, some 45% of diabetes, 25% of IHDs and up to 41% of certain cancers [3].Four major bioactive compounds from seaweeds which have the potential as anti-obesity agents are fucoxanthin, alginates, fucoidans and phlorotannins [4].Alginates are amongst the seaweed fibers that are well-known for their anti-obesity effects. They have been shown to inhibit pepsin, pancreatic lipase [5], reduced body weight, BMI, and the blood glucose level [6], ameliorate fat accumulation, TG and TC [7] in experimental animals. Koo et.al, 2019 reported Fucoxanthin powder developed from microalga

Phaeodactylum tricornutum plus CLA or Xanthigen improved lipid metabolism, reduced body weight gain and adipose tissue [8]. Individually, fucoxanthin lowers glycated hemoglobin, especially in in healthy subjectswith a certain UCP1 genotype [9]. Mendez et.al, 2019 reported anti-obesogenic potential of seaweed dulse (*Palmaria palmata*) (**Figure 2**) in High-fat Fed mice [10]. Seca et.al, 2018 suggested that small peptides from seaweed may possess bioactivity, for example, of relevance for BP regulation [11]. Yang et.al, 2019 reported Fucoidan A2 from the brown seaweed *Ascophyllum nodosum* (**Figure 3**) lowers lipid by improving reverse cholesterol transport in mice [12]. Sørensen et.al, 2019 reported improved HbA1Cand lipid profile with *Saccharinalatissima*or sugar kelp (**Figure 4**) in mice [13]. Fucoidan taken twice daily for a period of 90 days did not markedly affect insulin resistance in obese, nondiabetic cohort [14], but attenuates obesity-induced severe oxidative damage [15], show anticoagulant activity [16], suppress fat accumulation [17], may improve obesity-induced OA [18], antioxidant and lipolytic activities [19]. Catarino et.al, 2019 and 2017 reported *Fucus vesiculosus* (**Figure 5**) phlorotannin-rich extracts have significant effect on α-glucosidase, α-amylase and pancreatic lipase [20]. Phlorotannins, farnesylacetones and other constituents from seaweeds—have also been described for their potential use in hypertension due to their reported vasodilator effects [21]. Sun et.al, 2019 reported the hydrogen bond and Zn (II) interactions between the peptides of Marine Macroalga *Ulva intestinalis* and ACE [22].

In similar studies, peptides from *Sargassum siliquosum*, *Sargassum polycystum* [23], *Fucus spiralis* L [24], *Palmaria palmata* [25], *Pyropia yezoensis*, *Undaria pinnatifida*, *Enteromorpha clathrate*, *Ulva rigida* C, *Gracilariopsis lemaneiformis*, *Pyropia columbina*, *Ecklonia cava* Kjellman, *Ecklonia stolonifera* Okamura, *Pelvetia canaliculate*, *Sargassum thunbergii* [26], *Porphyra yezoensis* [27], *Lomentaria catenata*, *Lithophyllum okamurae*, *Ahnfeltiopsis flabelliformi*s [28] show potential ACE inhibitory activities. Besides the activation of Ag II, ACE plays a concomitant role in the regulation of hypertension via the inactivation of an endothelium-dependent vasodilatory peptide, bradykinin [28, 29]. Kammoun et.al, 2018 reported hypolipidemic and cardio protective effects of *Ulva lactuca*, which effectively counteracts cardiotoxic effects of hypercholesterolemic regime [30]. In several studies Ulva species showed hypotensive, hypoglycemic, hypolipaemic and antiatherogenic properties [31-40]. Moreover, studies also support seaweed induced effects of postprandial lipoproteinaemia [41-43] postprandial hyperglycemia [44-55], lipid metabolism and atherosclerosis [56-70], reduce body weight [71-80], HbA1c [13], [34], [52], [55], [81-90], reduce BP/episodes of hypertension [11], [26], [28], [46], [49], [53], [66], [80], [91-102] and prevent obesity induced oxidative damage [4], [8], [13], [34], [103-120].Increased seaweed consumption may be linked to the lower incidence of metabolic syndrome in eastern Asia[28].

Figure2. *Palmaria* palmate (Source: What is Dulse Seaweed? Mara Seaweed October 17, 2017).

Figure3. *Ascophyllum nodosum* (Source: Ascophyllum nodosum. Jiloca Industrial, S.A. Agronutrientes Blog)

Figure4. ***Saccharina latissima*** or sugar kelp (Source: Nature Picture Library).

Figure6. ***Fucus vesiculosus L.*** (Source: Seaweed Site of M.D. Guiry)

CANCER PREVENTION & TUMOR CONTROL

In 2019, 1,762,450 new cancer cases and 606,880 cancer deaths are projected to occur in the United States [121]. Globally, cancer responsible for at least 20% of all mortality [122], 18.1 million new cancer, 9.5 million deathin 2018 [123,124], 5- year prevalence 43.8 million [125], is predicted to rise by 61.4% to 27.5 million in 2040 [126]. Approximately 70% of deaths from cancer occur in LMICs [127]. Asia, Africa, and Latin America are collectively home to more than 50% of cancer patients; with more than half of global cancer-related mortalities occurring in Asia alone [128]. Cancer causes 46 billion in productivity lost in major emerging economies [129] and economic costs of tobacco-related cancers exceed USD 200 billion each year [130]. Compounds from natural sources with anti-proliferative activity represent an important and novel alternative to treat several types of cancer. *Egregia menziesii* (brown seaweed) (**Figure 6**) [131], *Portieria hornemannii* [132], *Grateloupia elliptica* [133] *Sargassum serratifolium* [134], Chitosan alginate (polysaccharide from seaweeds) [135-143], xanthophylls(astaxanthin, fucoxanthin) and Phlorotannins (phloroglucinol) obtained from the microalgae [144-155], are reported in brain tumor (glioblastoma) studies. astaxanthin and fucoxanthin are major marine carotenoids. Major seaweed sources of astaxanthinmono- and di- esters are green algae (*Haematococcus pluvialis* (**Figure7**), *Chlorella zofingiensis*, *Chlorococcum*) and red-pigmented fermenting yeast *Phaffia rhodozyma* [156,157]. Fucoxanthin present in Chromophyta (*Heterokontophyta* or *Ochrophyta*), including brown seaweeds (*Phaeophyceae*) and diatoms (*Bacillariophyta*) [158]. Several 2019 reviews reveal fucoidans (sulfated polysaccharide mainly derived from brown seaweed) in lung cancer management. Brown algae like *Fucus vesiculosus*, *Turbinaria conoides*, *Laminaria japonica* (**Figure 8**) are reported in inhibition of tumor migration and invasion, apoptosis induction and inhibition lung cancer cell progression respectively [159]. *Fucus evanescens*, *Sargassum* sp. (**Figure 9**), *Saccharina Japonica* was reported to inhibit proliferation and metastasis, and inducing apoptosis in vitro [160]. *Undaria pinnatifida* acted on ERK1/2 MAPK and p38, PI3K/Akt signaling, *F. evanescens* increased metastatic activity of cyclophosphamide and showed cytolytic activity of natural killer cells in 2 different studies and *F. vesiculosus*decreased NF-κB in LLC [161].*U. pinnatifida* was found to show average antitumor and superior efficacy against LLC in review of Misra et.al, 2019 [162]. Sponge alkaloids from Aaptos showed potential in human lung adenocarcinoma A549, from *Fascaplysinopsis*exerted an anti-proliferative and pro-apoptotic effect in lung cancer, from blue sponge Xestospongia showed apoptosis as well as stimulate anoikis in H460 lung cancer cells in review by Ercolano et.al, 2019[163].The most common breast cancer type is the invasive ductal carcinoma accounting for 70-80% of all breast cancers diagnosed [164].Brown seaweed fucoidan inhibited human breast cancer progression by upregulating microRNA (miR)-29c and downregulating miR-17-5p, thereby suppressing their target genes [165]. *Lophocladia* sp (Lophocladines), *Fucus*sp (fucoidan), *Sargassum muticum* (polyphenol), *Porphyra dentata* (sterol fraction), *Cymopolia barbata* (CYP1 inhibitors), *Gracilaria termistipitata* was found to be effective in breast cancer studies [166]. High Urokinase-type plasminogen activator receptor (uPAR)

expression predicts for more aggressive disease in several cancer types [167], dietary seaweed may help lowering breast cancer incidence by diminishing levels of uPAR [168]. The tropical edible red seaweed *Eucheuma cottonii* L. (**Figure 10**) is rich in polyphenols that exhibited strong anticancer effect with enzyme modulating properties [169]. Jazzara et.al, 2016 concluded that λ-carrageenan (sulfated galactans found in certain red seaweeds) could be a promising bioactive polymer [170], showed a remarkable inhibitory effect on MDA-MB-231(triple negative breast cancer cell line) cell migration [171]. Several studies support polyphenols [172-176], flavonoids[177-186], fucoidan [159,160], [166], [187-195], lutein/zeaxanthin [196-200], other seaweed alkaloids, peptides, tannins and polysaccharides [132], [164], [201-210] in breast cancer management.

The number of deaths from colorectal cancer in Japan continues to increase [211], it is the third most common diagnosis and second deadliest malignancy for both sexes combined [212]. It has been projected that there will be 140,250 new cases of colorectal cancer in 2018, with an estimated 50,630 people dying of this disease [213]. High intake of red and processed meat and alcohol increase the risk of colorectal cancer [214]. *U. pinnatifida* [159], [188], [215-221], *Saccharina latissimi* [222], *Fucus vesiculosus* [117], [160], [223,224], *Sargassum hemiphyllum* [155], [225,226] have proven efficacy in this situation. Also, Algae derived astaxanthin [150], [227-232], fucoxanthin [233-237], lutein and zeaxanthin [238-241], polyphenols [242-246] shown individual excellence.

Figure6. *Egregia menziesii brown seaweed* (Source: University of British Columbia Garden).

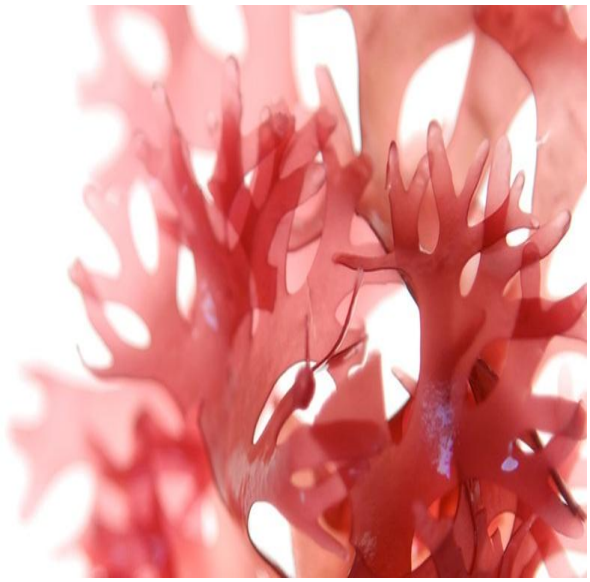

Figure7. *Haematococcus Pluvialis* (Source: VERYMWL, Thailand)

Figure8. *Laminaria japonica* (Source: TCM Herbs)

Figure9. *Sargassum sp.* (Source: POND5)

Figure10. ***Eucheuma cottonii L*** (Source: Blog at WordPress.com).

NEURO PROTECTION IN STROKE, ALZHEIMER'S AND PARKINSONISM

Stroke is a leading cause for disability and morbidity associated with increased economic burden due to treatment and post-stroke care. Acute ischemic stroke has enormous societal and financial costs due to rehabilitation, long-term care, and lost productivity. Between 2010 and 2030, stroke is expected to increase by more or less 60% in men and 40% in women [248]. Several studies reported neuro protective role of astaxanthin and fucoxanthin [145], [248-268] in stroke prevention, Alzheimer's, Parkinsonism and other neurodegenerative diseases. Barbalace et.al, 2019 reported that marine algae inhibit pro-inflammatory enzymes such as COX-2 and iNOS, modulate MAPK pathways, and activate NK-kB [269].

Neorhodomelaaculeate, Rhodomela confervoides [26], [270], *Ecklonia cava* (**Figure 11**) [271-275], *Laminaria japonica* [276-281], *Fucus vesiculosus* [282-287], *Sargassum*spp. [288-295], *Saccorhiza polyschide* [283], *Codium tomentosum* [296], Ulva spp [256], [267], [293], [297-300], *Ecklonia maxima* [256], [301-303], *Gracilaria*spp. (**Figure 12**) [296], [304-311], *Gelidium pristoides* [312,313], *Halimeda incrassate* [314,315], *Bryothamniom triquetrum* [316-318], *Chondrus crispus* (**Figure 13**) [319,320], *Hypnea valentiae* (**Figure 14**) [298], *Ecklonia stolonifera* [321-323] were reported in several studies as neuro-protectives and suggested in neurodegenerative situations or already in use in as such conditions.

Figure11. ***Ecklonia cava*** (Source: Predator Nutrition)

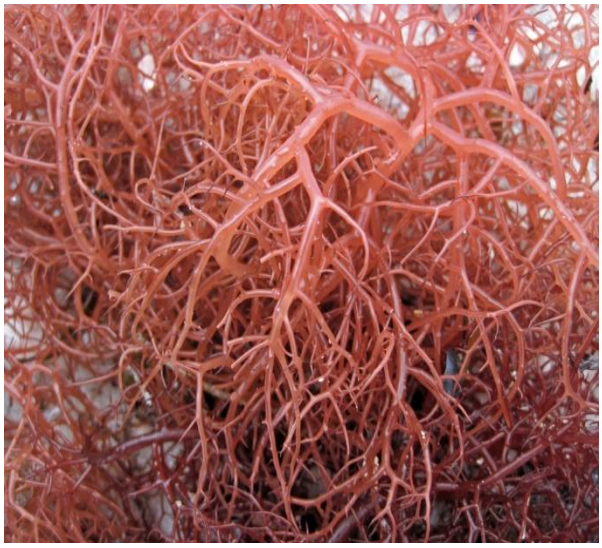

Figure12. ***Gracilaria tikvahiae*** Red Seaweed (Source: Flickr)

Figure13. ***Chondrus crispus - Carragheen or Irish Moss*** (Source: APHOTOMARINE)

Figure14. ***Hypnea valentiae*** (Source:iNaturalist)

ALIMENTARY DISORDERS

In the USA, the sales of prescription GI therapeutic drugs were $25 billion, the 10th leading therapeutic class in terms of sales [324], spend $135.9 billion for GI diseases in 2015 [325].Urbanization, western diet, hygiene, and childhood immunological factors are associated with IBD in Asia [326]. On the other hand, 14% of the global population is affected by IBS and 30% by constipation [327,328]. Na- alginate, has been used in the treatment of heartburn and GERD, although ESPGHAN/NASPGHAN Guidelinesdo not recommend it's use in chronic GERD [329,330]. The [^{13}C]-Spirulina platensis GEBT is an easy to measure of gastric emptying with accuracy [331-333].*Laminaria japonica* (vomiting, hemorrhoids, IBD, probiotic synergist) [334,335], *Eucheuma cottonii* (IBD, hepatoprotective, anti-food allergy)[336-338], *Caulerpa Mexicana*(**Figure 15**) (Gastroprotective, IBD) [339-341], *Hypnea musciformis* (IBD) [336], [342], *Fucus vesicolosus* (gastroprotective, ulcerative colitis) [117], [343], *Laminaria hyperborean*, *Laminaria digitate* (IBD) [344,345], *Undaria pinnatifida* (**Figure 16**) (improves gut health)are reported in gut health modulation [346]. In addition, seaweed polysaccharides are atypical in structure to terrestrial glycans, and were found to resist gastric acidity, host digestive enzymes, and GI absorption [347]. Maternal seaweed extract supplementation can reduce both sow fecal *Enter obacteriaceae* populations at parturition and piglet *E. coli* populations at weaning [348]. Also, seaweeds are good source of prebiotics that improve intestinal microbiota and may exert positive effects on IBD and IBS [349,350].

Figure15. ***Caulerpa Mexicana*** (Source: Reefs.com)

Figure16. ***Undaria pinnatifida*** (Source: The Marine Life Information Network)

THYROID FUNCTION

Seaweeds are rich source of Iodine and Tyrosine [351], palatable and acceptable to consumers as a whole food or as a food ingredient and effective as a source of iodine in an iodine-insufficient population [352]. In addition, daily diet should include thyroid boosting foods like those rich in iodine, amino acid tyrosine, minerals like selenium, zinc, copper, iron, various vitamins including, B2, B3, B6, C and E [353]. Edible seaweeds are rich in these vitamins and minerals [95].Although high iodine intakes are well tolerated by most healthy individuals, but in some people, it may precipitate hyperthyroidism, hypothyroidism, goiter, and/or thyroid autoimmunity [354]. Excess intake of iodine through seafood consumption is a suspected risk factor for thyroid cancer [355]. Also, some seaweed is contaminated with arsenic, mercury, cadmium and other heavy metals that have positive association with thyroid hormones in adults [356-360].

Analgesic and Anti-inflammatory Potential

Neuropathic pain estimates of 60% among those with chronic pain. Mild -to-moderate pain may be relieved by non-drug techniques alone [128].1g of brown seaweed extract (85% *F. vesiculosus* fucoidan) daily could reduce joint pain and stiffness by more than 50% [361,362]. Association between algae consumption and a lower incidence of chronic degenerative diseases is also reported for The Japanese [363]. Carrageenan has been widely used as a tool in the screening of novel anti-inflammatory drugs [364].

Among others, *Porphyra vietnamensis* [365,366], *Eucheuma Cottonii* [367], *Dichotomaria obtusata* (**Figure 17**) [368], *Cystoseira sedoides*,*Cladostephus spongiosis*, *Padina pavonica* (**Figure 18**) [369], *Ecklonia cava* (due to phlorotannins) [370-372], *Caulerpa racemose* [373], *Sarcodia ceylanica* [374], *actinotrichia fragilis* [375], *Dictyota menstrualis* (**Figure 19**) [376], *Gracilaria cornea* [377], Gracilaria birdiae [378], Class Phaeophyceae, Rhodophyceae and Chlorophyceae [379], *Caulerpa curpressoides* [380,381], *Ulva lactuca* (**Figure 20**) [382], *Sargassum wightii* and *Halophila ovalis* [383], *Grateloupia lanceolate* [384], *Sargassum fulvellum* and *Sargassum thunbergii* [385], *Briareum excavatum* [386], Caulerpa racemose [387], *Sargassum hemiphyllum* [388], *Laurencia obtusa*[389], *Caulerpa kempfii* [390] *Caulerpa cupressoides* [391] are reported for their analgesic and anti-inflammatory properties.

Figure17. *Dichotomaria obtusata*, Tubular Thicket Algae (reefguide.org)

Figure18. *Padina pavonica* (Source: Alchetron)

Figure19. *Dictyota menstrualis* (Source: flowergarden.noaa.gov)

Figure20. *Ulva lactuca, Sea Lettuce* (Source: Addictive Reef Keeping)

Antimicrobial Properties

Rising antimicrobial resistance is a threat to modern medicine. Infections with resistant organisms have higher morbidity and mortality, are costlier to treat andestimated to cause 10 million deaths annually by 2050with global economic loss US$100 trillion [392-394]. Lu

et.al, 2019 reported *Laminaria japonica*, *Sargassum*, *Gracilaria* sp. and *Porphyra dentate* potentiated the activities of macrolides against *E. coli* [394]. Carragelose ® (first marketed product from algae) in the has ability to block viral attachment to the host cells being effective against a broad spectrum of respiratory viruses [395]. Besednova et.al, 2019 reported that fucoidans, carrageenans, ulvans, lectins, and polyphenols are biologically active compounds from seaweeds that target proteins or genes of the influenza virus and host components [396].

Table1. *Antimicrobial activity of different solvent extracts from seaweeds [397].*

Red Seaweed	**Organisms**
Alsidium corallinum	Escherichia coli, Klebsiella pneumoniae, Staphylococcus aureus
Ceramium rubrum	E. coli, Enterococcus faecalis, S. aureus
Ceramium virgatum	Salmonella enteritidis, E.coli, Listeria monocytogenes, Bacillus cereus
Chondrocanthus acicularis	E. coli, K. pneumoniae, E. faecalis, S. aureus
Chondracanthus canaliculatus	S. aureus, Streptococcus pyogenes
Chondrus crispus	L. monocytogenes, Salmonella abony, E. faecalis, P. aeruginosa
C. crispus	Pseudoalteromonas elyakovii, Vibrio aestuarianus, Polaribacter irgensii, Halomonas marina, Shewanella putrefaciens
Corallina elongata	B. subtilis, S. aureus, E. coli, Salmonella typhi, K. pneumoniae, Candida albicans
Gelidium attenatum	E. coli, K. pneumoniae, E. faecalis, S. aureus
Gelidium micropterum	V. parahaemolyticus, V. alcaligenes
Gelidium pulchellum	E. coli, E. faecalis, S. aureus
Gelidium robustum	S. aureus, S. pyogenes
Gelidium spinulosum	E. coli, E. faecalis, S. aureus
Gracilaria dura	V. ordalii, V. alginolyticus
Gracilaria gracilis	V. salmonicida
Grateloupia livida	S. aureus, E. coli, P. aeruginosa
Gracilaria ornata	E. coli
Gracilaria subsecundata	S. aureus, S. pyogenes
Green Seaweed	
Boodlea composita	V. harveyi, V. alginolyticus, V. vulnificus, V. parahaemolyticus, V. alcaligenes
Bryopsis pennata	V. vulnificus, V. parahaemolyticus
Caulerpa lentillifera	E. coli, Staphylococcus aureus, Streptococcus sp., Salmonella sp.
Caulerpa parvula	V. vulnificus, V. alcaligenes
Caulerpa racemosa	E. coli, S. aureus, Streptococcus sp., Salmonella sp.
Chaetomorpha aerea	Bacilus subtilis, Micrococcus luteus, S. aureus
Chaetomorpha linum	V. ordalii, V. vulnificus
Cladophora albida	V. harveyi, V. alginolyticus, V. vulnificus, V. parahaemolyticus, V. alcaligenes
Cladophora glomerata	V. fischeri, V. vulnificus, V. anguillarum, V. parahaemolyticus
Brown Seaweed	
Chnoospora implexa	S. aureus, S. pyogenes
Cladophora rupestris	E. coli, S. aureus, P. aeruginosa, V. harveyii, V. parahaemolyticus, V. alginolyticus
C. rupestris	E. coli, S. aureus, P. aeruginosa, V. harveyii, V. parahaemolyticus, V. alginolyticus
C. rupestris	E. coli, S. aureus, P. aeruginosa, V. harveyii, V. parahaemolyticus
Colpomenia sinuosa	S. aureus, S. pyogenes, B. subtilis, S. aureus, E. coli, S. typhi, K. pneumoniae, C. albicans
Colpomenia tuberculata	S. aureus, Sreptococcus pyogenes
Cystoseira osmundacea	S. pyogenes
Cystoseira trinodis	S. aureus, B. subtilis, E. coli, P. aeruginosa
Dictyopteris delicatula	S. aureus, S. pyogenes

Dictyopteris undulata	S. aureus, S. pyogenes
Dictyota dichotoma	S. aureus, B. subtilis, E. coli, P. aeruginosa
Dictyota flabellata	S. aureus, S. pyogenes
Dictyota indica	S. aureus, B. subtilis, E. coli, P. aeruginosa
Dictyota sp.	S. aureus, Enterococcus faecalis, P. aeruginosa
Eisenia bicyclis	S. aureus, S. epidermidis, Propionibacterium acnes

OTHER HEALTH ISSUES

Walsh et.al, 2019 reported osteogenic potential of brown seaweeds *Laminaria digitata* and *Ascophyllum nodosum* [398].Seaweed contains several compounds with antioxidant properties (phlorotannins, pigments, tocopherols, flavonoids, polyphenols and polysaccharides) [399]. Antioxidant properties of *Fucus vesiculosus* and *Ascophyllum nodosum* (due to phlorotannins) [399], *Turbinaria conoides* (2H-pyranoids) [400],*Ulva clathrate*(phenolics and flavonoid contents)[401], *Bifurcaria bifurcate* (**Figure 21**) (diterpenes eleganolone and eleganonal) [402], *Cystoseira* spp. (phenolic constituents) [119], *Sargassum siliquastrum* (phenolic compounds, ascorbic acid) [403], *Ulva compressa* (phenolic contents) [404], *Saccharina japonica*(polysaccharides) and *Sargassum horneri* (phenolic contents) [405,406], *Halophila ovalis* (**Figure 22**) and *Halophila beccarii*(flavonoids) [407,408], *Cystoseira sedoides*(mannuronic acid than guluronic acid) [369], [409,410], *Caulerpa peltata*, *Gelidiella acerosa*, *Padina gymnospora*, and *Sargassum wightii* (phenols and flavonoids) [411], *Ecklonia cava Kjellman* (polyphenols) [412,413], *Undaria pinnatifida* (phlorotannins) [414] are well reported. Most other medicinal effects are mainly due to presence of these antioxidants. Mesripour et.al, 2019 reported antidepressant effects of *Sargassum plagyophylum* [415]. *Ecklonia bicyclis*, *Tribulus terrestris* improved sexual and ejaculation function and sexual QoL [416].

Chronic pain is often associated with sexual dysfunction, suggesting that pain can reduce libido [416]. However, red algae (especially sea moss/*Gracilaria* spp.), *Hypnea musciformis* (Vermifuge), *Porphyra crispata*are known to have aphrodisiac properties [417-419]. Thrombotic diseases are reported to contribute to 30% early deaths globally [420]. *Ulva rigida* [421], *Udotea flabellum* (**Figure 23**) [422], ulvans, and their oligosaccharides [380], *Nemacystus decipieus*, *Undaria pinnatifida* [423], *Porphyra yezoensis*, *Coscinoderma mathewsi*, *Sargassum micranthum*, *Sargassum yezoense*, *Canistrocarpus cervicornis* (**Figure 24**), *Dictyota menstrualis*, *Ecklonia Kurome*, *Ecklonia*spp. [424] have shown anticoagulant and anti-thrombotic properties. He et.al, al, 2019 reported that seaweed consumption may be a dietary predictor of elevated MEP, MiBP, and ∑DEHP concentrations among pregnant women [425]. Urolithiasis affects approximately 10% of the world population and is strongly associated with calcium oxalate (CaOx) crystals.Gomes et.al, 2019 reported anti-urolithic effect of green seaweed *Caulerpa cupressoides* [426]. *Grateloupia elliptica*has the potential to treat alopecia via inhibitory activity against *Pityrosporum ovale* [427].Strong fungus-inhibitory effects of *Ochtodes secundiramea* and *Laurencia dendroidea* extracts were observed Banana and papaya during storage [428]. Marine macroalgae are a promising source of diverse bioactive compounds with applications in the biocontrol of harmful cyanobacteria blooms [429].

Figure21. *Bifurcaria bifurcate* (Source: APHOTOMARINE)

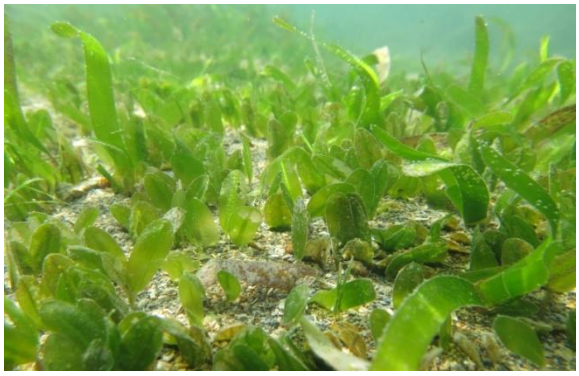

Figure22. *Halophila ovalis*, Spoon Seagrass (Source: CoMBINe)

Figure23. ***Udotea flabellum*** (Source: Insta Phenomenons)

Figure24. ***Canistrocarpus cervicornis*** (Source: Backyard Nature)

Figure25. ***Grateloupia elliptica*** (Source: Papago. naver.com)

CONCLUSION

Seaweeds are well-known for their exceptional capacity to accumulate essential minerals and trace elements needed for human nutrition, although their levels are commonly very variable depending on their morphological features, environmental conditions, and geographic location. Food security, legislative measures to ensure monitoring and labeling of food products are needed. Being subject to environmental influences from its habitat, seaweeds also entail water-borne health risks such as organic pollutants, toxins, parasites, and heavy metals. Having in mind the serious environmental problems raised in coastal areas by urbanization and industrialization, the concentration of toxic elements in edible macroalgae is now a growing concern, mainly considering their increment in Western diet. Although many studies demonstrated their therapeutic value in various ailments but most of them performed on experimental animals. Proper labelling is necessary along with instruction of content, source and use. Furthermore, controlled human intervention studies with health-related end points to elucidate therapeutic efficacy are required.

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ABBREVIATIONS

monoisobutyl phthalate (MiBP), monoethyl phthalate (MEP); The molar sum of MEHHP and MEOHP (∑DEHP); mono (2-ethylhexyl) phthalate (MEHP); mono(2-ethyl-5-oxohexyl) phthalate (MEOHP);World Economic Forum (WEF); Ischemic Heart Diseases (IHDs); Food and Agriculture Organization of the United Nations (UN-FAO); Gastric Emptying Breath Test (GEBT); Low and Middle Income Countries (LMICs); Conjugated Linoleic Acid (CLA); State of Food and Agriculture (SOFA); Uncoupling protein-1 (UCP-1); Hemoglobin A1c (HbA1c); extracellular signal–regulated kinases (ERK); Inflammatory bowel disease (IBD); Angiotensin Converting Enzyme (ACE); Osteoarthritis (OA); Cytochrome P450 1 (CYP1); Mitogen-Activated Protein Kinases (MAPK); Cyclooxygenase-2 (COX 2); Phosphatidylinositol 3-Kinase/Protein Kinase B (PI3K/Akt); Nuclear Factor Kappa-Light-Chain-Enhancer Of Activated B cells (NF-κB)

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BIBLIOGRAPHY AND WEBLIOGRAPHY

[1] Ma RCW, Schmidt MI, Tam WH, McIntyre HD, Catalano PM. Clinical management of pregnancy in the obese mother: before conception, during pregnancy, and post partum. Lancet Diabetes Endocrinol. 2016 Dec;4(12):1037-1049. doi: 10.1016/S2213-8587(16)30278-9. Epub 2016 Oct 12. Review. PubMed PMID: 27743977.

[2] Panuganti KK, Gossman WG. Obesity. [Updated 2019 May 15]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2019 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK459357/

[3] Dagne S, Gelaw YA, Abebe Z, Wassie MM. Factors associated with overweight and obesity among adults in northeast Ethiopia: a cross-sectional study. Diabetes Metab Syndr Obes. 2019 Mar 22;12:391-399. doi: 10.2147/DMSO.S179699. eCollection 2019. PubMed PMID: 30962699; PubMed Central PMCID: PMC6434910.

[4] Wan-Loy C, Siew-Moi P. Marine Algae as a Potential Source for Anti-Obesity Agents. Mar Drugs. 2016 Dec 7; 14(12). pii: E222. Review. PubMed PMID: 27941599; PubMed Central PMCID: PMC5192459.

[5] Chater PI, Wilcox M, Cherry P, Herford A, Mustar S, Wheater H, Brownlee I, Seal C, Pearson J. Inhibitory activity of extracts of Hebridean brown seaweeds on lipase activity. J Appl Phycol. 2016; 28:1303-1313. Epub 2015 May 26. PubMed PMID: 27057089; PubMed Central PMCID: PMC4789227.

[6] Tran VC, Cho SY, Kwon J, Kim D. Alginate oligosaccharide (AOS) improves immuno-metabolic systems by inhibiting STOML2 overexpression in high-fat-diet-induced obese zebrafish. Food Funct. 2019 Jul 10. doi: 10.1039/c9fo00982e. [Epub ahead of print] PubMed PMID: 31290903.

[7] Wang X, Liu F, Gao Y, Xue CH, Li RW, Tang QJ. Transcriptome analysis revealed anti-obesity effects of the Sodium Alginate in high-fat diet -induced obese mice. Int J Biol Macromol. 2018 Aug;115:861-870. doi: 10.1016/j.ijbiomac.2018.04.042. Epub 2018 Apr 10. PubMed PMID: 29649537.

[8] Koo SY, Hwang JH, Yang SH, Um JI, Hong KW, Kang K, Pan CH, Hwang KT, Kim SM. Anti-Obesity Effect of Standardized Extract of Microalga Phaeodactylum tricornutum Containing Fucoxanthin. Mar Drugs. 2019 May 27;17(5). pii: E311. doi: 10.3390/md17050311. PubMed PMID: 31137922; PubMed Central PMCID: PMC6562887.

[9] Mikami N, Hosokawa M, Miyashita K, Sohma H, Ito YM, Kokai Y. Reduction of HbA1c levels by fucoxanthin-enriched akamoku oil possibly involves the thrifty allele of uncoupling protein 1 (UCP1): a randomised controlled trial in normal-weight and obese Japanese adults. J Nutr Sci. 2017 Feb 14;6:e5. doi: 10.1017/jns.2017.1. eCollection 2017. PubMed PMID: 28620480; PubMed Central PMCID: PMC5465861.

[10] Mendez R, Miranda C, Armour C, Sharpton T, Stevens JF, Kwon J. Antiobesogenic Potential of Seaweed Dulse (Palmaria palmata) in High-fat Fed C57BL/6 J Mice (P21-014-19), Current Developments in Nutrition, Volume 3, Issue Supplement_1, June 2019, nzz041.P21–014–19, https://doi.org/_10.1093 /cdn/nzz041.P21-014-19

[11] Seca AML, Pinto DCGA. Overview on the Antihypertensive and Anti-Obesity Effects of Secondary Metabolites from Seaweeds. Mar Drugs. 2018 Jul 14;16(7). pii: E237. doi: 10.3390/md16070237. Review. PubMed PMID: 30011911; PubMed Central PMCID: PMC6070913.

[12] Yang Z, Liu G, Wang Y, Yin J, Wang J, Xia B, Li T, Yang X, Hou P, Hu S, Song W, Guo S. Fucoidan A2 from the Brown Seaweed Ascophyllum nodosum Lowers Lipid by Improving Reverse Cholesterol Transport in C57BL/6J Mice Fed a High-Fat Diet. J Agric Food Chem. 2019 May 22;67(20):5782-5791. doi: 10.1021/acs.jafc.9b01321. Epub 2019 May 13. PubMed PMID: 31055921.

[13] Sørensen LE, Jeppesen PB, Christiansen CB, Hermansen K, Gregersen S. Nordic Seaweed and Diabetes Prevention: Exploratory Studies in KK-Ay Mice. Nutrients. 2019 Jun 25;11(6). pii: E1435. doi: 10.3390/nu11061435. PubMed PMID: 31242682; PubMed Central PMCID: PMC6627585.

[14] Wright CM, Bezabhe W, Fitton JH, Stringer DN, Bereznicki LRE, Peterson GM. Effect of a Fucoidan Extract on Insulin Resistance and Cardiometabolic Markers in Obese, Nondiabetic Subjects: A Randomized, Controlled Trial. J Altern Complement Med. 2019 Mar;25(3):346-352. doi: 10.1089/acm.2018.0189. Epub 2018 Oct 12. PubMed PMID: 30312135.

[15] Ahn JH, Shin MC, Kim DW, Kim H, Song M, Lee TK, Lee JC, Kim H, Cho JH, Kim YM, Kim JD, Choi SY, Won MH, Park JH. Antioxidant Properties of Fucoidan Alleviate Acceleration and Exacerbation of Hippocampal Neuronal Death Following Transient Global Cerebral Ischemia in High-Fat Diet-Induced Obese Gerbils. Int J Mol Sci. 2019 Jan 28;20(3). pii: E554. doi: 10.3390/ijms20030554. PubMed PMID: 30696078; PubMed Central PMCID: PMC6387260.

[16] Wang Y, Xing M, Cao Q, Ji A, Liang H, Song S. Biological Activities of Fucoidan and the Factors Mediating Its Therapeutic Effects: A Review of Recent Studies. Mar Drugs. 2019 Mar 20; 17(3). pii: E183. doi: 10.3390/md17030183. Review. PubMed PMID: 30897733; PubMed Central PMCID: PMC6471298.

[17] Kim MJ, Jeon J, Lee JS. Fucoidan prevents high-fat diet-induced obesity in animals by suppression of fat accumulation. Phytother Res. 2014 Jan;28(1):137-43. doi: 10.1002/ptr.4965. Epub 2013 Apr 12. PubMed PMID: 23580241.

[18] Sudirman S, Ong AD, Chang HW, Kong ZL. Effect of Fucoidan on Anterior Cruciate Ligament Transection and Medial Meniscectomy Induced Osteoarthritis in High-Fat Diet-Induced Obese Rats. Nutrients. 2018 May 28;10(6). pii: E686. doi: 10.3390/nu10060686. PubMed PMID: 29843440; PubMed Central PMCID: PMC6024650.

[19] Oliveira RM, Câmara RBG, Monte JFS, Viana RLS, Melo KRT, Queiroz MF, Filgueira LGA, Oyama LM, Rocha HAO. Commercial Fucoidans from Fucus vesiculosus Can Be Grouped into Antiadipogenic and Adipogenic Agents. Mar Drugs. 2018 Jun 4;16(6). pii: E193. doi: 10.3390/md16060193. PubMed PMID: 29867001; PubMed Central PMCID: PMC6025566.

[20] Catarino MD, Silva AMS, Mateus N, Cardoso SM. Optimization of Phlorotannins Extraction from Fucus vesiculosus and Evaluation of Their Potential to Prevent Metabolic Disorders. Mar Drugs. 2019 Mar 8; 17(3). pii: E162. doi: 10.3390/md17030162. PubMed PMID: 30857204; PubMed Central PMCID: PMC6471631.

[21] Catarino MD, Silva AMS, Cardoso SM. Fucaceae: A Source of Bioactive Phlorotannins. Int J Mol Sci. 2017 Jun 21; 18(6). pii: E1327. doi: 10.3390/ijms18061327. Review. PubMed PMID: 28635652; PubMed Central PMCID: PMC5486148.

[22] Sun S, Xu X, Sun X, Zhang X, Chen X, Xu N. Preparation and Identification of ACE Inhibitory Peptides from the Marine Macroalga Ulva intestinalis. Mar Drugs. 2019 Mar 19; 17(3). pii: E179. doi: 10.3390/md17030179. PubMed PMID: 30893907; PubMed Central PMCID: PMC6471128.

[23] Nagappan H, Pee PP, Kee SHY, Ow JT, Yan SW, Chew LY, Kong KW. Malaysian brown seaweeds Sargassum siliquosum and Sargassum polycystum: Low density lipoprotein (LDL) oxidation, angiotensin converting enzyme (ACE), α-amylase, and α-glucosidase inhibition activities. Food Res Int. 2017 Sep;99(Pt 2):950-958. doi: 10.1016/j.foodres.2017.01.023. Epub 2017 Jan 27. PubMed PMID: 28847432.

[24] Paiva L, Lima E, Neto AI, Baptista J. Angiotensin I-Converting Enzyme (ACE) Inhibitory Activity, Antioxidant Properties, Phenolic Content and Amino Acid Profiles of Fucus spiralis L. Protein Hydrolysate Fractions. Mar Drugs. 2017 Oct 13;15(10). pii: E311. doi: 10.3390/md15100311. PubMed PMID: 29027934; PubMed Central PMCID: PMC5666419.

[25] Seca AML, Pinto DCGA. Overview on the Antihypertensive and Anti-Obesity Effects of Secondary Metabolites from Seaweeds. Mar Drugs. 2018 Jul 14; 16(7). pii: E237. doi: 10.3390/md16070237. Review. PubMed PMID: 30011911; PubMed Central PMCID: PMC6070913.

[26] Pangestuti R, Kim SK. Bioactive Peptide of Marine Origin for the Prevention and Treatment of Non-Communicable Diseases. Mar Drugs. 2017 Mar 9; 15(3). pii: E67. doi: 10.3390/md15030067. Review. PubMed PMID: 28282929; PubMed Central PMCID: PMC5367024.

[27] Collins KG, Fitzgerald GF, Stanton C, Ross RP. Looking Beyond the Terrestrial: The Potential of Seaweed Derived Bioactives to Treat Non-Communicable Diseases. Mar Drugs. 2016 Mar 18;14(3). pii: E60. doi: 10.3390/md14030060. Review. PubMed PMID: 26999166; PubMed Central PMCID: PMC4820313.

[28] Gómez-Guzmán M, Rodríguez-Nogales A, Algieri F, Gálvez J. Potential Role of Seaweed Polyphenols in Cardiovascular-Associated Disorders. Mar Drugs. 2018 Jul 28; 16(8). pii: E250. doi: 10.3390/md16080250. Review. PubMed PMID: 30060542; PubMed Central PMCID: PMC6117645.

[29] Majumder K, Wu J. Molecular targets of antihypertensive peptides: understanding the mechanisms of action based on the pathophysiology of hypertension. Int J Mol Sci. 2014 Dec 24;16(1):256-83. doi: 10.3390/ijms16010256. Review. PubMed PMID: 25547491; PubMed Central PMCID: PMC4307246.

[30] Kammoun I, Ben Salah H, Ben Saad H, Cherif B, Droguet M, Magné C, Kallel C, Boudawara O, Hakim A, Gharsallah N, Ben Amara I. Hypolipidemic and cardioprotective effects of Ulva lactuca ethanolic extract in hypercholesterolemic mice. Arch Physiol Biochem. 2018 Oct;124(4):313-325. doi: 10.1080/13813455.2017.1401641. Epub 2017 Nov 24. PubMed PMID: 29171301.

[31] Pengzhan Y, Ning L, Xiguang L, Gefei Z, Quanbin Z, Pengcheng L. Antihyperlipidemic effects of different molecular weight sulfated

polysaccharides from Ulva pertusa (Chlorophyta). Pharmacol Res. 2003 Dec; 48(6):543-9. PubMed PMID: 14527817.

[32] Wang R, Paul VJ, Luesch H. Seaweed extracts and unsaturated fatty acid constituents from the green alga Ulva lactuca as activators of the cytoprotective Nrf2-ARE pathway. Free Radic Biol Med. 2013 Apr; 57:141-53. doi: 10.1016/j.freeradbiomed.2012.12.019. Epub 2013 Jan 4. PubMed PMID: 23291594; PubMed Central PMCID: PMC3663146.

[33] Yu Y, Li Y, Du C, Mou H, Wang P. Compositional and structural characteristics of sulfated polysaccharide from Enteromorpha prolifera. Carbohydr Polym. 2017 Jun 1; 165:221-228. doi: 10.10 16/j.carbpol.2017.02.011. Epub 2017 Feb 3. PubMed PMID: 28363544.

[34] Sharifuddin Y, Chin YX, Lim PE, Phang SM. Potential Bioactive Compounds from Seaweed for Diabetes Management. Mar Drugs. 2015 Aug 21; 13(8):5447-91. doi: 10.3390/md13085447. Review. PubMed PMID: 26308010; PubMed Central PMCID: PMC4557030.

[35] Tair ZI, Bensalah F, Boukortt F. [Effect of green alga Ulva lactuca polysaccharides supplementation on blood pressure and on atherogenic risk factors, in rats fed a high fat diet]. Ann Cardiol Angeiol (Paris). 2018 Jun; 67(3):133-140. doi: 10.1016/j.ancard.2018.04.016. French. PubMed PMID: 29776647.

[36] Lauritano C, Ianora A. Marine Organisms with Anti-Diabetes Properties. Mar Drugs. 2016 Dec 1;14(12). pii: E220. Review. PubMed PMID: 27916864; PubMed Central PMCID: PMC5192457.

[37] Mohapatra L, Bhattamishra SK, Panigrahy R, Parida S, Pati P. Antidiabetic effect of Sargassum wightii and Ulva fasciata in high fat diet and multi low dose streptozotocin induced type 2 diabetic mice. UK J Pharm Biosci. 2016;4:13–23. doi: 10.20510/ukjpb/4/i2/97081.

[38] Celikler S, Tas S, Vatan O, Ziyanok-Ayvalik S, Yildiz G, Bilaloglu R. Anti-hyperglycemic and antigenotoxic potential of Ulva rigida ethanolic extract in the experimental diabetes mellitus. Food Chem Toxicol. 2009 Aug;47(8):1837-40. doi: 10.1016/j.fct.2009.04.039. Epub 2009 May 5. PubMed PMID: 19422873.

[39] Hassan S, El-Twab SA, Hetta M, Mahmoud B. Improvement of lipid profile and antioxidant of hypercholesterolemic albino rats by polysaccharides extracted from the green alga Ulva lactuca Linnaeus. Saudi J Biol Sci. 2011 Oct; 18(4): 333-40. doi: 10.1016/j. sjbs. 2011.01.005. Epub 2011 Feb 3. PubMed PMID: 23961145; PubMed Central PMCID: PMC3730952.

[40] BelHadj S, Hentati O, Elfeki A, Hamden K. Inhibitory activities of Ulva lactuca polysaccharides on digestive enzymes related to diabetes and obesity. Arch Physiol Biochem. 2013 May; 119(2):81-7. doi: 10.3109/13813455.2013.775159. PubMed PMID: 23638862.

[41] Bocanegra A, Bastida S, Benedí J, Nus M, Sánchez-Montero JM, Sánchez-Muniz FJ. Effect of seaweed and cholesterol-enriched diets on postprandial lipoproteinaemia in rats. Br J Nutr. 2009 Dec; 102(12):1728-39. doi: 10.1017/S000711450999105X. PubMed PMID: 19728895.

[42] Schultz Moreira AR, Olivero-David R, Vázquez-Velasco M, González-Torres L, Benedí J, Bastida S, Sánchez-Muniz FJ. Protective effects of sea spaghetti-enriched restructured pork against dietary cholesterol: effects on arylesterase and lipoprotein profile and composition of growing rats. J Med Food. 2014 Aug;17(8):921-8. doi: 10.1089/jmf.2013.0100. Epub 2014 Mar 20. PubMed PMID: 24650072.

[43] Nasir M, Saeidnia S, Mashinchian-Moradi A, Gohari AR. Sterols from the red algae, Gracilaria salicornia and Hypnea flagelliformis, from Persian Gulf. Pharmacogn Mag. 2011 Apr; 7(26):97-100. doi: 10.4103/0973-1296.80663. PubMed PMID: 21716930; PubMed Central PMCID: PMC3113362.

[44] Gabbia D, Dall'Acqua S, Di Gangi IM, Bogialli S, Caputi V, Albertoni L, Marsilio I, Paccagnella N, Carrara M, Giron MC, De Martin S. The Phytocomplex from Fucus vesiculosus and Ascophyllum nodosum Controls Postprandial Plasma Glucose Levels: An In Vitro and In Vivo Study in a Mouse Model of NASH. Mar Drugs. 2017 Feb 15;15(2). pii: E41. doi: 10.3390/md15020041. PubMed PMID: 28212301; PubMed Central PMCID: PMC5334621.

[45] Kim MS, Kim JY, Choi WH, Lee SS. Effects of seaweed supplementation on blood glucose concentration, lipid profile, and antioxidant enzyme activities in patients with type 2 diabetes mellitus. Nutr Res Pract. 2008 Summer; 2(2):62-7. doi: 10.4162/nrp. 2008 .2.2.62. Epub 2008 Jun 30. PubMed PMID: 20126367; PubMed Central PMCID: PMC2815322.

[46] Murray M, Dordevic AL, Ryan L, Bonham MP. The Impact of a Single Dose of a Polyphenol-Rich Seaweed Extract on Postprandial Glycaemic Control in Healthy Adults: A Randomised Cross-Over Trial. Nutrients. 2018 Feb 27; 10(3). pii: E270. doi: 10.3390/nu10030270. PubMed PMID: 29495492; PubMed Central PMCID: PMC5872688.

[47] Tanemura Y, Yamanaka-Okumura H, Sakuma M, Nii Y, Taketani Y, Takeda E. Effects of the intake of Undaria pinnatifida (Wakame) and its sporophylls (Mekabu) on postprandial glucose and insulin metabolism. J Med Invest. 2014; 61(3-4):291-7. PubMed PMID: 25264047.

[48] Haskell-Ramsay CF, Jackson PA, Dodd FL, Forster JS, Bérubé J, Levinton C, Kennedy DO. Acute Post-Prandial Cognitive Effects of Brown Seaweed Extract in Humans. Nutrients. 2018 Jan 13;10(1). pii: E85. doi: 10.3390/nu10010085. PubMed PMID: 29342865; PubMed Central PMCID: PMC5793313.

[49] Cherry P, O'Hara C, Magee PJ, McSorley EM, Allsopp PJ. Risks and benefits of consuming edible seaweeds. Nutr Rev. 2019 May 1; 77(5):307-329. doi: 10.1093/nutrit/nuy066. PubMed PMID: 30840077; PubMed Central PMCID: PMC6551690.

[50] Gotama TL, Husni A, Ustadi. Antidiabetic Activity of Sargassum hystrix Extracts in Streptozotocin-Induced Diabetic Rats. Prev Nutr Food Sci. 2018 Sep;23(3):189-195. doi: 10.3746/pnf.2018.23.3.189. Epub 2018 Sep 30. PubMed PMID: 30386746; PubMed Central PMCID: PMC6195887.

[51] Lee CW, Han JS. Hypoglycemic Effect of Sargassum ringgoldianum Extract in STZ-induced Diabetic Mice. Prev Nutr Food Sci. 2012 Mar; 17(1):8-13. doi: 10.3746/pnf.2012.17.1.008. PubMed PMID: 24471057; PubMed Central PMCID: PMC3866760.

[52] Yang HW, Fernando KHN, Oh JY, Li X, Jeon YJ, Ryu B. Anti-Obesity and Anti-Diabetic Effects of Ishige okamurae. Mar Drugs. 2019 Mar 29;17(4). pii: E202. doi: 10.3390/md17040202. Review. PubMed PMID: 30934943; PubMed Central PMCID: PMC6520893.

[53] Murray M, Dordevic AL, Ryan L, Bonham MP. A Single-Dose of a Polyphenol-Rich Fucus Vesiculosus Extract is Insufficient to Blunt the Elevated Postprandial Blood Glucose Responses Exhibited by Healthy Adults in the Evening: A Randomised Crossover Trial. Antioxidants (Basel). 2019 Feb 24;8(2). pii: E49. doi: 10.3390/antiox8020049. PubMed PMID: 30813480; PubMed Central PMCID: PMC6406275.

[54] Coe S, Ryan L. Impact of polyphenol-rich sources on acute postprandial glycaemia: a systematic review. J Nutr Sci. 2016 Jun 6; 5:e24. doi: 10.1017/jns.2016.11. eCollection 2016. Review. PubMed PMID: 27547387; PubMed Central PMCID: PMC4976115.

[55] Murugan AC, Karim MR, Yusoff MB, Tan SH, Asras MF, Rashid SS. New insights into seaweed polyphenols on glucose homeostasis. Pharm Biol. 2015 Aug; 53(8):1087-97. doi: 10.3109/ 13880209 .2014.959615. Epub 2015 Jan 29. Review. PubMed PMID: 25630358.

[56] Yang Z, Yin J, Wang Y, Wang J, Xia B, Li T, Yang X, Hu S, Ji C, Guo S. The fucoidan A3 from the seaweed Ascophyllum nodosum enhances RCT-related genes expression in hyperlipidemic C57BL/6J mice. Int J Biol Macromol. 2019 Aug 1; 134:759-769. doi: 10.1016/j.ijbiomac.2019.05.070. Epub 2019 May 14. PubMed PMID: 31100394.

[57] Kamunde C, Sappal R, Melegy TM. Brown seaweed (AquaArom) supplementation increases food intake and improves growth, antioxidant status and resistance to temperature stress in Atlantic salmon, Salmo salar. PLoS One. 2019 Jul 15;14(7):e0219792. doi: 10.1371/journal.pone.0219792. eCollection 2019. PubMed PMID: 31306449; PubMed Central PMCID: PMC6629153.

[58] Yang Z, Liu G, Wang Y, Yin J, Wang J, Xia B, Li T, Yang X, Hou P, Hu S, Song W, Guo S. Fucoidan A2 from the Brown Seaweed Ascophyllum nodosum Lowers Lipid by Improving Reverse Cholesterol Transport in C57BL/6J Mice Fed a High-Fat Diet. J Agric Food Chem. 2019 May 22;67(20):5782-5791. doi: 10.1021/acs.jafc.9b01321. Epub 2019 May 13. PubMed PMID: 31055921.

[59] Yone Y, Furuichi M, Urano K. Effects of wakame Undaria pinnatifida and Ascophyllum nodosum on absorption of dietary nutrients, and blood sugar and plasma free amino-N levels of red sea bream. Nippon Suisan Gakkaishi. 1986; 52: 1817.

[60] Dy Peñaflorida V, Golez NV, Peikflorida VD, Golez NV. Use of seaweed meals from Kappaphycus alvarezii and Gracilaria heteroclada as binders in diets for juvenile shrimp Penaeus monodon. Aquaculture 1996; 143: 393.

[61] Nakagawa H. Effect of dietary algae on improvement of lipid metabolism in fish. Biomed Pharmacother. 1997; 51(8):345-8. Review. PubMed PMID: 9436528.

[62] Gille A, Stojnic B, Derwenskus F, Trautmann A, Schmid-Staiger U, Posten C, Briviba K, Palou A, Bonet ML, Ribot J. A Lipophilic Fucoxanthin-Rich Phaeodactylum tricornutum Extract Ameliorates Effects of Diet-Induced Obesity in C57BL/6J Mice. Nutrients. 2019 Apr 6;11(4). pii: E796.doi:10.3390/nu 11040796. PubMed PMID: 30959933; PubMed Central PMCID: PMC6521120.

[63] Jeon SM, Kim HJ, Woo MN, Lee MK, Shin YC, Park YB, Choi MS. Fucoxanthin-rich seaweed extract suppresses body weight gain and improves lipid metabolism in high-fat-fed C57BL/6J mice. Biotechnol J. 2010

Sep;5(9):961-9. doi: 10.1002/biot.201000215. PubMed PMID: 20845386.

[64] Chin YX, Mi Y, Cao WX, Lim PE, Xue CH, Tang QJ. A Pilot Study on Anti-Obesity Mechanisms of Kappaphycus Alvarezii: The Role of Native κ-Carrageenan and the Leftover Sans-Carrageenan Fraction. Nutrients. 2019 May 21;11(5). pii: E1133. doi: 10.3390/nu11051133. PubMed PMID: 31117266; PubMed Central PMCID: PMC6566674.

[65] Ha AW, Kim WK. The effect of fucoxanthin rich power on the lipid metabolism in rats with a high fat diet. Nutr Res Pract. 2013 Aug; 7(4):287-93. doi: 10.4162/nrp.2013.7.4.287. Epub 2013 Aug 7. PubMed PMID: 23964316; PubMed Central PMCID: PMC3746163.

[66] Patil NP, Le V, Sligar AD, Mei L, Chavarria D, Yang EY, Baker AB. Algal Polysaccharides as Therapeutic Agents for Atherosclerosis. Front Cardiovasc Med. 2018 Oct 26; 5:153. doi: 10.3389/fcvm.2018.00153. eCollection 2018. Review. PubMed PMID: 30417001; PubMed Central PMCID: PMC6214344.

[67] Wan X, Li T, Liu D, Chen Y, Liu Y, Liu B, Zhang H, Zhao C. Effect of Marine Microalga Chlorella pyrenoidosa Ethanol Extract on Lipid Metabolism and Gut Microbiota Composition in High-Fat Diet-Fed Rats. Mar Drugs. 2018 Dec 9;16(12). pii: E498. doi: 10.3390/md16120498. PubMed PMID: 30544856; PubMed Central PMCID: PMC6315526.

[68] Li TT, Liu YY, Wan XZ, Huang ZR, Liu B, Zhao C. Regulatory Efficacy of the Polyunsaturated Fatty Acids from Microalgae Spirulina platensis on Lipid Metabolism and Gut Microbiota in High-Fat Diet Rats. Int J Mol Sci. 2018 Oct 9;19(10). pii: E3075. doi: 10.3390/ijms19103075. PubMed PMID: 30304774; PubMed Central PMCID: PMC6213792.

[69] Yin J, Wang J, Li F, Yang Z, Yang X, Sun W, Xia B, Li T, Song W, Guo S. The fucoidan from the brown seaweed Ascophyllum nodosum ameliorates atherosclerosis in apolipoprotein E-deficient mice. Food Funct. 2019 Jul 31. doi: 10.1039/c9fo00619b. [Epub ahead of print] PubMed PMID: 31364648.

[70] Shijo Y, Maruyama C, Nakamura E, Nakano R, Shima M, Mae A, Okabe Y, Park S, Kameyama N, Hirai S. Japan Diet Intake Changes Serum Phospholipid Fatty Acid Compositions in Middle-Aged Men: A Pilot Study. J Atheroscler Thromb. 2019 Jan 1;26(1):3-13. doi: 10.5551/jat.43448. Epub 2018 Apr 12. PubMed PMID: 29643271; PubMed Central PMCID: PMC6308266.

[71] Zhao B, Cui Y, Fan X, Qi P, Liu C, Zhou X, Zhang X. Anti-obesity effects of Spirulina platensis protein hydrolysate by modulating brain-liver axis in high-fat diet fed mice. PLoS One. 2019 Jun 20;14(6):e0218543. doi: 10.1371/journal.pone.0218543. eCollection 2019. PubMed PMID: 31220177; PubMed Central PMCID: PMC6586325.

[72] Coué M, Tesse A, Falewée J, Aguesse A, Croyal M, Fizanne L, Chaigneau J, Boursier J, Ouguerram K. Spirulina Liquid Extract Protects against Fibrosis Related to Non-Alcoholic Steatohepatitis and Increases Ursodeoxycholic Acid. Nutrients. 2019 Jan 18; 11(1). pii: E194. doi: 10.3390/nu11010194. PubMed PMID: 30669332; PubMed Central PMCID: PMC6357008.

[73] Huang H, Liao D, Pu R, Cui Y. Quantifying the effects of spirulina supplementation on plasma lipid and glucose concentrations, body weight, and blood pressure. Diabetes Metab Syndr Obes. 2018 Nov 14;11: 729-742. doi: 10.2147/DMSO.S185672. eCollection 2018. PubMed PMID: 30532573; PubMed Central PMCID: PMC6241722.

[74] Masuda K, Chitundu M. Multiple micronutrient supplementation using spirulina platensis and infant growth, morbidity, and motor development: Evidence from a randomized trial in Zambia. PLoS One. 2019 Feb 13;14(2):e0211693. doi: 10.1371/journal.pone.0211693. eCollection 2019. PubMed PMID: 30759117; PubMed Central PMCID: PMC6373937.

[75] Hu J, Li Y, Pakpour S, Wang S, Pan Z, Liu J, Wei Q, She J, Cang H, Zhang RX. Dose Effects of Orally Administered Spirulina Suspension on Colonic Microbiota in Healthy Mice. Front Cell Infect Microbiol. 2019 Jul 5;9:243. doi: 10.3389/fcimb.2019.00243. eCollection 2019. PubMed PMID: 31334136; PubMed Central PMCID: PMC6624478.

[76] Hernández-Lepe MA, Wall-Medrano A, López-Díaz JA, Juárez-Oropeza MA, Hernández-Torres RP, Ramos-Jiménez A. Hypolipidemic Effect of Arthrospira (Spirulina) maxima Supplementation and a Systematic Physical Exercise Program in Overweight and Obese Men: A Double-Blind, Randomized, and Crossover Controlled Trial. Mar Drugs. 2019 May 7;17(5). pii: E270. doi: 10.3390/md17050270. PubMed PMID: 31067674; PubMed Central PMCID: PMC6562443.

[77] Kim JY, Kwon YM, Kim IS, Kim JA, Yu DY, Adhikari B, Lee SS, Choi IS, Cho KK. Effects of the Brown Seaweed Laminaria japonica Supplementation on Serum Concentrations of IgG, Triglycerides, and Cholesterol, and Intestinal Microbiota Composition in Rats. Front Nutr. 2018 Apr 12; 5:23. doi: 10.3389/fnut.2018.00023. eCollection 2018.

PubMed PMID: 29707542; PubMed Central PMCID: PMC5906548.

[78] Barros-Gomes JAC, Nascimento DLA, Silveira ACR, Silva RK, Gomes DL, Melo KRT, Almeida-Lima J, Camara RBG, Silva NB, Rocha HAO. In Vivo Evaluation of the Antioxidant Activity and Protective Action of the Seaweed Gracilaria birdiae. Oxid Med Cell Longev. 2018 Aug 1; 2018:9354296. doi: 10.1155/2018/9354296. eCollection 2018. PubMed PMID: 30154951; PubMed Central PMCID: PMC6093003.

[79] López-Rios L, Vega T, Chirino R, Jung JC, Davis B, Pérez-Machín R, Wiebe JC. Toxicological assessment of Xanthigen (®) nutraceutical extract combination: Mutagenicity, genotoxicity and oral toxicity. Toxicol Rep. 2018 Oct 9; 5:1021-1031. doi: 10.1016/j.toxrep.2018.10.007. eCollection 2018. PubMed PMID: 30386730; PubMed Central PMCID: PMC6205089.

[80] Wanyonyi S, du Preez R, Brown L, Paul NA, Panchal SK. Kappaphycus alvarezii as a Food Supplement Prevents Diet-Induced Metabolic Syndrome in Rats. Nutrients. 2017 Nov 17; 9(11). pii: E1261. doi: 10.3390/nu9111261. PubMed PMID: 29149029; PubMed Central PMCID: PMC5707733.

[81] Mikami N, Hosokawa M, Miyashita K, Sohma H, Ito YM, Kokai Y. Reduction of HbA1c levels by fucoxanthin-enriched akamoku oil possibly involves the thrifty allele of uncoupling protein 1 (UCP1): a randomised controlled trial in normal-weight and obese Japanese adults. J Nutr Sci. 2017 Feb 14; 6:e5. doi: 10.1017/jns.2017.1. eCollection 2017. PubMed PMID: 28620480; PubMed Central PMCID: PMC5465861.

[82] Seo YJ, Lee K, Chei S, Jeon YJ, Lee BY. Ishige okamurae Extract Ameliorates the Hyperglycemia and Body Weight Gain of db/db Mice through Regulation of the PI3K/Akt Pathway and Thermogenic Factors by FGF21. Mar Drugs. 2019 Jul 9; 17(7). pii: E407. doi: 10.3390/md17070407. PubMed PMID: 31323977.

[83] Sakai C, Abe S, Kouzuki M, Shimohiro H, Ota Y, Sakinada H, Takeuchi T, Okura T, Kasagi T, Hanaki K. A Randomized Placebo-controlled Trial of an Oral Preparation of High Molecular Weight Fucoidan in Patients with Type 2 Diabetes with Evaluation of Taste Sensitivity. Yonago Acta Med. 2019 Mar 28;62(1):14-23. eCollection 2019 Mar. PubMed PMID: 30962740; PubMed Central PMCID: PMC6437402.

[84] Choi J, Kim KJ, Koh EJ, Lee BY. Gelidium elegans Extract Ameliorates Type 2 Diabetes via Regulation of MAPK and PI3K/Akt Signaling. Nutrients. 2018 Jan 6; 10(1). pii: E51. doi: 10.3390/nu10010051. PubMed PMID: 29316644; PubMed Central PMCID: PMC5793279.

[85] Maeda H, Fukuda S, Izumi H, Saga N. Anti-Oxidant and Fucoxanthin Contents of Brown Alga Ishimozuku (Sphaerotrichia divaricata) from the West Coast of Aomori, Japan. Mar Drugs. 2018 Jul 30;16(8). pii: E255. doi: 10.3390/md16080255. PubMed PMID: 30061511; PubMed Central PMCID: PMC6117725.

[86] McMacken M, Shah S. A plant-based diet for the prevention and treatment of type 2 diabetes. J Geriatr Cardiol. 2017 May; 14(5):342-354. doi: 10.11909/j.issn.1671-5411.2017.05.009. Review. PubMed PMID: 28630614; PubMed Central PMCID: PMC5466941.

[87] Takahashi K, Kamada C, Yoshimura H, Okumura R, Iimuro S, Ohashi Y, Araki A, Umegaki H, Sakurai T, Yoshimura Y, Ito H; Japanese Elderly Diabetes Intervention Trial Study Group. Effects of total and green vegetable intakes on glycated hemoglobin A1c and triglycerides in elderly patients with type 2 diabetes mellitus: the Japanese Elderly Intervention Trial. Geriatr Gerontol Int. 2012 Apr;12 Suppl 1:50-8. doi: 10.1111/j.1447-0594.2011.00812.x. PubMed PMID: 22435940.

[88] Motshakeri M, Ebrahimi M, Goh YM, Matanjun P, Mohamed S. Sargassum polycystum reduces hyperglycaemia, dyslipidaemia and oxidative stress via increasing insulin sensitivity in a rat model of type 2 diabetes. J Sci Food Agric. 2013 May;93(7):1772-8. doi: 10.1002/jsfa.5971. Epub 2012 Dec 4. PubMed PMID: 23208488.

[89] Motshakeri M, Ebrahimi M, Goh YM, Othman HH, Hair-Bejo M, Mohamed S. Effects of Brown Seaweed (Sargassum polycystum) Extracts on Kidney, Liver, and Pancreas of Type 2 Diabetic Rat Model. Evid Based Complement Alternat Med. 2014; 2014:379407. doi: 10.1155/2014/379407. Epub 2014 Jan 8. PubMed PMID: 24516503; PubMed Central PMCID: PMC3910465.

[90] Johnson J. What are the benefits of seaweed? Medical News Today, 6 December 2018.

[91] Son M, Oh S, Lee HS, Ryu B, Jiang Y, Jang JT, Jeon YJ, Byun K. Pyrogallol-Phloroglucinol-6,6'-Bieckol from Ecklonia cava Improved Blood Circulation in Diet-Induced Obese and Diet-Induced Hypertension Mouse Models. Mar Drugs. 2019 May 8;17(5). pii: E272. doi: 10.3390/md17050272. PubMed PMID: 31071969; PubMed Central PMCID: PMC6562948.

[92] Wada K, Nakamura K, Tamai Y, Tsuji M, Sahashi Y, Watanabe K, Ohtsuchi S, Yamamoto K, Ando K, Nagata C. Seaweed intake and blood pressure levels in healthy pre-

school Japanese children. Nutr J. 2011 Aug 10;10:83. doi: 10.1186/1475-2891-10-83. PubMed PMID: 21827710; PubMed Central PMCID: PMC3199754.

[93] Wells ML, Potin P, Craigie JS, Raven JA, Merchant SS, Helliwell KE, Smith AG, Camire ME, Brawley SH. Algae as nutritional and functional food sources: revisiting our understanding. J Appl Phycol. 2017;29(2):949-982. doi: 10.1007/s10811-016-0974-5. Epub 2016 Nov 21. Review. PubMed PMID: 28458464; PubMed Central PMCID: PMC5387034.

[94] Gammone MA, Riccioni G, Parrinello G, D'Orazio N. Omega-3 Polyunsaturated Fatty Acids: Benefits and Endpoints in Sport. Nutrients. 2018 Dec 27; 11(1). pii: E46. doi: 10.3390/nu11010046. Review. PubMed PMID: 30591639; PubMed Central PMCID: PMC6357022.

[95] Circuncisão AR, Catarino MD, Cardoso SM, Silva AMS. Minerals from Macroalgae Origin: Health Benefits and Risks for Consumers. Mar Drugs. 2018 Oct 23;16(11). pii: E400. doi: 10.3390/md16110400. Review. PubMed PMID: 30360515; PubMed Central PMCID: PMC6266857.

[96] Martínez-Villaluenga C, Peñas E, Rico D, Martin-Diana AB, Portillo MP, Macarulla MT, de Luis DA, Miranda J. Potential Usefulness of a Wakame/Carob Functional Snack for the Treatment of Several Aspects of Metabolic Syndrome: From In Vitro to In Vivo Studies. Mar Drugs. 2018 Dec 17;16(12). pii: E512. doi: 10.3390/md16120512. PubMed PMID: 30562926; PubMed Central PMCID: PMC6315385.

[97] Jung IH, Kim SE, Lee YG, Kim DH, Kim H, Kim GS, Baek NI, Lee DY. Antihypertensive Effect of Ethanolic Extract from Acanthopanax sessiliflorus Fruits and Quality Control of Active Compounds. Oxid Med Cell Longev. 2018 Apr 23; 2018:5158243. doi: 10.1155/2018/5158243. eCollection 2018. PubMed PMID: 29849899; PubMed Central PMCID: PMC5937377.

[98] Kawamura A, Kajiya K, Kishi H, Inagaki J, Mitarai M, Oda H, Umemoto S, Kobayashi S. The Nutritional Characteristics of the Hypotensive WASHOKU-modified DASH Diet: A Sub-analysis of the DASH-JUMP Study. Curr Hypertens Rev. 2018;14(1):56-65. doi: 10.2174/1573402114666180405100430. PubMed PMID: 29618312; PubMed Central PMCID: PMC6094561.

[99] Fitzgerald C, Aluko RE, Hossain M, Rai DK, Hayes M. Potential of a renin inhibitory peptide from the red seaweed Palmaria palmata as a functional food ingredient following confirmation and characterization of a hypotensive effect in spontaneously hypertensive rats. J Agric Food Chem. 2014 Aug 20;62(33):8352-6. doi: 10.1021/jf500983n. Epub 2014 Aug 7. PubMed PMID: 25062358.

[100] Cardoso SM, Pereira OR, Seca AM, Pinto DC, Silva AM. Seaweeds as Preventive Agents for Cardiovascular Diseases: From Nutrients to Functional Foods. Mar Drugs. 2015 Nov 12;13(11):6838-65. doi: 10.3390/md13116838. Review. PubMed PMID: 26569268; PubMed Central PMCID: PMC4663556.

[101] Bleakley S, Hayes M. Algal Proteins: Extraction, Application, and Challenges Concerning Production. Foods. 2017 Apr 26;6(5). pii: E33. doi: 10.3390/foods6050033. Review. PubMed PMID: 28445408; PubMed Central PMCID: PMC5447909.

[102] Sellimi S, Ksouda G, Benslima A, Nasri R, Rinaudo M, Nasri M, Hajji M. Enhancing colour and oxidative stabilities of reduced-nitrite turkey meat sausages during refrigerated storage using fucoxanthin purified from the Tunisian seaweed Cystoseira barbata. Food Chem Toxicol. 2017 Sep; 107(Pt B):620-629. doi: 10.1016/j.fct.2017.04.001. Epub 2017 Apr 4. PubMed PMID: 28389351.

[103] Heo S.-J., Jeon Y.-J. Evaluation of diphlorethohydroxycarmalol isolated from Ishige okamurae for radical scavenging activity and its protective effect against H2O2-induced cell damage. Process Biochem. 2009; 44:412–418. doi: 10.1016/j.procbio.2008.12.005.

[104] Heo S.-J., Jeon Y.-J. Radical scavenging capacity and cytoprotective effect of enzymatic digests of Ishige okamurae. J. Appl. Phycol. 2008; 20:1087–1095. doi: 10.1007/s10811-008-9320-x

[105] Kang M.-C., Lee S.-H., Lee W.-W., Kang N., Kim E.-A., Kim S.Y., Lee D.H., Kim D., Jeon Y.-J. Protective effect of fucoxanthin isolated from Ishige okamurae against high-glucose induced oxidative stress in human umbilical vein endothelial cells and zebrafish model. J. Funct. Foods. 2014; 11:304–312. doi: 10.1016/j.jff.2014.09.007.

[106] Ahn S.-M., Hong Y.-K., Kwon G.-S., Sohn H.-Y. Evaluation of antioxidant and nitrite scavenging activity of seaweed extracts. J. Life Sci. 2011; 21:576–583. doi: 10.5352/JLS.2011.21.4.576.

[107] Kang MC, Wijesinghe WA, Lee SH, Kang SM, Ko SC, Yang X, Kang N, Jeon BT, Kim J, Lee DH, Jeon YJ. Dieckol isolated from brown seaweed Ecklonia cava attenuates type II diabetes in db/db mouse model. Food Chem Toxicol. 2013 Mar; 53:294-8. doi: 10.1016/j.fct.2012.12.012. Epub 2012 Dec 20. PubMed PMID: 23261675.

[108] Lee SH, Park MH, Kang SM, Ko SC, Kang MC, Cho S, Park PJ, Jeon BT, Kim SK, Han

JS, Jeon YJ. Dieckol isolated from Ecklonia cava protects against high-glucose induced damage to rat insulinoma cells by reducing oxidative stress and apoptosis. Biosci Biotechnol Biochem. 2012; 76(8):1445-51. Epub 2012 Aug 7. PubMed PMID: 22878185.

[109] Apostolidis E, Lee CM. In vitro potential of Ascophyllum nodosum phenolic antioxidant-mediated alpha-glucosidase and alpha-amylase inhibition. J Food Sci. 2010 Apr; 75(3):H97-102. doi: 10.1111/j.1750-3841.2010.01544.x. PubMed PMID: 20492300.

[110] Maeda H. Nutraceutical effects of fucoxanthin for obesity and diabetes therapy: a review. J Oleo Sci. 2015;64(2):125-32. doi: 10.5650/jos.ess14226. Epub 2015 Jan 20. Review. PubMed PMID: 25748372.

[111] Manandhar B, Paudel P, Seong SH, Jung HA, Choi JS. Characterizing Eckol as a Therapeutic Aid: A Systematic Review. Mar Drugs. 2019 Jun 18;17(6). pii: E361. doi: 10.3390/md17060361. Review. PubMed PMID: 31216636; PubMed Central PMCID: PMC6627842.

[112] Kumar MS. Peptides and Peptidomimetics as Potential Antiobesity Agents: Overview of Current Status. Front Nutr. 2019 Feb 18; 6:11. doi: 10.3389/fnut.2019.00011. eCollection 2019. Review. PubMed PMID: 30834248; PubMed Central PMCID: PMC6388543.

[113] Sanjeewa, K.K.A.; Lee, W.W.; Jeon, Y.J. Nutrients and bioactive potentials of edible green and red seaweed in Korea. Fish. Aquat. Sci. 2018, 21, 19.

[114] Savini I, Catani MV, Evangelista D, Gasperi V, Avigliano L. Obesity-associated oxidative stress: strategies finalized to improve redox state. Int J Mol Sci. 2013 May 21;14(5):10497-538. doi: 10.3390/ijms140510497. Review. PubMed PMID: 23698776; PubMed Central PMCID: PMC3676851.

[115] Gammone MA, D'Orazio N. Anti-obesity activity of the marine carotenoid fucoxanthin. Mar Drugs. 2015 Apr 13; 13(4):2196-214. doi: 10.3390/md13042196. Review. PubMed PMID: 25871295; PubMed Central PMCID: PMC4413207.

[116] Maeda H, Kanno S, Kodate M, Hosokawa M, Miyashita K. Fucoxanthinol, Metabolite of Fucoxanthin, Improves Obesity-Induced Inflammation in Adipocyte Cells. Mar Drugs. 2015 Aug 4; 13(8):4799-813. doi: 10.3390/md13084799. PubMed PMID: 26248075; PubMed Central PMCID: PMC4557005.

[117] Catarino MD, Silva AMS, Cardoso SM. Phycochemical Constituents and Biological Activities of Fucus spp. Mar Drugs. 2018 Jul 27;16(8). pii: E249. doi: 10.3390/md16080249. Review. PubMed PMID: 30060505; PubMed Central PMCID: PMC6117670.

[118] Gammone MA, Riccioni G, D'Orazio N. Marine Carotenoids against Oxidative Stress: Effects on Human Health. Mar Drugs. 2015 Sep 30; 13(10):6226-46. doi: 10.3390/md13106226. Review. PubMed PMID: 26437420; PubMed Central PMCID: PMC4626686.

[119] Mhadhebi L, Mhadhebi A, Robert J, Bouraoui A. Antioxidant, Anti-inflammatory and Antiproliferative Effects of Aqueous Extracts of Three Mediterranean Brown Seaweeds of the Genus Cystoseira. Iran J Pharm Res. 2014 Winter; 13(1):207-20. PubMed PMID: 24734073; PubMed Central PMCID: PMC3985253.

[120] Kiokias S, Proestos C, Oreopoulou V. Effect of Natural Food Antioxidants against LDL and DNA Oxidative Changes. Antioxidants (Basel). 2018 Oct 3; 7(10). pii: E133. doi: 10.3390/antiox7100133. Review. PubMed PMID: 30282925; PubMed Central PMCID: PMC6211048.

[121] Siegel RL, Miller KD, Jemal A. Cancer statistics, 2019. CA Cancer J Clin. 2019 Jan; 69(1):7-34. doi: 10.3322/caac.21551. Epub 2019 Jan 8. PubMed PMID: 30620402.

[122] Shah SC, Kayamba V, Peek RM Jr, Heimburger D. Cancer Control in Low- and Middle-Income Countries: Is It Time to Consider Screening? J Glob Oncol. 2019 Mar; 5:1-8. doi: 10.1200/JGO.18.00200. PubMed PMID: 30908147; PubMed Central PMCID: PMC6452918.

[123] Ferlay J, Colombet M, Soerjomataram I, Mathers C, Parkin DM, Piñeros M, Znaor A, Bray F. Estimating the global cancer incidence and mortality in 2018: GLOBOCAN sources and methods. Int J Cancer. 2019 Apr 15; 144(8):1941-1953. doi: 10.1002/ijc.31937. Epub 2018 Dec 6. PubMed PMID: 30350310.

[124] Feng RM, Zong YN, Cao SM, Xu RH. Current cancer situation in China: good or bad news from the 2018 Global Cancer Statistics? Cancer Commun (Lond). 2019 Apr 29; 39(1):22. doi: 10.1186/s40880-019-0368-6. PubMed PMID: 31030667; PubMed Central PMCID: PMC6487510.

[125] WHO. Latest global cancer data: Cancer burden rises to 18. 1 million new cases and 9. 6 million cancer deaths in 2018. Presse Release, 12 September 2018. Available From: https://www.who.int/cancer/PRGlobocanFinal.pdf

[126] Schüz J, Espina C, Wild CP. Primary prevention: a need for concerted action. Mol Oncol. 2019 Mar; 13(3):567-578. doi: 10.1002/1878-0261.12432. Epub 2019 Jan 18.

Review. PubMed PMID: 30582778; PubMed Central PMCID: PMC6396360.

[127] WHO. Cancer. Health Topics, 12 September 2018. Available from: https:// www.who.int/news-room/fact-sheets/detail/cancer

[128] AK Mohiuddin. Non-drug pain management: opportunities to explore (e-book). Publisher: BiomedGrid LLC, USA May 09, 2019, ISBN: 978-1-946628-01-5.

[129] WHO. $46 billion in productivity lost to cancer in major emerging economies. Presse Release, 31 January, 2018. Available From: https://www.iarc.fr/wp-content/uploads/2018/07/pr255_E.pdf

[130] World Cancer Day. Available From: https://www.worldcancerday.org/financial-and-economic-impact

[131] Olivares-Bañuelos T, Gutiérrez-Rodríguez AG, Méndez-Bellido R, Tovar-Miranda R, Arroyo-Helguera O, Juárez-Portilla C, Meza-Menchaca T, Aguilar-Rosas LE, Hernández-Kelly LCR, Ortega A, Zepeda RC. Brown Seaweed Egregia menziesii's Cytotoxic Activity against Brain Cancer Cell Lines. Molecules. 2019 Jan 11; 24(2). pii: E260. doi: 10.3390/molecules24020260. PubMed PMID: 30641974; PubMed Central PMCID: PMC6359252.

[132] Rocha DHA, Seca AML, Pinto DCGA. Seaweed Secondary Metabolites In Vitro and In Vivo Anticancer Activity. Mar Drugs. 2018 Oct 26; 16(11). pii: E410. doi: 10.3390/md16110410. Review. PubMed PMID: 30373208; PubMed Central PMCID: PMC6266495.

[133] Cho M, Park GM, Kim SN, Amna T, Lee S, Shin WS. Glioblastoma-specific anticancer activity of pheophorbide a from the edible red seaweed Grateloupia elliptica. J Microbiol Biotechnol. 2014 Mar 28; 24(3):346-53. PubMed PMID: 24296458.

[134] Park MN, Song HS, Kim M, Lee MJ, Cho W, Lee HJ, Hwang CH, Kim S, Hwang Y, Kang B, Kim B. Review of Natural Product-Derived Compounds as Potent Antiglioblastoma Drugs. Biomed Res Int. 2017; 2017:8139848. doi: 10.1155/2017/8139848. Epub 2017 Oct 18. Review. PubMed PMID: 29181405; PubMed Central PMCID: PMC5664208.

[135] Florczyk SJ, Kievit FM, Wang K, Erickson AE, Ellenbogen RG, Zhang M. 3D Porous Chitosan-Alginate Scaffolds Promote Proliferation and Enrichment of Cancer Stem-Like Cells. J Mater Chem B. 2016 Oct 14;4(38):6326-6334. doi: 10.1039/C6TB01713D. Epub 2016 Aug 31. PubMed PMID: 28133535; PubMed Central PMCID: PMC5260821.

[136] Kievit FM, Wang K, Erickson AE, Lan Levengood SK, Ellenbogen RG, Zhang M. Modeling the tumor microenvironment using chitosan-alginate scaffolds to control the stem-like state of glioblastoma cells. Biomater Sci. 2016 Apr; 4(4):610-3. doi: 10.1039/c5bm00514k. Epub 2015 Dec 21. PubMed PMID: 26688867; PubMed Central PMCID: PMC4803622.

[137] Wang K, Kievit FM, Erickson AE, Silber JR, Ellenbogen RG, Zhang M. Culture on 3D Chitosan-Hyaluronic Acid Scaffolds Enhances Stem Cell Marker Expression and Drug Resistance in Human Glioblastoma Cancer Stem Cells. Adv Healthc Mater. 2016 Dec; 5(24):3173-3181. doi: 10. 1002/adhm.201600684. Epub 2016 Nov 2. PubMed PMID: 27805789; PubMed Central PMCID: PMC5253135.

[138] Xiao W, Sohrabi A, Seidlits SK. Integrating the glioblastoma microenvironment into engineered experimental models. Future Sci OA. 2017 Mar 24;3(3):FSO189. doi: 10.4155/fsoa-2016-0094. eCollection 2017 Aug. Review. PubMed PMID: 28883992; PubMed Central PMCID: PMC5583655.

[139] Florczyk SJ, Wang K, Jana S, Wood DL, Sytsma SK, Sham J, Kievit FM, Zhang M. Porous chitosan-hyaluronic acid scaffolds as a mimic of glioblastoma microenvironment ECM. Biomaterials. 2013 Dec; 34(38):10143-50. doi: 10.1016/j.biomaterials.2013.09.034. Epub 2013 Sep 26. PubMed PMID: 24075410; PubMed Central PMCID: PMC3843957.

[140] Palamà IE, D'Amone S, Cortese B. Microenvironmental Rigidity of 3D Scaffolds and Influence on Glioblastoma Cells: A Biomaterial Design Perspective. Front Bioeng Biotechnol. 2018 Sep 24;6:131. doi: 10.3389/fbioe.2018.00131. eCollection 2018. PubMed PMID: 30320080; PubMed Central PMCID: PMC6166390.

[141] Wang K, Kievit FM, Florczyk SJ, Stephen ZR, Zhang M. 3D Porous Chitosan-Alginate Scaffolds as an In Vitro Model for Evaluating Nanoparticle-Mediated Tumor Targeting and Gene Delivery to Prostate Cancer. Biomacromolecules. 2015 Oct 12; 16(10):3362-72. doi: 10.1021/acs.biomac.5b01032. Epub 2015 Sep 16. PubMed PMID: 26347946; PubMed Central PMCID: PMC4831622.

[142] Musah-Eroje A, Watson S. A novel 3D in vitro model of glioblastoma reveals resistance to temozolomide which was potentiated by hypoxia. J Neurooncol. 2019 Apr; 142(2):231-240. doi: 10.1007/s11060-019-03107-0. Epub 2019 Jan 29. PubMed PMID: 30694423; PubMed Central PMCID: PMC6449313.

[143] Yang J, Li Y, Zhang T, Zhang X. Development of bioactive materials for glioblastoma therapy. Bioact Mater. 2016 Apr 23; 1(1):29-38. doi: 10.1016/j.bioactmat.2016.03.003. eCollection

2016 Sep. Review. PubMed PMID: 29744393; PubMed Central PMCID: PMC5883963.

[144] Wu HL, Fu XY, Cao WQ, Xiang WZ, Hou YJ, Ma JK, Wang Y, Fan CD. Induction of Apoptosis in Human Glioma Cells by Fucoxanthin via Triggering of ROS-Mediated Oxidative Damage and Regulation of MAPKs and PI3K-AKT Pathways. J Agric Food Chem. 2019 Feb 27;67(8):2212-2219. doi: 10.1021/acs.jafc.8b07126. Epub 2019 Feb 13. PubMed PMID: 30688446.

[145] Afzal S, Garg S, Ishida Y, Terao K, Kaul SC, Wadhwa R. Rat Glioma Cell-Based Functional Characterization of Anti-Stress and Protein Deaggregation Activities in the Marine Carotenoids, Astaxanthin and Fucoxanthin. Mar Drugs. 2019 Mar 23; 17(3). pii: E189. doi: 10.3390/md17030189. PubMed PMID: 30909572; PubMed Central PMCID: PMC6470788.

[146] Garg S, Afzal S, Elwakeel A, Sharma D, Radhakrishnan N, Dhanjal JK, Sundar D, Kaul SC, Wadhwa R. Marine Carotenoid Fucoxanthin Possesses Anti-Metastasis Activity: Molecular Evidence. Mar Drugs. 2019 Jun 5; 17(6). pii: E338. doi: 10.3390/md17060338. PubMed PMID: 31195739; PubMed Central PMCID: PMC6627158.

[147] Miao L, Chi S, Wu M, Liu Z, Li Y. Deregulation of phytoene-β-carotene synthase results in derepression of astaxanthin synthesis at high glucose concentration in Phaffia rhodozyma astaxanthin-overproducing strain MK19. BMC Microbiol. 2019 Jun 15; 19(1):133. doi: 10.1186/s12866-019-1507-6. PubMed PMID: 31202260; PubMed Central PMCID: PMC6570914.

[148] Liu Y, Zheng J, Zhang Y, Wang Z, Yang Y, Bai M, Dai Y. Fucoxanthin Activates Apoptosis via Inhibition of PI3K/Akt/mTOR Pathway and Suppresses Invasion and Migration by Restriction of p38-MMP-2/9 Pathway in Human Glioblastoma Cells. Neurochem Res. 2016 Oct; 41(10):2728-2751. Epub 2016 Jul 9. PubMed PMID: 27394418.

[149] Zhang L, Wang H, Xu J, Zhu J, Ding K. Inhibition of cathepsin S induces autophagy and apoptosis in human glioblastoma cell lines through ROS-mediated PI3K/AKT/ mTOR/ p70S6K and JNK signaling pathways. Toxicol Lett. 2014 Aug 4; 228(3):248-59. doi: 10.1016/ j.toxlet. 2014.05. 015. Epub 2014 May 27. PubMed PMID: 24875536.

[150] Hormozi M, Ghoreishi S, Baharvand P. Astaxanthin induces apoptosis and increases activity of antioxidant enzymes in LS-180 cells. Artif Cells Nanomed Biotechnol. 2019 Dec; 47 (1): 891-895. doi: 10.1080/21691401. 2019. 15 80286. PubMed PMID: 30873887.

[151] Lu DY, Chang CS, Yeh WL, Tang CH, Cheung CW, Leung YM, Liu JF, Wong KL. The novel phloroglucinol derivative BFP induces apoptosis of glioma cancer through reactive oxygen species and endoplasmic reticulum stress pathways. Phytomedicine. 2012 Sep 15; 19(12):1093-100. doi: 10.1016/ j.phymed. 2012.06.010. Epub 2012 Jul 21. PubMed PMID: 22819448.

[152] Pinhatti AV, de Barros FM, de Farias CB, Schwartsmann G, Poser GL, Abujamra AL. Antiproliferative activity of the dimeric phloroglucinol and benzophenone derivatives of Hypericum spp. native to southern Brazil. Anticancer Drugs. 2013 Aug; 24(7):699-703. doi:10.1097/CAD.0b013e3283626626. PubMed PMID: 23669242.

[153] Jakobs D, Hage-Hülsmann A, Prenner L, Kolb C, Weiser D, Häberlein H. Downregulation of β1 -adrenergic receptors in rat C6 glioblastoma cells by hyperforin and hyperoside from St John's wort. J Pharm Pharmacol. 2013 Jun; 65(6):907-15. doi: 10.1111/jphp.12050. Epub 2013 Mar 18. PubMed PMID: 23647684.

[154] Lai SW, Huang BR, Liu YS, Lin HY, Chen CC, Tsai CF, Lu DY, Lin C. Differential Characterization of Temozolomide-Resistant Human Glioma Cells. Int J Mol Sci. 2018 Jan 2; 19(1). pii: E127. doi: 10.3390/ijms19010127. PubMed PMID: 29301329; PubMed Central PMCID: PMC5796076.

[155] Tsai CF, Yeh WL, Chen JH, Lin C, Huang SS, Lu DY. Osthole suppresses the migratory ability of human glioblastoma multiforme cells via inhibition of focal adhesion kinase-mediated matrix metalloproteinase-13 expression. Int J Mol Sci. 2014 Mar 4; 15(3):3889-903. doi: 10.3390/ijms15033889. PubMed PMID: 24599080; PubMed Central PMCID: PMC3975374.

[156] Alghazwi M, Smid S, Musgrave I, Zhang W. In vitro studies of the neuroprotective activities of astaxanthin and fucoxanthin against amyloid beta (Aβ (1-42)) toxicity and aggregation. Neurochem Int. 2019 Mar; 124:215-224. doi: 10.1016/j.neuint.2019.01.010. Epub 2019 Jan 9. PubMed PMID: 30639263.

[157] Raposo MF, de Morais AM, de Morais RM. Carotenoids from Marine Microalgae: A Valuable Natural Source for the Prevention of Chronic Diseases. Mar Drugs. 2015 Aug 14; 13(8):5128-55. doi: 10.3390/md13085128. Review. PubMed PMID: 26287216; PubMed Central PMCID: PMC4557017.

[158] Peng J, Yuan JP, Wu CF, Wang JH. Fucoxanthin, a marine carotenoid present in brown seaweeds and diatoms: metabolism and bioactivities relevant to human health. Mar Drugs. 2011; 9(10):1806-28. doi: 10.3390/ md9101806. Epub 2011 Oct 10. Review.

PubMed PMID: 22072997; PubMed Central PMCID: PMC3210606.

[159]Hsu HY, Hwang PA. Clinical applications of fucoidan in translational medicine for adjuvant cancer therapy. Clin Transl Med. 2019 May 1;8(1):15. doi: 10.1186/s40169-019-0234-9. Review. PubMed PMID: 31041568; PubMed Central PMCID: PMC6491526.

[160]van Weelden G, Bobiński M, Okła K, van Weelden WJ, Romano A, Pijnenborg JMA. Fucoidan Structure and Activity in Relation to Anti-Cancer Mechanisms. Mar Drugs. 2019 Jan 7; 17(1). pii: E32. doi: 10.3390/md17010032. Review. PubMed PMID: 30621045; PubMed Central PMCID: PMC6356449.

[161]Wang Y, Xing M, Cao Q, Ji A, Liang H, Song S. Biological Activities of Fucoidan and the Factors Mediating Its Therapeutic Effects: A Review of Recent Studies. Mar Drugs. 2019 Mar 20; 17(3). pii: E183. doi: 10.3390/md17030183. Review. PubMed PMID: 30897733; PubMed Central PMCID: PMC6471298.

[162]Misra P, Singh S. Role of cytokines in combinatorial immunotherapeutics of non-small cell lung cancer through systems perspective. Cancer Med. 2019 May; 8(5):1976-1995. doi: 10.1002/cam4.2112. Epub 2019 Apr 17. Review. PubMed PMID: 30997737; PubMed Central PMCID: PMC6536974.

[163]Ercolano G, De Cicco P, Ianaro A. New Drugs from the Sea: Pro-Apoptotic Activity of Sponges and Algae Derived Compounds. Mar Drugs. 2019 Jan 7; 17(1). pii: E31. doi: 10.3390/md17010031. Review. PubMed PMID: 30621025; PubMed Central PMCID: PMC6356258.

[164]Erfani N, Nazemosadat Z, Moein M. Cytotoxic activity of ten algae from the Persian Gulf and Oman Sea on human breast cancer cell lines; MDA-MB-231, MCF-7, and T-47D. Pharmacognosy Res. 2015 Apr-Jun; 7(2):133-7. doi: 10.4103/0974-8490.150539. PubMed PMID: 25829786; PubMed Central PMCID: PMC4357963.

[165]Wu SY, Wu AT, Yuan KS, Liu SH. Brown Seaweed Fucoidan Inhibits Cancer Progression by Dual Regulation of mir-29c/ADAM12 and miR-17-5p/PTEN Axes in Human Breast Cancer Cells. J Cancer. 2016 Dec 9; 7(15) :2408-2419. eCollection 2016. PubMed PMID: 27994679; PubMed Central PMCID: PMC5166552.

[166]Moussavou G, Kwak DH, Obiang-Obonou BW, Maranguy CA, Dinzouna-Boutamba SD, Lee DH, Pissibanganga OG, Ko K, Seo JI, Choo YK. Anticancer effects of different seaweeds on human colon and breast cancers. Mar Drugs. 2014 Sep 24; 12(9):4898-911. doi: 10.3390/md12094898. Review. PubMed PMID: 25255129; PubMed Central PMCID: PMC4178489.

[167]Montuori N, Pesapane A, Rossi FW, Giudice V, De Paulis A, Selleri C, Ragno P. Urokinase type plasminogen activator receptor (uPAR) as a new therapeutic target in cancer. Transl Med UniSa. 2016 Nov 1; 15:15-21. eCollection 2016 Nov. PubMed PMID: 27896223; PubMed Central PMCID: PMC5120746.

[168]Teas J, Vena S, Cone DL, Irhimeh M. The consumption of seaweed as a protective factor in the etiology of breast cancer: proof of principle. J Appl Phycol. 2013 Jun;25(3):771-779. Epub 2012 Nov 10. PubMed PMID: 23678231; PubMed Central PMCID: PMC3651528.

[169]Shamsabadi FT, Khoddami A, Fard SG, Abdullah R, Othman HH, Mohamed S. Comparison of tamoxifen with edible seaweed (Eucheuma cottonii L.) extract in suppressing breast tumor. Nutr Cancer. 2013;65(2):255-62. doi: 10.1080/01635581.2013.756528. PubMed PMID: 23441613.

[170]Jazzara M, Ghannam A, Soukkarieh C, Murad H. Anti-Proliferative Activity of λ-Carrageenan Through the Induction of Apoptosis in Human Breast Cancer Cells, Int J Cancer Manag. 2016 ; 9(4):e3836. doi: 10.17795/ijcp-3836.

[171]Groult H, Cousin R, Chot-Plassot C, Maura M, Bridiau N, Piot JM, Maugard T, Fruitier-Arnaudin I. λ-Carrageenan Oligosaccharides of Distinct Anti-Heparanase and Anticoagulant Activities Inhibit MDA-MB-231 Breast Cancer Cell Migration. Mar Drugs. 2019 Feb 27; 17(3). pii: E140. doi: 10.3390/md17030140. PubMed PMID: 30818840; PubMed Central PMCID: PMC6471403.

[172]Losada-Echeberría M, Herranz-López M, Micol V, Barrajón-Catalán E. Polyphenols as Promising Drugs against Main Breast Cancer Signatures. Antioxidants (Basel). 2017 Nov 7; 6(4). pii: E88. doi: 10.3390/antiox6040088. Review. PubMed PMID: 29112149; PubMed Central PMCID: PMC5745498.

[173]Namvar F, Mohamad R, Baharara J, Zafar-Balanejad S, Fargahi F, Rahman HS. Antioxidant, antiproliferative, and antiangiogenesis effects of polyphenol-rich seaweed (Sargassum muticum). Biomed Res Int. 2013; 2013:604787. doi: 10.1155/ 2013/ 604787. Epub 2013 Sep 4. PubMed PMID: 24078922; PubMed Central PMCID: PMC3776361.

[174]Niedzwiecki A, Roomi MW, Kalinovsky T, Rath M. Anticancer Efficacy of Polyphenols and Their Combinations. Nutrients. 2016 Sep 9; 8(9). pii: E552. doi: 10.3390/nu8090552. Review. PubMed PMID: 27618095; PubMed Central PMCID: PMC5037537.

[175]Kapinova A, Kubatka P, Golubnitschaja O, Kello M, Zubor P, Solar P, Pec M. Dietary phytochemicals in breast cancer research:

anticancer effects and potential utility for effective chemoprevention. Environ Health Prev Med. 2018 Aug 9; 23(1):36. doi:10. 1186/s12199-018-0724-1. Review. PubMed PMID: 30092754; PubMed Central PMCID: PMC6085646.

[176] Keating E, Martel F. Antimetabolic Effects of Polyphenols in Breast Cancer Cells: Focus on Glucose Uptake and Metabolism. Front Nutr. 2018 Apr 16; 5:25. doi: 10.3389/ fnut. 2018.00025. eCollection 2018. Review. PubMed PMID: 29713632; PubMed Central PMCID: PMC5911477.

[177] Sudhakaran M, Sardesai S, Doseff AI. Flavonoids: New Frontier for Immuno-Regulation and Breast Cancer Control. Antioxidants (Basel). 2019 Apr 16;8(4). pii: E103. doi: 10.3390/antiox8040103. Review. PubMed PMID: 30995775; PubMed Central PMCID: PMC6523469.

[178] Hui C, Qi X, Qianyong Z, Xiaoli P, Jundong Z, Mantian M. Flavonoids, flavonoid subclasses and breast cancer risk: a meta-analysis of epidemiologic studies. PLoS One. 2013; 8(1):e54318. doi: 10.1371/ journal. pone. 0054318. Epub 2013 Jan 18. PubMed PMID: 23349849; PubMed Central PMCID: PMC3548848.

[179] Sak K. Epidemiological Evidences on Dietary Flavonoids and Breast Cancer Risk: A Narrative Review. Asian Pac J Cancer Prev. 2017 Sep 27; 18(9): 2309-2328. PubMed PMID: 28950673; PubMed Central PMCID: PMC5720631.

[180] Takemura H, Sakakibara H, Yamazaki S, Shimoi K. Breast cancer and flavonoids - a role in prevention. Curr Pharm Des. 2013; 19(34):6125-32. Review. PubMed PMID: 23448447.

[181] Batra P, Sharma AK. Anti-cancer potential of flavonoids: recent trends and future perspectives. 3 Biotech. 2013 Dec; 3(6):439-459. doi: 10.1007/s13205-013-0117-5. Epub 2013 Feb 12. PubMed PMID: 28324424; PubMed Central PMCID: PMC3824783.

[182] Magne Nde CB, Zingue S, Winter E, Creczynski-Pasa TB, Michel T, Fernandez X, Njamen D, Clyne C. Flavonoids, Breast Cancer Chemopreventive and/or Chemotherapeutic Agents. Curr Med Chem. 2015;22(30):3434-46. Review. PubMed PMID: 26502949.

[183] Abotaleb M, Samuel SM, Varghese E, Varghese S, Kubatka P, Liskova A, Büsselberg D. Flavonoids in Cancer and Apoptosis. Cancers (Basel). 2018 Dec 28; 11(1). pii: E28. doi: 10.3390/cancers11010028. Review. PubMed PMID: 30597838; PubMed Central PMCID: PMC6357032.

[184] Pang BB, Chu YK, Yang H. [Anti-breast cancer mechanism of flavonoids]. Zhongguo Zhong Yao Za Zhi. 2018 Mar; 43(5):913-920. doi: 10.19540/j.cnki.cjcmm.20171211.005. Review. Chinese. PubMed PMID: 29676087.

[185] Zhang HW, Hu JJ, Fu RQ, Liu X, Zhang YH, Li J, Liu L, Li YN, Deng Q, Luo QS, Ouyang Q, Gao N. Flavonoids inhibit cell proliferation and induce apoptosis and autophagy through downregulation of PI3Kγ mediated PI3K/ AKT/mTOR/p70S6K/ULK signaling pathway in human breast cancer cells. Sci Rep. 2018 Jul 26; 8(1):11255. doi: 10.1038/s41598-018-29308-7. PubMed PMID: 30050147; PubMed Central PMCID: PMC6062549.

[186] Rodríguez-García C, Sánchez-Quesada C, J Gaforio J. Dietary Flavonoids as Cancer Chemopreventive Agents: An Updated Review of Human Studies. Antioxidants (Basel). 2019 May 18; 8(5). pii: E137. doi: 10.3390/ antiox 8050137. Review. PubMed PMID: 31109072; PubMed Central PMCID: PMC6562590.

[187] Atashrazm F, Lowenthal RM, Woods GM, Holloway AF, Dickinson JL. Fucoidan and cancer: a multifunctional molecule with anti-tumor potential. Mar Drugs. 2015 Apr 14; 13(4):2327-46. doi: 10.3390/md13042327. Review. PubMed PMID: 25874926; PubMed Central PMCID: PMC4413214.

[188] Lu J, Shi KK, Chen S, Wang J, Hassouna A, White LN, Merien F, Xie M, Kong Q, Li J, Ying T, White WL, Nie S. Fucoidan Extracted from the New Zealand Undaria pinnatifida-Physicochemical Comparison against Five Other Fucoidans: Unique Low Molecular Weight Fraction Bioactivity in Breast Cancer Cell Lines. Mar Drugs. 2018 Nov 22; 16(12). pii: E461. doi: 10.3390/md16120461. PubMed PMID: 30469516; PubMed Central PMCID: PMC6316445.

[189] Zorofchian Moghadamtousi S, Karimian H, Khanabdali R, Razavi M, Firoozinia M, Zandi K, Abdul Kadir H. Anticancer and antitumor potential of fucoidan and fucoxanthin, two main metabolites isolated from brown algae. ScientificWorldJournal. 2014 Jan 2; 2014: 768323. doi: 10.1155/2014/768323. eCollection 2014. Review. PubMed PMID: 24526922; PubMed Central PMCID: PMC3910333.

[190] Xue M, Ge Y, Zhang J, Wang Q, Hou L, Liu Y, Sun L, Li Q. Anticancer properties and mechanisms of fucoidan on mouse breast cancer in vitro and in vivo. PLoS One. 2012; 7(8):e43483. doi: 10.1371/journal.pone.0043483. Epub 2012 Aug 20. PubMed PMID: 22916270; PubMed Central PMCID: PMC3423341.

[191] Pawar VK, Singh Y, Sharma K, Shrivastav A, Sharma A, Singh A, Meher JG, Singh P, Raval K, Kumar A, Bora HK, Datta D, Lal J, Chourasia MK. Improved chemotherapy against breast cancer through immunotherapeutic activity of fucoidan decorated electrostatically assembled nanoparticles bearing doxorubicin. Int J Biol

Macromol. 2019 Feb 1; 122:1100-1114. doi: 10.1016/j.ijbiomac.2018.09.059. Epub 2018 Sep 13. PubMed PMID: 30219515.

[192] He X, Xue M, Jiang S, Li W, Yu J, Xiang S. Fucoidan Promotes Apoptosis and Inhibits EMT of Breast Cancer Cells. Biol Pharm Bull. 2019; 42(3):442-447. doi: 10.1248/bpb.b18-00777. PubMed PMID: 30828076.

[193] Xue M, Ge Y, Zhang J, Liu Y, Wang Q, Hou L, Zheng Z. Fucoidan inhibited 4T1 mouse breast cancer cell growth in vivo and in vitro via downregulation of Wnt/β-catenin signaling. Nutr Cancer. 2013; 65(3):460-8. doi: 10.1080/01635581.2013.757628. PubMed PMID: 23530646.

[194] Xue M, Ji X, Liang H, Liu Y, Wang B, Sun L, Li W. The effect of fucoidan on intestinal flora and intestinal barrier function in rats with breast cancer. Food Funct. 2018 Feb 21; 9(2):1214-1223. doi: 10.1039/c7fo01677h. PubMed PMID: 29384543.

[195] Oliveira C, Neves NM, Reis RL, Martins A, Silva TH. Gemcitabine delivered by fucoidan/chitosan nanoparticles presents increased toxicity over human breast cancer cells. Nanomedicine (Lond). 2018 Aug;13(16):2037-2050. doi: 10.2217/nnm-2018-0004. Epub 2018 Sep 7. PubMed PMID: 30189774.

[196] Gong X, Smith JR, Swanson HM, Rubin LP. Carotenoid Lutein Selectively Inhibits Breast Cancer Cell Growth and Potentiates the Effect of Chemotherapeutic Agents through ROS-Mediated Mechanisms. Molecules. 2018 Apr 14; 23(4). pii: E905. doi: 10.3390/molecules23040905. PubMed PMID: 29662002; PubMed Central PMCID: PMC6017803.

[197] Chang J, Zhang Y, Li Y, Lu K, Shen Y, Guo Y, Qi Q, Wang M, Zhang S. NrF2/ARE and NF-κB pathway regulation may be the mechanism for lutein inhibition of human breast cancer cell. Future Oncol. 2018 Apr; 14(8):719-726. doi: 10.2217/fon-2017-0584. Epub 2018 Jan 16. PubMed PMID: 29336610.

[198] Mignone LI, Giovannucci E, Newcomb PA, Titus-Ernstoff L, Trentham-Dietz A, Hampton JM, Willett WC, Egan KM. Dietary carotenoids and the risk of invasive breast cancer. Int J Cancer. 2009 Jun 15;124(12):2929-37. doi: 10.1002/ijc.24334. PubMed PMID: 19330841; PubMed Central PMCID: PMC3564658.

[199] Li Y, Zhang Y, Liu X, Wang M, Wang P, Yang J, Zhang S. Lutein inhibits proliferation, invasion and migration of hypoxic breast cancer cells via downregulation of HES1. Int J Oncol. 2018 Jun; 52(6):2119-2129. doi: 10.3892/ijo.2018.4332. Epub 2018 Mar 23. PubMed PMID: 29620169.

[200] Yan B, Lu MS, Wang L, Mo XF, Luo WP, Du YF, Zhang CX. Specific serum carotenoids are inversely associated with breast cancer risk among Chinese women: a case-control study. Br J Nutr. 2016 Jan 14; 115(1):129-37. doi: 10.1017/S000711451500416X. Epub 2015 Oct 20. PubMed PMID: 26482064.

[201] Li YX, Himaya SW, Dewapriya P, Zhang C, Kim SK. Fumigaclavine C from a marine-derived fungus Aspergillus fumigatus induces apoptosis in MCF-7 breast cancer cells. Mar Drugs. 2013 Dec 13; 11(12):5063-86. doi: 10.3390/md11125063. PubMed PMID: 24351905; PubMed Central PMCID: PMC3877903.

[202] Dyshlovoy SA, Honecker F. Marine Compounds and Cancer: Where Do We Stand? Mar Drugs. 2015 Sep; 13(9):5657-65. Epub 2015 Sep 2. PubMed PMID: 26540740; PubMed Central PMCID: PMC4584346.

[203] Vaikundamoorthy R, Krishnamoorthy V, Vilwanathan R, Rajendran R. Structural characterization and anticancer activity (MCF7 and MDA-MB-231) of polysaccharides fractionated from brown seaweed Sargassum wightii. Int J Biol Macromol. 2018 May; 111:1229-1237. doi: 10.1016/j.ijbiomac.2018.01.125. Epub 2018 Feb 19. PubMed PMID: 29415413.

[204] Sithranga Boopathy N, Kathiresan K. Anticancer drugs from marine flora: an overview. J Oncol. 2010; 2010:214186. doi: 10.1155/2010/214186. Epub 2011 Feb 27. PubMed PMID: 21461373; PubMed Central PMCID: PMC3065217.

[205] Abd-Ellatef GF, Ahmed OM, Abdel-Reheim ES, Abdel-Hamid AZ. Ulva lactuca polysaccharides prevent Wistar rat breast carcinogenesis through the augmentation of apoptosis, enhancement of antioxidant defense system, and suppression of inflammation. Breast Cancer (Dove Med Press). 2017 Feb 27; 9:67-83. doi: 10.2147/BCTT.S125165. eCollection 2017. PubMed PMID: 28280387; PubMed Central PMCID: PMC5340250.

[206] Fedorov SN, Ermakova SP, Zvyagintseva TN, Stonik VA. Anticancer and cancer preventive properties of marine polysaccharides: some results and prospects. Mar Drugs. 2013 Dec 2; 11(12):4876-901. doi: 10.3390/md11124876. PubMed PMID: 24317475; PubMed Central PMCID: PMC3877892.

[207] Ghannam A, Murad H, Jazzara M, Odeh A, Allaf AW. Isolation, Structural characterization, and antiproliferative activity of phycocolloids from the red seaweed Laurencia papillosa on MCF-7 human breast cancer cells. Int J Biol Macromol. 2018 Mar; 108:916-926. doi: 10.1016/j.ijbiomac.2017.11.001. Epub 2017 Nov 4. PubMed PMID: 29113895.

[208] Vishchuk OS, Ermakova SP, Zvyagintseva TN. Sulfated polysaccharides from brown seaweeds Saccharina japonica and Undaria pinnatifida: isolation, structural characteristics, and

antitumor activity. Carbohydr Res. 2011 Dec 13; 346 (17):2769-76. doi: 10.1016/j.carres.2011.09.034. Epub 2011 Oct 5. PubMed PMID: 22024567.

[209] Vaseghi G, Sharifi M, Dana N, Ghasemi A, Yegdaneh A. Cytotoxicity of Sargassum angustifolium Partitions against Breast and Cervical Cancer Cell Lines. Adv Biomed Res. 2018 Mar 27; 7:43. doi: 10.4103/abr.abr_259_16. eCollection 2018. PubMed PMID: 29657928; PubMed Central PMCID: PMC5887695.

[210] Kim EK, Tang Y, Kim YS, Hwang JW, Choi EJ, Lee JH, Lee SH, Jeon YJ, Park PJ. First evidence that Ecklonia cava-derived dieckol attenuates MCF-7 human breast carcinoma cell migration. Mar Drugs. 2015 Mar 30; 13(4):1785-97. doi: 10.3390/md13041785. PubMed PMID: 25830682; PubMed Central PMCID: PMC4413187.

[211] Hashiguchi Y, Muro K, Saito Y, Ito Y, Ajioka Y, Hamaguchi T, Hasegawa K, Hotta K, Ishida H, Ishiguro M, Ishihara S, Kanemitsu Y, Kinugasa Y, Murofushi K, Nakajima TE, Oka S, Tanaka T, Taniguchi H, Tsuji A, Uehara K, Ueno H, Yamanaka T, Yamazaki K, Yoshida M, Yoshino T, Itabashi M, Sakamaki K, Sano K, Shimada Y, Tanaka S, Uetake H, Yamaguchi S, Yamaguchi N, Kobayashi H, Matsuda K, Kotake K, Sugihara K; Japanese Society for Cancer of the Colon and Rectum. Japanese Society for Cancer of the Colon and Rectum (JSCCR) guidelines 2019 for the treatment of colorectal cancer. Int J Clin Oncol. 2019 Jun 15. doi: 10.1007/s10147-019-01485-z. [Epub ahead of print] PubMed PMID: 31203527.

[212] Recio-Boiles A, Waheed A, Cagir B. Cancer, Colon. [Updated 2019 Jun 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2019 Jan-. Available from: https://www.ncbi. nlm.nih.gov/ books/NBK470380/

[213] Thanikachalam K, Khan G. Colorectal Cancer and Nutrition. Nutrients. 2019 Jan 14; 11(1). pii: E164. doi: 10.3390/nu11010164. Review. PubMed PMID: 30646512; PubMed Central PMCID: PMC6357054.

[214] Vieira AR, Abar L, Chan DSM, Vingeliene S, Polemiti E, Stevens C, Greenwood D, Norat T. Foods and beverages and colorectal cancer risk: a systematic review and meta-analysis of cohort studies, an update of the evidence of the WCRF-AICR Continuous Update Project. Ann Oncol. 2017 Aug 1; 28(8):1788-1802. doi: 10.1093/annonc/mdx171. Review. PubMed PMID: 28407090.

[215] Kim J, Lee J, Oh JH, Chang HJ, Sohn DK, Shin A, Kim J. Associations among dietary seaweed intake, c-MYC rs6983267 polymorphism, and risk of colorectal cancer in a Korean population: a case-control study. Eur J Nutr. 2019 Jul 12. doi: 10.1007/s00394-019-02046-w. [Epub ahead of print] PubMed PMID: 31300834.

[216] Zhao Y, Zheng Y, Wang J, Ma S, Yu Y, White WL, Yang S, Yang F, Lu J. Fucoidan Extracted from Undaria pinnatifida: Source for Nutraceuticals/Functional Foods. Mar Drugs. 2018 Sep 9; 16(9). pii: E321. doi: 10.3390/md16090321. Review. PubMed PMID: 30205616; PubMed Central PMCID: PMC6164441.

[217] Tsai HL, Tai CJ, Huang CW, Chang FR, Wang JY. Efficacy of Low-Molecular-Weight Fucoidan as a Supplemental Therapy in Metastatic Colorectal Cancer Patients: A Double-Blind Randomized Controlled Trial. Mar Drugs. 2017 Apr 21;15(4). pii: E122. doi: 10.3390/md15040122. PubMed PMID: 28430159; PubMed Central PMCID: PMC5408268.

[218] Wang SK, Li Y, White WL, Lu J. Extracts from New Zealand Undaria pinnatifida Containing Fucoxanthin as Potential Functional Biomaterials against Cancer in Vitro. J Funct Biomater. 2014 Mar 31; 5(2):29-42. doi: 10.3390/jfb5020029. PubMed PMID: 24956438; PubMed Central PMCID: PMC4099972.

[219] Han YS, Lee JH, Lee SH. Fucoidan inhibits the migration and proliferation of HT-29 human colon cancer cells via the phosphoinositide-3 kinase/Akt/mechanistic target of rapamycin pathways. Mol Med Rep. 2015 Sep;12(3):3446-3452. doi: 10.3892/mmr.2015.3804. Epub 2015 May 21. PubMed PMID: 25998232; PubMed Central PMCID: PMC4526071.

[220] Han YS, Lee JH, Lee SH. Antitumor Effects of Fucoidan on Human Colon Cancer Cells via Activation of Akt Signaling. Biomol Ther (Seoul). 2015 May; 23(3):225-32. doi: 10.4062/biomolther.2014.136. Epub 2015 May 1. PubMed PMID: 25995820; PubMed Central PMCID: PMC4428714.

[221] Chen LM, Liu PY, Chen YA, Tseng HY, Shen PC, Hwang PA, Hsu HL. Oligo-Fucoidan prevents IL-6 and CCL2 production and cooperates with p53 to suppress ATM signaling and tumor progression. Sci Rep. 2017 Sep 19; 7(1):11864. doi: 10.1038/s41598-017-12111-1. PubMed PMID: 28928376; PubMed Central PMCID: PMC5605496.

[222] Kim S-K, Karagozlu MZ. Chapter 17. Marine algae: Natural Product Source for the gastrointestinal Cancer Treatment. In: Marine Medicinal Foods: Implications and Applications, Macro and Microalgae, Volume 64 of Advances in Food and Nutrition Research, ISSN 1043-4526. Editors: Se-Kwon Kim, Steve Taylor Publisher:Academic Press, 2011 ISBN0123876699, 9780123876690

[223] Bakunina I, Chadova O, Malyarenko O, Ermakova S. The Effect of Fucoidan from the

Brown Alga Fucus evanescence on the Activity of α-N-Acetylgalactosaminidase of Human Colon Carcinoma Cells. Mar Drugs. 2018 May 10; 16(5). pii: E155. doi: 10.3390/md16050155. PubMed PMID: 29748462; PubMed Central PMCID: PMC5983286.

[224] Kim IH, Kwon MJ, Nam TJ. Differences in cell death and cell cycle following fucoidan treatment in high-density HT-29 colon cancer cells. Mol Med Rep. 2017 Jun; 15(6):4116-4122. doi: 10.3892/mmr. 2017.6520. Epub 2017 Apr 27. PubMed PMID: 28487956; PubMed Central PMCID: PMC5436236.

[225] Kim HY, Kim YM, Hong S. Astaxanthin suppresses the metastasis of colon cancer by inhibiting the MYC-mediated downregulation of microRNA-29a-3p and microRNA-200a. Sci Rep. 2019 Jul 1; 9(1):9457. doi: 10.1038/s41598-019-45924-3. PubMed PMID: 31263239; PubMed Central PMCID: PMC6603017.

[226] Nagendraprabhu P, Sudhandiran G. Astaxanthin inhibits tumor invasion by decreasing extracellular matrix production and induces apoptosis in experimental rat colon carcinogenesis by modulating the expressions of ERK-2, NFkB and COX-2. Invest New Drugs. 2011 Apr; 29(2):207-24. doi: 10.1007/s10637-009-9342-5. Epub 2009 Oct 30. PubMed PMID: 19876598.

[227] Yasui Y, Hosokawa M, Mikami N, Miyashita K, Tanaka T. Dietary astaxanthin inhibits colitis and colitis-associated colon carcinogenesis in mice via modulation of the inflammatory cytokines. Chem Biol Interact. 2011 Aug 15; 193(1):79-87. doi: 10.1016/j.cbi.2011.05.006. Epub 2011 May 20. PubMed PMID: 21621527.

[228] Liu X, Song M, Gao Z, Cai X, Dixon W, Chen X, Cao Y, Xiao H. Stereoisomers of Astaxanthin Inhibit Human Colon Cancer Cell Growth by Inducing G2/M Cell Cycle Arrest and Apoptosis. J Agric Food Chem. 2016 Oct 19; 64(41):7750-7759. doi: 10.1021/acs.jafc.6b03636. Epub 2016 Oct 11. PubMed PMID: 27726394.

[229] Wayakanon K, Rueangyotchanthana K, Wayakanon P, Suwannachart C. The inhibition of Caco-2 proliferation by astaxanthin from Xanthophyllomyces dendrorhous. J Med Microbiol. 2018 Apr; 67(4):507-513. doi: 10.1099/jmm.0.000710. Epub 2018 Mar 5. PubMed PMID: 29504932.

[230] Tanaka T, Kawamori T, Ohnishi M, Makita H, Mori H, Satoh K, Hara A. Suppression of azoxymethane-induced rat colon carcinogenesis by dietary administration of naturally occurring xanthophylls astaxanthin and canthaxanthin during the postinitiation phase. Carcinogenesis. 1995 Dec; 16(12):2957-63. PubMed PMID: 8603470.

[231] Terasaki M, Iida T, Kikuchi F, Tamura K, Endo T, Kuramitsu Y, Tanaka T, Maeda H, Miyashita K, Mutoh M. Fucoxanthin potentiates anoikis in colon mucosa and prevents carcinogenesis in AOM/DSS model mice. J Nutr Biochem. 2019 Feb; 64:198-205. doi: 10.1016/j.jnutbio.2018.10.007. Epub 2018 Oct 25. PubMed PMID: 30530259.

[232] Terasaki M, Masaka S, Fukada C, Houzaki M, Endo T, Tanaka T, Maeda H, Miyashita K, Mutoh M. Salivary Glycine Is a Significant Predictor for the Attenuation of Polyp and Tumor Microenvironment Formation by Fucoxanthin in AOM/DSS Mice. In Vivo. 2019 Mar-Apr;33(2):365-374. doi: 10.21873/invivo.11483. PubMed PMID: 30804114; PubMed Central PMCID: PMC6506301.

[233] Terasaki M, Matsumoto N, Hashimoto R, Endo T, Maeda H, Hamada J, Osada K, Miyashita K, Mutoh M. Fucoxanthin administration delays occurrence of tumors in xenograft mice by colonospheres, with an anti-tumor predictor of glycine. J Clin Biochem Nutr. 2019 Jan; 64(1):52-58. doi: 10.3164/jcbn.18-45. Epub 2018 Jul 25. PubMed PMID: 30705512; PubMed Central PMCID: PMC6348407.

[234] Das SK, Hashimoto T, Shimizu K, Yoshida T, Sakai T, Sowa Y, Komoto A, Kanazawa K. Fucoxanthin induces cell cycle arrest at G0/G1 phase in human colon carcinoma cells through up-regulation of p21WAF1/Cip1. Biochim Biophys Acta. 2005 Nov 30; 1726(3):328-35. Epub 2005 Oct 3. PubMed PMID: 16236452.

[235] Hosokawa M, Kudo M, Maeda H, Kohno H, Tanaka T, Miyashita K. Fucoxanthin induces apoptosis and enhances the antiproliferative effect of the PPARgamma ligand, troglitazone, on colon cancer cells. Biochim Biophys Acta. 2004 Nov 18; 1675(1-3):113-9. PubMed PMID: 15535974.

[236] Kim JM, Araki S, Kim DJ, Park CB, Takasuka N, Baba-Toriyama H, Ota T, Nir Z, Khachik F, Shimidzu N, Tanaka Y, Osawa T, Uraji T, Murakoshi M, Nishino H, Tsuda H. Chemopreventive effects of carotenoids and curcumins on mouse colon carcinogenesis after 1,2-dimethylhydrazine initiation. Carcinogenesis. 1998 Jan; 19(1):81-5. PubMed PMID: 9472697.

[237] Konishi I, Hosokawa M, Sashima T, Kobayashi H, Miyashita K. Halocynthiaxanthin and fucoxanthinol isolated from Halocynthia roretzi induce apoptosis in human leukemia, breast and colon cancer cells. Comp Biochem Physiol C Toxicol Pharmacol. 2006 Jan-Feb; 142(1-2):53-9. Epub 2005 Dec 7. PubMed PMID: 16337836.

[238] Kim J, Lee J, Oh JH, Chang HJ, Sohn DK, Kwon O, Shin A, Kim J. Dietary Lutein Plus Zeaxanthin Intake and DICER1 rs3742330 A > G Polymorphism Relative to Colorectal

Cancer Risk. Sci Rep. 2019 Mar 4; 9(1):3406. doi: 10.1038/s41598-019-39747-5. PubMed PMID: 30833603; PubMed Central PMCID: PMC6399314.

[239] Reynoso-Camacho R, González-Jasso E, Ferriz-Martínez R, Villalón-Corona B, Loarca-Piña GF, Salgado LM, Ramos-Gomez M. Dietary supplementation of lutein reduces colon carcinogenesis in DMH-treated rats by modulating K-ras, PKB, and β-catenin proteins. Nutr Cancer. 2011; 63(1):39-45. doi: 10.1080/01635581.2010.516477. PubMed PMID: 21128180.

[240] Grudzinski W, Piet M, Luchowski R, Reszczynska E, Welc R, Paduch R, Gruszecki WI. Different molecular organization of two carotenoids, lutein and zeaxanthin, in human colon epithelial cells and colon adenocarcinoma cells. Spectrochim Acta A Mol Biomol Spectrosc. 2018 Jan 5; 188:57-63. doi: 10.1016/j.saa.2017.06.041. Epub 2017 Jul 5. PubMed PMID: 28689079.

[241] Kohler LN, Harris RB, Oren E, Roe DJ, Lance P, Jacobs ET. Adherence to Nutrition and Physical Activity Cancer Prevention Guidelines and Development of Colorectal Adenoma. Nutrients. 2018 Aug 16; 10(8). pii: E1098. doi: 10.3390/nu10081098. PubMed PMID: 30115827; PubMed Central PMCID: PMC 6115749.

[242] Wang ZJ, Ohnaka K, Morita M, Toyomura K, Kono S, Ueki T, Tanaka M, Kakeji Y, Maehara Y, Okamura T, Ikejiri K, Futami K, Maekawa T, Yasunami Y, Takenaka K, Ichimiya H, Terasaka R. Dietary polyphenols and colorectal cancer risk: the Fukuoka colorectal cancer study. World J Gastroenterol. 2013 May 7; 19(17):2683-90. doi: 10.3748/wjg.v19.i17.2683. PubMed PMID: 23674876; PubMed Central PMCID: PMC3645387.

[243] Alam MN, Almoyad M, Huq F. Polyphenols in Colorectal Cancer: Current State of Knowledge including Clinical Trials and Molecular Mechanism of Action. Biomed Res Int. 2018 Jan 15; 2018:4154185. doi: 10.1155/2018/4154185. eCollection 2018. Review. PubMed PMID: 29568751; PubMed Central PMCID: PMC5820674.

[244] Murphy N, Achaintre D, Zamora-Ros R, Jenab M, Boutron-Ruault MC, Carbonnel F, Savoye I, Kaaks R, Kühn T, Boeing H, Aleksandrova K, Tjønneland A, Kyrø C, Overvad K, Quirós JR, Sánchez MJ, Altzibar JM, María Huerta J, Barricarte A, Khaw KT, Bradbury KE, Perez-Cornago A, Trichopoulou A, Karakatsani A, Peppa E, Palli D, Grioni S, Tumino R, Sacerdote C, Panico S, Bueno-de-Mesquita HBA, Peeters PH, Rutegård M, Johansson I, Freisling H, Noh H, Cross AJ, Vineis P, Tsilidis K, Gunter MJ, Scalbert A. A prospective evaluation of plasma polyphenol levels and colon cancer risk. Int J Cancer. 2018 Apr 26. doi: 10.1002/ijc.31563. [Epub ahead of print] PubMed PMID: 29696648; PubMed Central PMCID: PMC6175205.

[245] Mileo AM, Nisticò P, Miccadei S. Polyphenols: Immunomodulatory and Therapeutic Implication in Colorectal Cancer. Front Immunol. 2019 Apr 11; 10:729. doi: 10.3389/fimmu.2019.00729. eCollection 2019. Review. PubMed PMID: 31031748; PubMed Central PMCID: PMC6470258.

[246] Zamora-Ros R, Cayssials V, Jenab M, Rothwell JA, Fedirko V, Aleksandrova K, Tjønneland A, Kyrø C, Overvad K, Boutron-Ruault MC, Carbonnel F, Mahamat-Saleh Y, Kaaks R, Kühn T, Boeing H, Trichopoulou A, Valanou E, Vasilopoulou E, Masala G, Pala V, Panico S, Tumino R, Ricceri F, Weiderpass E, Lukic M, Sandanger TM, Lasheras C, Agudo A, Sánchez MJ, Amiano P, Navarro C, Ardanaz E, Sonestedt E, Ohlsson B, Nilsson LM, Rutegård M, Bueno-de-Mesquita B, Peeters PH, Khaw KT, Wareham NJ, Bradbury K, Freisling H, Romieu I, Cross AJ, Vineis P, Scalbert A. Dietary intake of total polyphenol and polyphenol classes and the risk of colorectal cancer in the European Prospective Investigation into Cancer and Nutrition (EPIC) cohort. Eur J Epidemiol. 2018 Nov;33(11):1063-1075. doi: 10.1007/s10654-018-0408-6. Epub 2018 May 15. PubMed PMID: 29761424.

[247] van der Veen DJ, Döpp CME, Siemonsma PC, Nijhuis-van der Sanden MWG, de Swart BJM, Steultjens EM. Factors influencing the implementation of Home-Based Stroke Rehabilitation: Professionals' perspective. PLoS One. 2019 Jul 25; 14(7):e0220226. doi: 10.1371/journal.pone.0220226. eCollection 2019. PubMed PMID: 31344103; PubMed Central PMCID: PMC6657875.

[248] Galasso C, Orefice I, Pellone P, Cirino P, Miele R, Ianora A, Brunet C, Sansone C. On the Neuroprotective Role of Astaxanthin: New Perspectives? Mar Drugs. 2018 Jul 24; 16(8). pii: E247. doi: 10.3390/md16080247. Review. PubMed PMID: 30042358; PubMed Central PMCID: PMC6117702.

[249] Deng X, Wang M, Hu S, Feng Y, Shao Y, Xie Y, Wu M, Chen Y, Shi X. The Neuroprotective Effect of Astaxanthin on Pilocarpine-Induced Status Epilepticus in Rats. Front Cell Neurosci. 2019 Mar 29; 13:123. doi: 10.3389/fncel.2019.00123. eCollection 2019. PubMed PMID: 30983975; PubMed Central PMCID: PMC6449650.

[250] Grimmig B, Kim SH, Nash K, Bickford PC, Douglas Shytle R. Neuroprotective mechanisms of astaxanthin: a potential therapeutic role in preserving cognitive function in age and neurodegeneration. Geroscience. 2017 Feb; 39(1):19-32. doi: 10.1007/s11357-017-9958-x.

Epub 2017 Feb 13. Review. PubMed PMID: 28299644; PubMed Central PMCID: PMC5352583.

[251] Alghazwi M, Smid S, Zhang W. In vitro protective activity of South Australian marine sponge and macroalgae extracts against amyloid beta (Aβ(1-42)) induced neurotoxicity in PC-12 cells. Neurotoxicol Teratol. 2018 Jul - Aug;68: 72-83. doi: 10.1016/j.ntt.2018.05.002. Epub 2018 May 18. PubMed PMID: 29782912.

[252] Cho KS, Shin M, Kim S, Lee SB. Recent Advances in Studies on the Therapeutic Potential of Dietary Carotenoids in Neurodegenerative Diseases. Oxid Med Cell Longev. 2018 Apr 16; 2018:4120458. doi: 10.1155/2018/4120458. eCollection 2018. Review. PubMed PMID: 29849893; PubMed Central PMCID: PMC5926482.

[253] Grimmig B, Daly L, Subbarayan M, Hudson C, Williamson R, Nash K, Bickford PC. Astaxanthin is neuroprotective in an aged mouse model of Parkinson's disease. Oncotarget. 2017 Dec 28; 9(12):10388-10401. doi: 10.18632/oncotarget.23737. eCollection 2018 Feb 13. PubMed PMID: 29535814; PubMed Central PMCID: PMC5828206.

[254] Sathasivam R, Ki JS. A Review of the Biological Activities of Microalgal Carotenoids and Their Potential Use in Healthcare and Cosmetic Industries. Mar Drugs. 2018 Jan 12; 16(1). pii: E26. doi: 10.3390/md16010026. Review. PubMed PMID: 29329235; PubMed Central PMCID: PMC5793074.

[255] Bahonar A, Saadatnia M, Khorvash F, Maracy M, Khosravi A. Carotenoids as Potential Antioxidant Agents in Stroke Prevention: A Systematic Review. Int J Prev Med. 2017 Sep 14; 8:70. doi: 10.4103/ijpvm.IJPVM_112_17. eCollection 2017. Review. PubMed PMID: 28983399; PubMed Central PMCID: PMC5625359.

[256] Olasehinde TA, Olaniran AO, Okoh AI. Therapeutic Potentials of Microalgae in the Treatment of Alzheimer's Disease. Molecules. 2017 Mar 18;22(3). pii: E480. doi: 10.3390/molecules22030480. Review. PubMed PMID: 28335462; PubMed Central PMCID: PMC6155420.

[257] Wu H, Niu H, Shao A, Wu C, Dixon BJ, Zhang J, Yang S, Wang Y. Astaxanthin as a Potential Neuroprotective Agent for Neurological Diseases. Mar Drugs. 2015 Sep 11; 13(9):5750-66. doi: 10.3390/md13095750. Review. PubMed PMID: 26378548; PubMed Central PMCID: PMC4584352.

[258] Barros MP, Poppe SC, Bondan EF. Neuroprotective properties of the marine carotenoid astaxanthin and omega-3 fatty acids, and perspectives for the natural combination of both in krill oil. Nutrients. 2014 Mar 24; 6(3):1293-317. doi: 10.3390/nu6031293. Review. PubMed PMID: 24667135; PubMed Central PMCID: PMC3967194.

[259] Wen X, Huang A, Hu J, Zhong Z, Liu Y, Li Z, Pan X, Liu Z. Neuroprotective effect of astaxanthin against glutamate-induced cytotoxicity in HT22 cells: Involvement of the Akt/GSK-3β pathway. Neuroscience. 2015 Sep 10; 303:558-68. doi: 10.1016/j.neuroscience.2015.07.034. Epub 2015 Jul 18. PubMed PMID: 26197224.

[260] Ito N, Saito H, Seki S, Ueda F, Asada T. Effects of Composite Supplement Containing Astaxanthin and Sesamin on Cognitive Functions in People with Mild Cognitive Impairment: A Randomized, Double-Blind, Placebo-Controlled Trial. J Alzheimers Dis. 2018;62(4):1767-1775. doi: 10.3233/JAD-170969. PubMed PMID: 29614679; PubMed Central PMCID: PMC5900571.

[261] Yamagishi R, Aihara M. Neuroprotective effect of astaxanthin against rat retinal ganglion cell death under various stresses that induce apoptosis and necrosis. Mol Vis. 2014 Dec 31; 20:1796-805. eCollection 2014. PubMed PMID: 25593507; PubMed Central PMCID: PMC4287717.

[262] Zhang XS, Zhang X, Wu Q, Li W, Wang CX, Xie GB, Zhou XM, Shi JX, Zhou ML. Astaxanthin offers neuroprotection and reduces neuroinflammation in experimental subarachnoid hemorrhage. J Surg Res. 2014 Nov;192(1):206-13. doi: 10.1016/j.jss.2014.05.029. Epub 2014 May 21. PubMed PMID: 24948541.

[263] Zhang XS, Zhang X, Zhou ML, Zhou XM, Li N, Li W, Cong ZX, Sun Q, Zhuang Z, Wang CX, Shi JX. Amelioration of oxidative stress and protection against early brain injury by astaxanthin after experimental subarachnoid hemorrhage. J Neurosurg. 2014 Jul;121(1):42-54. doi: 10.3171/2014.2.JNS13730. Epub 2014 Apr 11. PubMed PMID: 24724856.

[264] Yu J, Lin JJ, Yu R, He S, Wang QW, Cui W, Zhang JR. Fucoxanthin prevents H(2)O(2)-induced neuronal apoptosis via concurrently activating the PI3-K/Akt cascade and inhibiting the ERK pathway. Food Nutr Res. 2017 Mar 28;61(1):1304678. doi: 10.1080/16546628.2017.1304678. eCollection 2017. PubMed PMID: 28469544; PubMed Central PMCID: PMC5404425.

[265] Zhang L, Wang H, Fan Y, Gao Y, Li X, Hu Z, Ding K, Wang Y, Wang X. Fucoxanthin provides neuroprotection in models of traumatic brain injury via the Nrf2-ARE and Nrf2-autophagy pathways. Sci Rep. 2017 Apr 21;7:46763. doi: 10.1038/srep46763. PubMed PMID: 28429775; PubMed Central PMCID: PMC5399453.

[266] Lin J, Yu J, Zhao J, Zhang K, Zheng J, Wang J, Huang C, Zhang J, Yan X, Gerwick WH, Wang Q, Cui W, He S. Fucoxanthin, a Marine

Carotenoid, Attenuates β-Amyloid Oligomer-Induced Neurotoxicity Possibly via Regulating the PI3K/Akt and the ERK Pathways in SH-SY5Y Cells. Oxid Med Cell Longev. 2017;2017:6792543. doi: 10.1155/2017/6792543. Epub 2017 Aug 8. PubMed PMID: 28928905; PubMed Central PMCID: PMC5591933.

[267]Barbosa M, Valentão P, Andrade PB. Bioactive compounds from macroalgae in the new millennium: implications for neurodegenerative diseases. Mar Drugs. 2014 Sep 25;12(9):4934-72. doi: 10.3390/md12094934. Review. PubMed PMID: 25257784; PubMed Central PMCID: PMC4178484.

[268]Giacoppo S, Galuppo M, Montaut S, Iori R, Rollin P, Bramanti P, Mazzon E. An overview on neuroprotective effects of isothiocyanates for the treatment of neurodegenerative diseases. Fitoterapia. 2015 Oct;106:12-21. doi: 10.1016/j.fitote.2015.08.001. Epub 2015 Aug 6. Review. PubMed PMID: 26254971.

[269]Barbalace MC, Malaguti M, Giusti L, Lucacchini A, Hrelia S, Angeloni C. Anti-Inflammatory Activities of Marine Algae in Neurodegenerative Diseases. Int J Mol Sci. 2019 Jun 22;20(12). pii: E3061. doi: 10.3390/ijms20123061. Review. PubMed PMID: 31234555; PubMed Central PMCID: PMC6628294.

[270]Lim CS, Jin DQ, Sung JY, Lee JH, Choi HG, Ha I, Han JS. Antioxidant and anti-inflammatory activities of the methanolic extract of Neorhodomela aculeate in hippocampal and microglial cells. Biol Pharm Bull. 2006 Jun;29(6):1212-6. PubMed PMID: 16755019.

[271]Kang SM, Cha SH, Ko JY, Kang MC, Kim D, Heo SJ, Kim JS, Heu MS, Kim YT, Jung WK, Jeon YJ. Neuroprotective effects of phlorotannins isolated from a brown alga, Ecklonia cava, against H2O2-induced oxidative stress in murine hippocampal HT22 cells. Environ Toxicol Pharmacol. 2012 Jul;34(1):96-105. doi: 10.1016/j.etap.2012.03.006. Epub 2012 Mar 13. PubMed PMID: 22465981.

[272]Kim JH, Lee NS, Jeong YG, Lee JH, Kim EJ, Han SY. Protective efficacy of an Ecklonia cava extract used to treat transient focal ischemia of the rat brain. Anat Cell Biol. 2012 Jun;45(2):103-13. doi: 10.5115/acb.2012.45.2.103. Epub 2012 Jun 30. PubMed PMID: 22822465; PubMed Central PMCID: PMC3398172.

[273]Lee S, Youn K, Kim DH, Ahn MR, Yoon E, Kim OY, Jun M. Anti-Neuroinflammatory Property of Phlorotannins from Ecklonia cava on Aβ(25-35)-Induced Damage in PC12 Cells. Mar Drugs. 2018 Dec 22;17(1). pii: E7. doi: 10.3390/md17010007. PubMed PMID: 30583515; PubMed Central PMCID: PMC6356621.

[274]Park SK, Kang JY, Kim JM, Park SH, Kwon BS, Kim GH, Heo HJ. Protective Effect of Fucoidan Extract from Ecklonia cava on Hydrogen Peroxide-Induced Neurotoxicity. J Microbiol Biotechnol. 2018 Jan 28;28(1):40-49. doi: 10.4014/jmb.1710.10043. PubMed PMID: 29121706.

[275]Cui Y, Amarsanaa K, Lee JH, Rhim JK, Kwon JM, Kim SH, Park JM, Jung SC, Eun SY. Neuroprotective mechanisms of dieckol against glutamate toxicity through reactive oxygen species scavenging and nuclear factor-like 2/heme oxygenase-1 pathway. Korean J Physiol Pharmacol. 2019 Mar;23(2):121-130. doi: 10.4196/kjpp.2019.23.2.121. Epub 2019 Feb 15. PubMed PMID: 30820156; PubMed Central PMCID: PMC6384196.

[276]Reid SNS, Ryu JK, Kim Y, Jeon BH. The Effects of Fermented Laminaria japonica on Short-Term Working Memory and Physical Fitness in the Elderly. Evid Based Complement Alternat Med. 2018 Jun 12;2018:8109621. doi: 10.1155/2018/8109621. eCollection 2018. Erratum in: Evid Based Complement Alternat Med. 2018 Sep 9;2018:1764038. PubMed PMID: 30008787; PubMed Central PMCID: PMC6020467.

[277]Reid SNS, Ryu JK, Kim Y, Jeon BH. GABA-enriched fermented Laminaria japonica improves cognitive impairment and neuroplasticity in scopolamine- and ethanol-induced dementia model mice. Nutr Res Pract. 2018 Jun;12(3):199-207. doi: 10.4162/nrp.2018.12.3.199. Epub 2018 Apr 25. PubMed PMID: 29854325; PubMed Central PMCID: PMC5974065.

[278]Wang J, Zhang Q, Zhang Z, Li Z. Antioxidant activity of sulfated polysaccharide fractions extracted from Laminaria japonica. Int J Biol Macromol. 2008 Mar 1;42(2):127-32. Epub 2007 Oct 9. PubMed PMID: 18023861.

[279]Wang J, Liu H, Jin W, Zhang H, Zhang Q. Structure-activity relationship of sulfated hetero/galactofucan polysaccharides on dopaminergic neuron. Int J Biol Macromol. 2016 Jan;82:878-83. doi: 10.1016/j.ijbiomac.2015.10.042. Epub 2015 Oct 18. PubMed PMID: 26484597.

[280]Wang J, Liu H, Zhang X, Li X, Geng L, Zhang H, Zhang Q. Sulfated Hetero-Polysaccharides Protect SH-SY5Y Cells from H_2O_2-Induced Apoptosis by Affecting the PI3K/Akt Signaling Pathway. Mar Drugs. 2017 Apr 6;15(4). pii: E110. doi: 10.3390/md15040110. PubMed PMID: 28383489; PubMed Central PMCID: PMC5408256.

[281]Zhang L, Hao J, Zheng Y, Su R, Liao Y, Gong X, Liu L, Wang X. Fucoidan Protects Dopaminergic Neurons by Enhancing the Mitochondrial Function in a Rotenone-induced Rat Model of Parkinson's Disease. Aging Dis. 2018 Aug 1;9(4):590-604. doi:

10.14336/AD.2017.0831. eCollection 2018 Aug. PubMed PMID: 30090649; PubMed Central PMCID: PMC6065300.

[282] Alghazwi M, Smid S, Karpiniec S, Zhang W. Comparative study on neuroprotective activities of fucoidans from Fucus vesiculosus and Undaria pinnatifida. Int J Biol Macromol. 2019 Feb 1;122:255-264. doi: 10.1016/j.ijbiomac.2018.10.168. Epub 2018 Oct 25. PubMed PMID: 30401646.

[283] Silva J, Alves C, Pinteus S, Mendes S, Pedrosa R. Neuroprotective effects of seaweeds against 6-hydroxidopamine-induced cell death on an in vitro human neuroblastoma model. BMC Complement Altern Med. 2018 Feb 14;18(1):58. doi: 10.1186/s12906-018-2103-2. PubMed PMID: 29444677; PubMed Central PMCID: PMC5813419.

[284] Jhamandas JH, Wie MB, Harris K, MacTavish D, Kar S. Fucoidan inhibits cellular and neurotoxic effects of beta-amyloid (A beta) in rat cholinergic basal forebrain neurons. Eur J Neurosci. 2005 May;21(10):2649-59. PubMed PMID: 15926913.

[285] Kim S-K, Pangestuti R. Chapter 3. Prospects and potential application of seaweeds as neuroprotective agents. In: Se-Kwon Kim. Marine Nutraceuticals: Prospects and Perspectives. Publisher: CRC Press, 2013 ISBN1466513527, 9781466513525.

[286] Dewapriya P, Kim S-K. Marine Algae for Protecting Your Brain: Neuroprotective Potentials of Marine Algae. In: Se-Kwon Kim, Katarzyna Chojnacka. Marine Algae Extracts, 2 Volume Set: Processes, Products, and Applications. Publisher: John Wiley & Sons, 2015 ISBN3527337083, 9783527337088

[287] Burchell SR, Iniaghe LO, Zhang JH, Tang J. Fucoidan from Fucus vesiculosus Fails to Improve OutcomesFollowing Intracerebral Hemorrhage in Mice. In: Richard L. Applegate, Gang Chen, Hua Feng, John H. Zhang. Brain Edema XVI: Translate Basic Science into Clinical Practice Volume 121 of Acta Neurochirurgica Supplement, Publisher : Springer, 2015 ISBN3319184970, 9783319184975

[288] Yende SR, Harle UN, Chaugule BB. Therapeutic potential and health benefits of Sargassum species. Pharmacogn Rev. 2014 Jan;8(15):1-7. doi: 10.4103/0973-7847.125514. Review. PubMed PMID: 24600190; PubMed Central PMCID: PMC3931196.

[289] Pinteus S, Lemos MFL, Silva J, Alves C, Neugebauer A, Freitas R, Duarte A, Pedrosa R. An Insight into Sargassum muticum Cytoprotective Mechanisms against Oxidative Stress on a Human Cell In Vitro Model. Mar Drugs. 2017 Nov 10;15(11). pii: E353. doi: 10.3390/md15110353. PubMed PMID: 29125578; PubMed Central PMCID: PMC5706042.

[290] Bogie J, Hoeks C, Schepers M, Tiane A, Cuypers A, Leijten F, Chintapakorn Y, Suttiyut T, Pornpakakul S, Struik D, Kerksiek A, Liu HB, Hellings N, Martinez-Martinez P, Jonker JW, Dewachter I, Sijbrands E, Walter J, Hendriks J, Groen A, Staels B, Lütjohann D, Vanmierlo T, Mulder M. Dietary Sargassum fusiforme improves memory and reduces amyloid plaque load in an Alzheimer's disease mouse model. Sci Rep. 2019 Mar 20;9(1):4908. doi: 10.1038/s41598-019-41399-4. PubMed PMID: 30894635; PubMed Central PMCID: PMC6426980.

[291] Zhao D, Zheng L, Qi L, Wang S, Guan L, Xia Y, Cai J. Structural Features and Potent Antidepressant Effects of Total Sterols and β-sitosterol Extracted from Sargassum horneri. Mar Drugs. 2016 Jun 28;14(7). pii: E123. doi: 10.3390/md14070123. PubMed PMID: 27367705; PubMed Central PMCID: PMC4962013.

[292] Jin W, Liu B, Li S, Chen J, Tang H, Jiang D, Zhang Q, Zhong W. The structural features of the sulfated heteropolysaccharide (ST-1) from Sargassum thunbergii and its neuroprotective activities. Int J Biol Macromol. 2018 Mar;108:307-313. doi: 10.1016/j.ijbiomac.2017.12.009. Epub 2017 Dec 5. PubMed PMID: 29217183.

[293] Huang CY, Kuo CH, Chen PW. Compressional-Puffing Pretreatment Enhances Neuroprotective Effects of Fucoidans from the Brown Seaweed Sargassum hemiphyllum on 6-Hydroxydopamine-Induced Apoptosis in SH-SY5Y Cells. Molecules. 2017 Dec 29;23(1). pii: E78. doi: 10.3390/molecules23010078. PubMed PMID: 29286349; PubMed Central PMCID: PMC6017888.

[294] Jin W, Zhang W, Wang J, Yao J, Xie E, Liu D, Duan D, Zhang Q. A study of neuroprotective and antioxidant activities of heteropolysaccharides from six Sargassum species. Int J Biol Macromol. 2014 Jun;67:336-42. doi: 10.1016/j.ijbiomac.2014.03.031. Epub 2014 Mar 27. PubMed PMID: 24680812.

[295] Jin W, Zhang W, Wang J, Zhang Q. The neuroprotective activities and antioxidant activities of the polysaccharides from Saccharina japonica. Int J Biol Macromol. 2013 Jul;58:240-4. doi: 10.1016/j.ijbiomac.2013.04.009. Epub 2013 Apr 12. PubMed PMID: 23588002.

[296] Torres MD, Flórez-Fernández N, Domínguez H. Integral Utilization of Red Seaweed for Bioactive Production. Mar Drugs. 2019 May 28;17(6). pii: E314. doi: 10.3390/md17060314. Review. PubMed PMID: 31142051; PubMed Central PMCID: PMC6627364.

[297] Jin DQ, Lim CS, Sung JY, Choi HG, Ha I, Han JS. Ulva conglobata, a marine algae, has neuroprotective and anti-inflammatory effects in murine hippocampal and microglial cells.

Neurosci Lett. 2006 Jul 10;402(1-2):154-8. Epub 2006 Apr 27. PubMed PMID: 16644126.

[298] Suganthy N, Karutha Pandian S, Pandima Devi K. Neuroprotective effect of seaweeds inhabiting South Indian coastal area (Hare Island, Gulf of Mannar Marine Biosphere Reserve): Cholinesterase inhibitory effect of Hypnea valentiae and Ulva reticulata. Neurosci Lett. 2010 Jan 14;468(3):216-9. doi: 10.1016/j.neulet.2009.11.001. Epub 2009 Nov 6. PubMed PMID: 19897016.

[299] Ratnayake R, Liu Y, Paul VJ, Luesch H. Cultivated sea lettuce is a multiorgan protector from oxidative and inflammatory stress by enhancing the endogenous antioxidant defense system. Cancer Prev Res (Phila). 2013 Sep;6(9):989-99. doi: 10.1158/1940-6207.CAPR-13-0014. PubMed PMID: 24005795; PubMed Central PMCID: PMC3819036.

[300] Ning C, Wang HD, Gao R, Chang YC, Hu F, Meng X, Huang SY. Marine-derived protein kinase inhibitors for neuroinflammatory diseases. Biomed Eng Online. 2018 Apr 24;17(1):46. doi: 10.1186/s12938-018-0477-5. Review. PubMed PMID: 29690896; PubMed Central PMCID: PMC5916827.

[301] Wang J, Zheng J, Huang C, Zhao J, Lin J, Zhou X, Naman CB, Wang N, Gerwick WH, Wang Q, Yan X, Cui W, He S. Eckmaxol, a Phlorotannin Extracted from Ecklonia maxima, Produces Anti-β-amyloid Oligomer Neuroprotective Effects Possibly via Directly Acting on Glycogen Synthase Kinase 3β. ACS Chem Neurosci. 2018 Jun 20;9(6):1349-1356. doi: 10.1021/acschemneuro.7b00527. Epub 2018 Apr 10. PubMed PMID: 29608860.

[302] Zhou X, Yi M, Ding L, He S, Yan X. Isolation and Purification of a Neuroprotective Phlorotannin from the Marine Algae Ecklonia maxima by Size Exclusion and High-Speed Counter-Current Chromatography. Mar Drugs. 2019 Apr 4;17(4). pii: E212. doi: 10.3390/md17040212. PubMed PMID: 30987394; PubMed Central PMCID: PMC6521176.

[303] Rengasamy RRK, Mutalib AA, Ashwell RN, Wendy AS, Johannes VS (2013) Acetylcholinesterase inhibitory activity of phlorotannins isolated from the brown alga, Ecklonia maxima (Osbeck) Papenfuss. Food Research International 54: 1250-1254.

[304] Olasehinde TA, Olaniran AO, Okoh AI. Aqueous-ethanol extracts of some South African seaweeds inhibit beta-amyloid aggregation, cholinesterases, and beta-secretase activities in vitro. J Food Biochem. 2019 Jul;43(7):e12870. doi: 10.1111/jfbc.12870. Epub 2019 Apr 26. PubMed PMID: 31353743.

[305] Souza RB, Frota AF, Sousa RS, Cezario NA, Santos TB, Souza LM, Coura CO, Monteiro VS, Cristino Filho G, Vasconcelos SM, da Cunha RM, Aguiar LM, Benevides NM. Neuroprotective Effects of Sulphated Agaran from Marine Alga Gracilaria cornea in Rat 6-Hydroxydopamine Parkinson's Disease Model: Behavioural, Neurochemical and Transcriptional Alterations. Basic Clin Pharmacol Toxicol. 2017 Feb;120(2):159-170. doi: 10.1111/bcpt.12669. Epub 2016 Oct 10. PubMed PMID: 27612165.

[306] Liu T, Tang X, Jia X, Wu X, Huang M, Zeng J, Chen W. The complete plastid genome and phylogenetic analysis of *Gracilaria edulis*, Mitochondrial DNA Part B, 2019;4(2):2598-2599, DOI: 10.1080/23802359.2019.1642161

[307] Yang JI, Yeh CC, Lee JC, Yi SC, Huang HW, Tseng CN, Chang HW. Aqueous extracts of the edible Gracilaria tenuistipitata are protective against H_2O_2-induced DNA damage, growth inhibition, and cell cycle arrest. Molecules. 2012 Jun 13;17(6):7241-54. doi: 10.3390/molecules17067241. PubMed PMID: 22695230; PubMed Central PMCID: PMC6268842.

[308] Natarajan S, Shanmugiahthevar KP, Kasi PD. Cholinesterase inhibitors from Sargassum and Gracilaria gracilis: seaweeds inhabiting South Indian coastal areas (Hare Island, Gulf of Mannar). Nat Prod Res. 2009;23(4):355-69. doi: 10.1080/14786410802156036. PubMed PMID: 19296376.

[309] Ghannadi A, Plubrukarn A, Zandi K, Sartavi K, Yegdaneh A. Screening for antimalarial and acetylcholinesterase inhibitory activities of some Iranian seaweeds. Res Pharm Sci. 2013 Apr;8(2):113-8. PubMed PMID: 24019820; PubMed Central PMCID: PMC3764674.

[310] Andriani Y, Syamsumir DF, Yee TC, Harisson FS, Herng GM, Abdullah SA, Orosco CA, Ali AM, Latip J, Kikuzaki H, Mohamada H. Biological Activities of Isolated Compounds from Three Edible Malaysian Red Seaweeds, Gracilaria changii, G. manilaensis and Gracilaria sp. Nat Prod Commun. 2016 Aug;11(8):1117-1120. PubMed PMID: 30725572.

[311] Ghannadi A, Shabani L, Yegdaneh A. Cytotoxic, antioxidant and phytochemical analysis of Gracilaria species from Persian Gulf. Adv Biomed Res. 2016 Aug 30;5:139. doi: 10.4103/2277-9175.187373. eCollection 2016. PubMed PMID: 27656608; PubMed Central PMCID: PMC5025924.

[312] Olasehinde TA, Olaniran AO, Okoh AI. Phenolic composition, antioxidant activity, anticholinesterase potential and modulatory effects of aqueous extracts of some seaweeds on β-amyloid aggregation and disaggregation. Pharm Biol. 2019 Dec;57(1):460-469. doi: 10.1080/13880209.2019.1634741. PubMed PMID: 31335235.

[313] Hannan MA, Mohibbullah M, Hong YK, Nam JH, Moon IS. Gelidium amansii promotes

dendritic spine morphology and synaptogenesis, and modulates NMDA receptor-mediated postsynaptic current. In Vitro Cell Dev Biol Anim. 2014;50(5):445-52. doi: 10.1007/s11626-013-9721-2. Epub 2014 Jan 8. PubMed PMID: 24399252.

[314] Linares AF, Loikkanen J, Jorge MF, Soria RB, Novoa AV. Antioxidant and neuroprotective activity of the extract from the seaweed, Halimeda incrassata (Ellis) Lamouroux, against in vitro and in vivo toxicity induced by methyl-mercury. Vet Hum Toxicol. 2004 Feb;46(1):1-5. PubMed PMID: 14748406.

[315] Fallarero A, Loikkanen JJ, Männistö PT, Castañeda O, Vidal A. Effects of aqueous extracts of Halimeda incrassata (Ellis) Lamouroux and Bryothamnion triquetrum (S.G.Gmelim) Howe on hydrogen peroxide and methyl mercury-induced oxidative stress in GT1-7 mouse hypothalamic immortalized cells. Phytomedicine. 2003 Jan;10(1):39-47. PubMed PMID: 12622462.

[316] Fallarero A, Peltoketo A, Loikkanen J, Tammela P, Vidal A, Vuorela P. Effects of the aqueous extract of Bryothamnion triquetrum on chemical hypoxia and aglycemia-induced damage in GT1-7 mouse hypothalamic immortalized cells. Phytomedicine. 2006 Mar;13(4):240-5. Epub 2005 Jun 29. PubMed PMID: 16492526.

[317] Cavalcante-Silva LH, da Matta CB, de Araújo MV, Barbosa-Filho JM, de Lira DP, de Oliveira Santos BV, de Miranda GE, Alexandre-Moreira MS. Antinociceptive and anti-inflammatory activities of crude methanolic extract of red alga Bryothamnion triquetrum. Mar Drugs. 2012 Sep;10(9):1977-92. doi: 10.3390/md10091977. Epub 2012 Sep 17. PubMed PMID: 23118715; PubMed Central PMCID: PMC3475267.

[318] Sánchez-Lamar Á., González-Pumariega M., Fuentes-León F., Vernhes Tamayo M., Schuch A.P., Menck C.F. Evaluation of Genotoxic and DNA Photo-Protective Activity of Bryothamnion triquetrum and Halimeda incrassata Seaweeds Extracts. Cosmetics. 2017;4:23. doi: 10.3390/cosmetics4030023

[319] Liu J, Banskota AH, Critchley AT, Hafting J, Prithiviraj B. Neuroprotective effects of the cultivated Chondrus crispus in a C. elegans model of Parkinson's disease. Mar Drugs. 2015 Apr 14;13(4):2250-66. doi: 10.3390/md13042250. PubMed PMID: 25874922; PubMed Central PMCID: PMC4413210.

[320] Sangha JS, Wally O, Banskota AH, Stefanova R, Hafting JT, Critchley AT, Prithiviraj B. A Cultivated Form of a Red Seaweed (Chondrus crispus), Suppresses β-Amyloid-Induced Paralysis in Caenorhabditis elegans. Mar Drugs. 2015 Oct 20;13(10):6407-24. doi: 10.3390/md13106407. PubMed PMID: 26492254; PubMed Central PMCID: PMC4626697.

[321] Oh JH, Choi JS, Nam TJ. Fucosterol from an Edible Brown Alga Ecklonia stolonifera Prevents Soluble Amyloid Beta-Induced Cognitive Dysfunction in Aging Rats. Mar Drugs. 2018 Oct 5;16(10). pii: E368. doi: 10.3390/md16100368. PubMed PMID: 30301140; PubMed Central PMCID: PMC6213915.

[322] Yoon N.Y., Lee S.H., Yong L., Kim S.K. Phlorotannins from Ishige okamurae and their acetyl- and butyrylcholinesterase inhibitory effects. J. Funct. Foods. 2009;1:331–335. doi: 10.1016/j.jff.2009.07.002.

[323] Dev K, Maurya R. Chapter 7. Marine Derived Anti-Alzheimer's Agents of Promise. In: Goutam Brahmachari. Neuroprotective Natural Products: Clinical Aspects and Mode of Action. Publisher: John Wiley & Sons, 2017 ISBN 3527341862, 9783527341863

[324] Tuppin P, Rivière S, Deutsch D, Gastaldi-Menager C, Sabaté JM. Burden of drug use for gastrointestinal symptoms and functional gastrointestinal disorders in France: a national study using reimbursement data for 57 million inhabitants. Therap Adv Gastroenterol. 2019 Jul 12;12:1756284819853790. doi: 10.1177/1756284819853790. eCollection 2019. PubMed PMID: 31320929; PubMed Central PMCID: PMC6628544.

[325] Peery AF, Crockett SD, Murphy CC, Lund JL, Dellon ES, Williams JL, Jensen ET, Shaheen NJ, Barritt AS, Lieber SR, Kochar B, Barnes EL, Fan YC, Pate V, Galanko J, Baron TH, Sandler RS. Burden and Cost of Gastrointestinal, Liver, and Pancreatic Diseases in the United States: Update 2018. Gastroenterology. 2019 Jan;156(1):254-272.e11. doi: 10.1053/j.gastro.2018.08.063. Epub 2018 Oct 10. Review. Erratum in: Gastroenterology. 2019 May;156(6):1936. PubMed PMID: 30315778.

[326] Hu PJ. Inflammatory Bowel Disease in Asia: The Challenges and Opportunities. Intest Res. 2015 Jul;13(3):188-90. doi: 10.5217/ir.2015.13.3.188. Epub 2015 Jun 9. PubMed PMID: 26130991; PubMed Central PMCID: PMC4479731.

[327] Werlang ME, Palmer WC, Lacy BE. Irritable Bowel Syndrome and Dietary Interventions. Gastroenterol Hepatol (N Y). 2019 Jan;15(1):16-26. PubMed PMID: 30899204; PubMed Central PMCID: PMC6423692.

[328] AK Mohiuddin. Complimentary Treatments for Minor GI Disorders. Adv Pharmacol Clin Trials 2019, 4 (1): 000153. DOI:10.23880/apct-16000153

[329] Leung AK, Hon KL. Gastroesophageal reflux in children: an updated review. Drugs Context. 2019 Jun 17;8:212591. doi: 10.7573/dic.212591. eCollection 2019. Review.

PubMed PMID: 31258618; PubMed Central PMCID: PMC6586172.

[330] Brun R, Kuo B. Functional dyspepsia. Therap Adv Gastroenterol. 2010 May;3(3):145-64. doi: 10.1177/1756283X10362639. PubMed PMID: 21180597; PubMed Central PMCID: PMC3002577.

[331] Savarino E, de Bortoli N, Zentilin P, Martinucci I, Bruzzone L, Furnari M, Marchi S, Savarino V. Alginate controls heartburn in patients with erosive and nonerosive reflux disease. World J Gastroenterol. 2012 Aug 28;18(32):4371-8. doi: 10.3748/wjg.v18.i32.4371. PubMed PMID: 22969201; PubMed Central PMCID: PMC3436053.

[332] Bharucha AE, Camilleri M, Veil E, Burton D, Zinsmeister AR. Comprehensive assessment of gastric emptying with a stable isotope breath test. Neurogastroenterol Motil. 2013 Jan;25(1):e60-9. doi: 10.1111/nmo.12054. Epub 2012 Dec 6. PubMed PMID: 23216872; PubMed Central PMCID: PMC3843948.

[333] Bharucha AE, Kudva Y, Basu A, Camilleri M, Low PA, Vella A, Zinsmeister AR. Relationship between glycemic control and gastric emptying in poorly controlled type 2 diabetes. Clin Gastroenterol Hepatol. 2015 Mar;13(3):466-476.e1. doi: 10.1016/j.cgh.2014.06.034. Epub 2014 Jul 17. PubMed PMID: 25041866; PubMed Central PMCID: PMC4297596.

[334] Ko SJ, Bu Y, Bae J, Bang YM, Kim J, Lee H, Beom-Joon L, Hyun YH, Park JW. Protective effect of Laminaria japonica with probiotics on murine colitis. Mediators Inflamm. 2014;2014:417814. doi: 10.1155/2014/417814. Epub 2014 May 18. PubMed PMID: 24948848; PubMed Central PMCID: PMC4052192.

[335] Jing Y, Liu H, Xu W, Yang Q. Amelioration of the DSS-induced colitis in mice by pretreatment with 4,4'-diaponeurosporene-producing Bacillus subtilis. Exp Ther Med. 2017 Dec;14(6):6069-6073. doi: 10.3892/etm.2017.5282. Epub 2017 Oct 11. PubMed PMID: 29285159; PubMed Central PMCID: PMC5740520.

[336] Sudirman S, Hsu YH, He JL, Kong ZL. Dietary polysaccharide-rich extract from Eucheuma cottonii modulates the inflammatory response and suppresses colonic injury on dextran sulfate sodium-induced colitis in mice. PLoS One. 2018 Oct 5;13(10):e0205252. doi: 10.1371/journal.pone.0205252. eCollection 2018. PubMed PMID: 30289911; PubMed Central PMCID: PMC6173412.

[337] Wardani G, Farida N, Andayani R, Kuntoro M, Sudjarwo SA. The Potency of Red Seaweed (Eucheuma cottonii) Extracts as Hepatoprotector on Lead Acetate-induced Hepatotoxicity in Mice. Pharmacognosy Res. 2017 Jul-Sep;9(3):282-286. doi: 10.4103/pr.pr_69_16. PubMed PMID: 28827971; PubMed Central PMCID: PMC5541486.

[338] Xu SS, Liu QM, Xiao AF, Maleki SJ, Alcocer M, Gao YY, Cao MJ, Liu GM. Eucheuma cottonii Sulfated Oligosaccharides Decrease Food Allergic Responses in Animal Models by Up-regulating Regulatory T (Treg) Cells. J Agric Food Chem. 2017 Apr 19;65(15):3212-3222. doi: 10.1021/acs.jafc.7b00389. Epub 2017 Apr 6. PubMed PMID: 28359154.

[339] Peng J, Zheng TT, Li X, Liang Y, Wang LJ, Huang YC, Xiao HT. Plant-Derived Alkaloids: The Promising Disease-Modifying Agents for Inflammatory Bowel Disease. Front Pharmacol. 2019 Apr 12;10:351. doi: 10.3389/fphar.2019.00351. eCollection 2019. Review. PubMed PMID: 31031622; PubMed Central PMCID: PMC6473079.

[340] Carneiro JG, Holanda TBL, Quinderé ALG, Frota AF, Soares VVM, Sousa RS, Carneiro MA, Martins DS, Gomes Duarte AS, Benevides NMB. Gastroprotective Effects of Sulphated Polysaccharides from the Alga Caulerpa mexicana Reducing Ethanol-Induced Gastric Damage. Pharmaceuticals (Basel). 2018 Jan 20;11(1). pii: E6. doi: 10.3390/ph11010006. PubMed PMID: 29361672; PubMed Central PMCID: PMC5874702.

[341] Hernández-Muñoz R, Montiel-Ruíz C, Vázquez-Martínez O. Gastric mucosal cell proliferation in ethanol-induced chronic mucosal injury is related to oxidative stress and lipid peroxidation in rats. Lab Invest. 2000 Aug;80(8):1161-9. PubMed PMID: 10950107.

[342] V Brito T, Barros FCN, Silva RO, Dias Júnior GJ, C Júnior JS, Franco ÁX, Soares PMG, Chaves LS, Abreu CMWS, de Paula RCM, Souza MHLP, Freitas ALP, R Barbosa AL. Sulfated polysaccharide from the marine algae Hypnea musciformis inhibits TNBS-induced intestinal damage in rats. Carbohydr Polym. 2016 Oct 20;151:957-964. doi: 10.1016/j.carbpol.2016.06.047. Epub 2016 Jun 14. PubMed PMID: 27474644.

[343] Lean QY, Eri RD, Fitton JH, Patel RP, Gueven N. Fucoidan Extracts Ameliorate Acute Colitis. PLoS One. 2015 Jun 17;10(6):e0128453. doi: 10.1371/journal.pone.0128453. eCollection 2015. PubMed PMID: 26083103; PubMed Central PMCID: PMC4471193.

[344] Nie Y, Lin Q, Luo F. Effects of Non-Starch Polysaccharides on Inflammatory Bowel Disease. Int J Mol Sci. 2017 Jun 27;18(7). pii: E1372. doi: 10.3390/ijms18071372. Review. PubMed PMID: 28654020; PubMed Central PMCID: PMC5535865.

[345] Ryan MT, O'Shea CJ, Collins CB, O'Doherty JV, Sweeney T. Effects of dietary supplementation with Laminaria hyperborea, Laminaria digitata, and Saccharomyces

cerevisiae on the IL-17 pathway in the porcine colon. J Anim Sci. 2012 Dec;90 Suppl 4:263-5. doi: 10.2527/jas.53802. PubMed PMID: 23365350.

[346] Shimazu T, Borjigin L, Katoh K, Roh SG, Kitazawa H, Abe K, Suda Y, Saito H, Kunii H, Nihei K, Uemoto Y, Aso H, Suzuki K. Addition of Wakame seaweed (Undaria pinnatifida) stalk to animal feed enhances immune response and improves intestinal microflora in pigs. Anim Sci J. 2019 Jul 18. doi: 10.1111/asj.13274. [Epub ahead of print] PubMed PMID: 31321863.

[347] O'Sullivan L, Murphy B, McLoughlin P, Duggan P, Lawlor PG, Hughes H, Gardiner GE. Prebiotics from marine macroalgae for human and animal health applications. Mar Drugs. 2010 Jul 1;8(7):2038-64. doi: 10.3390/md8072038. Review. PubMed PMID: 20714423; PubMed Central PMCID: PMC2920542.

[348] Jha R, Fouhse JM, Tiwari UP, Li L, Willing BP. Dietary Fiber and Intestinal Health of Monogastric Animals. Front Vet Sci. 2019 Mar 4;6:48. doi: 10.3389/fvets.2019.00048. eCollection 2019. Review. PubMed PMID: 30886850; PubMed Central PMCID: PMC6409295.

[349] de Jesus Raposo MF, de Morais AM, de Morais RM. Emergent Sources of Prebiotics: Seaweeds and Microalgae. Mar Drugs. 2016 Jan 28;14(2). pii: E27. doi: 10.3390/md14020027. Review. PubMed PMID: 26828501; PubMed Central PMCID: PMC4771980.

[350] Ko SJ, Kim J, Han G, Kim SK, Kim HG, Yeo I, Ryu B, Park JW. Laminaria japonica combined with probiotics improves intestinal microbiota: a randomized clinical trial. J Med Food. 2014 Jan;17(1):76-82. doi: 10.1089/jmf.2013.3054. PubMed PMID: 24456357.

[351] Shahid MA, Sharma S. Physiology, Thyroid Hormone. [Updated 2019 Mar 23]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2019 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK500006/

[352] Combet E, Ma ZF, Cousins F, Thompson B, Lean ME. Low-level seaweed supplementation improves iodine status in iodine-insufficient women. Br J Nutr. 2014 Sep 14;112(5):753-61. doi: 10.1017/S0007114514001573. Epub 2014 Jul 9. PubMed PMID: 25006699.

[353] Bajaj JK, Salwan P, Salwan S. Various Possible Toxicants Involved in Thyroid Dysfunction: A Review. J Clin Diagn Res. 2016 Jan;10(1):FE01-3. doi: 10.7860/JCDR/2016/15195.7092. Epub 2016 Jan 1. Review. PubMed PMID: 26894086; PubMed Central PMCID: PMC4740614.

[354] Farebrother J, Zimmermann MB, Andersson M. Excess iodine intake: sources, assessment, and effects on thyroid function. Ann N Y Acad Sci. 2019 Jun;1446(1):44-65. doi: 10.1111/nyas.14041. Epub 2019 Mar 20. PubMed PMID: 30891786.

[355] Wang C, Yatsuya H, Li Y, Ota A, Tamakoshi K, Fujino Y, Mikami H, Iso H, Tamakoshi A; JACC Study Group. Prospective study of seaweed consumption and thyroid cancer incidence in women: the Japan collaborative cohort study. Eur J Cancer Prev. 2016 May;25(3):239-45. doi: 10.1097/CEJ.0000000000000168. PubMed PMID: 26011104.

[356] Chen A, Kim SS, Chung E, Dietrich KN. Thyroid hormones in relation to lead, mercury, and cadmium exposure in the National Health and Nutrition Examination Survey, 2007-2008. Environ Health Perspect. 2013 Feb;121(2):181-6. doi: 10.1289/ehp.1205239. Epub 2012 Nov 16. PubMed PMID: 23164649; PubMed Central PMCID: PMC3569681.

[357] Buha A, Matovic V, Antonijevic B, Bulat Z, Curcic M, Renieri EA, Tsatsakis AM, Schweitzer A, Wallace D. Overview of Cadmium Thyroid Disrupting Effects and Mechanisms. Int J Mol Sci. 2018 May 17;19(5). pii: E1501. doi: 10.3390/ijms19051501. Review. PubMed PMID: 29772829; PubMed Central PMCID: PMC5983752.

[358] Nie X, Chen Y, Chen Y, Chen C, Han B, Li Q, Zhu C, Xia F, Zhai H, Wang N, Lu Y. Lead and cadmium exposure, higher thyroid antibodies and thyroid dysfunction in Chinese women. Environ Pollut. 2017 Nov;230:320-328. doi: 10.1016/j.envpol.2017.06.052. Epub 2017 Jun 28. PubMed PMID: 28667913.

[359] Yorita Christensen KL. Metals in blood and urine, and thyroid function among adults in the United States 2007-2008. Int J Hyg Environ Health. 2013 Nov;216(6):624-32. doi: 10.1016/j.ijheh.2012.08.005. Epub 2012 Oct 6. PubMed PMID: 23044211.

[360] Zava TT, Zava DT. Assessment of Japanese iodine intake based on seaweed consumption in Japan: A literature-based analysis. Thyroid Res. 2011 Oct 5;4:14. doi: 10.1186/1756-6614-4-14. PubMed PMID: 21975053; PubMed Central PMCID: PMC3204293.

[361] Myers SP, Mulder AM, Baker DG, Robinson SR, Rolfe MI, Brooks L, Fitton JH. Effects of fucoidan from Fucus vesiculosus in reducing symptoms of osteoarthritis: a randomized placebo-controlled trial. Biologics. 2016 May 26;10:81-8. doi: 10.2147/BTT.S95165. eCollection 2016. PubMed PMID: 27307702; PubMed Central PMCID: PMC4887044.

[362] Myers SP, O'Connor J, Fitton JH, Brooks L, Rolfe M, Connellan P, Wohlmuth H, Cheras PA, Morris C. A combined phase I and II open label study on the effects of a seaweed extract nutrient complex on osteoarthritis. Biologics.

2010 Mar 24;4:33-44. PubMed PMID: 20376172; PubMed Central PMCID: PMC2846142.

[363] Brown ES, Allsopp PJ, Magee PJ, Gill CI, Nitecki S, Strain CR, McSorley EM. Seaweed and human health. Nutr Rev. 2014 Mar;72(3):205-16. Review. PubMed PMID: 24697280.

[364] Cardoso LCP, Pinto NB, Nobre MEP, Silva MR, Pires GM, Lopes MJP, Viana GSB, Rodrigues LMR. Anti-inflammatory and antinociceptive effects of phonophoresis in animal models: a randomized experimental study. Braz J Med Biol Res. 2019 Jan 24;52(2):e7773. doi: 10.1590/1414-431X20187773. PubMed PMID: 30698227; PubMed Central PMCID: PMC6345359.

[365] Bhatia S, Sharma K, Sharma A, Nagpal K, Bera T. Anti-inflammatory, Analgesic and Antiulcer properties of Porphyra vietnamensis. Avicenna J Phytomed. 2015 Jan-Feb;5(1):69-77. PubMed PMID: 25767759; PubMed Central PMCID: PMC4352535.

[366] Bhatia S, Sardana S, Senwar KR, Dhillon A, Sharma A, Naved T. In vitro antioxidant and antinociceptive properties of Porphyra vietnamensis. Biomedicine (Taipei). 2019 Mar;9(1):3. doi: 10.1051/bmdcn/2019090103. Epub 2019 Feb 22. PubMed PMID: 30794150; PubMed Central PMCID: PMC6385614.

[367] Zakaria A, Jais MR, Ishak R. Analgesic Properties of Nigella Sativa and Eucheuma Cottonii Extracts. J Nat Sci Biol Med. 2018 Jan-Jun;9(1):23-26. doi: 10.4103/jnsbm.JNSBM_131_17. PubMed PMID: 29456388; PubMed Central PMCID: PMC5812069.

[368] Vázquez AI, Sánchez CM, Delgado NG, Alfonso AM, Ortega YS, Sánchez HC. Anti-inflammatory and analgesic activities of red seaweed Dichotomaria obtusata. Braz J Pharm Sci. 2011;47:111–8.

[369] Abdelhamid A, Jouini M, Bel Haj Amor H, Mzoughi Z, Dridi M, Ben Said R, Bouraoui A. Phytochemical Analysis and Evaluation of the Antioxidant, Anti-Inflammatory, and Antinociceptive Potential of Phlorotannin-Rich Fractions from Three Mediterranean Brown Seaweeds. Mar Biotechnol (NY). 2018 Feb;20(1):60-74. doi: 10.1007/s10126-017-9787-z. Epub 2018 Jan 18. PubMed PMID: 29344826.

[370] Kim S, Choi SI, Kim GH, Imm JY. Anti-Inflammatory Effect of Ecklonia cava Extract on Porphyromonas gingivalis Lipopolysaccharide-Stimulated Macrophages and a Periodontitis Rat Model. Nutrients. 2019 May 22;11(5). pii: E1143. doi: 10.3390/nu11051143. PubMed PMID: 31121899; PubMed Central PMCID: PMC6566535.

[371] Ha JW, Song H, Hong SS, Boo YC. Marine Alga Ecklonia cava Extract and Dieckol Attenuate Prostaglandin E(2) Production in HaCaT Keratinocytes Exposed to Airborne Particulate Matter. Antioxidants (Basel). 2019 Jun 21;8(6). pii: E190. doi: 10.3390/antiox8060190. PubMed PMID: 31234405; PubMed Central PMCID: PMC6617419.

[372] Kim JG, Lim DW, Cho S, Han D, Kim YT. The edible brown seaweed Ecklonia cava reduces hypersensitivity in postoperative and neuropathic pain models in rats. Molecules. 2014 Jun 10;19(6):7669-78. doi: 10.3390/molecules19067669. PubMed PMID: 24918539; PubMed Central PMCID: PMC6271726.

[373] de Souza ET, de Lira DP, de Queiroz AC, da Silva DJ, de Aquino AB, Mella EA, Lorenzo VP, de Miranda GE, de Araújo-Júnior JX, Chaves MC, Barbosa-Filho JM, de Athayde-Filho PF, Santos BV, Alexandre-Moreira MS. The antinociceptive and anti-inflammatory activities of caulerpin, a bisindole alkaloid isolated from seaweeds of the genus Caulerpa. Mar Drugs. 2009 Nov 26;7(4):689-704. doi: 10.3390/md7040689. PubMed PMID: 20098607; PubMed Central PMCID: PMC2810220.

[374] Shih CC, Hwang HR, Chang CI, Su HM, Chen PC, Kuo HM, Li PJ, Wang HD, Tsui KH, Lin YC, Huang SY, Wen ZH. Anti-Inflammatory and Antinociceptive Effects of Ethyl Acetate Fraction of an Edible Red Macroalgae Sarcodia ceylanica. Int J Mol Sci. 2017 Nov 17;18(11). pii: E2437. doi: 10.3390/ijms18112437. PubMed PMID: 29149031; PubMed Central PMCID: PMC5713404.

[375] Sayed AA, Sadek SA, Solimán AM, Marzouk M. PROSPECTIVE EFFECT OF RED ALGAE, ACTINOTRICHIA FRAGILIS, AGAINST SOME OSTEOARTHRITIS AETIOLOGY. Afr J Tradit Complement Altern Med. 2016 Nov 23;14(1):231-241. doi: 10.21010/ajtcam.v14i1.25. eCollection 2017. PubMed PMID: 28480401; PubMed Central PMCID: PMC5411875.

[376] Albuquerque IR, Cordeiro SL, Gomes DL, Dreyfuss JL, Filgueira LG, Leite EL, Nader HB, Rocha HA. Evaluation of anti-nociceptive and anti-inflammatory activities of a heterofucan from Dictyota menstrualis. Mar Drugs. 2013 Aug 2;11(8):2722-40. doi: 10.3390/md11082722. PubMed PMID: 23917068; PubMed Central PMCID: PMC3766861.

[377] Coura CO, de Araújo IW, Vanderlei ES, Rodrigues JA, Quinderé AL, Fontes BP, de Queiroz IN, de Menezes DB, Bezerra MM, e Silva AA, Chaves HV, Jorge RJ, Evangelista JS, Benevides NM. Antinociceptive and anti-inflammatory activities of sulphated

polysaccharides from the red seaweed Gracilaria cornea. Basic Clin Pharmacol Toxicol. 2012 Apr;110(4):335-41. doi: 10.1111/j.1742-7843.2011.00811.x. Epub 2011 Nov 10. PubMed PMID: 21985563.

[378]de Sousa Oliveira Vanderlei E, de Araújo IW, Quinderé AL, Fontes BP, Eloy YR, Rodrigues JA, e Silva AA, Chaves HV, Jorge RJ, de Menezes DB, Evangelista JS, Bezerra MM, Benevides NM. The involvement of the HO-1 pathway in the anti-inflammatory action of a sulfated polysaccharide isolated from the red seaweed Gracilaria birdiae. Inflamm Res. 2011 Dec;60(12):1121-30. doi: 10.1007/s00011-011-0376-8. Epub 2011 Aug 31. PubMed PMID: 21879365.

[379]Florez N, Gonzalez-Munoz MJ, Ribeiro D, Fernandes E, Dominguez H, Freitas M. Algae Polysaccharides' Chemical Characterization and their Role in the Inflammatory Process. Curr Med Chem. 2017;24(2):149-175. doi: 10.2174/0929867323666161028160416. Review. PubMed PMID: 27804878.

[380]Wang L, Wang X, Wu H, Liu R. Overview on biological activities and molecular characteristics of sulfated polysaccharides from marine green algae in recent years. Mar Drugs. 2014 Sep 25;12(9):4984-5020. doi: 10.3390/md12094984. Review. PubMed PMID: 25257786; PubMed Central PMCID: PMC4178480.

[381]da Conceição Rivanor RL, Chaves HV, do Val DR, de Freitas AR, Lemos JC, Rodrigues JA, Pereira KM, de Araújo IW, Bezerra MM, Benevides NM. A lectin from the green seaweed Caulerpa cupressoides reduces mechanical hyper-nociception and inflammation in the rat temporomandibular joint during zymosan-induced arthritis. Int Immunopharmacol. 2014 Jul;21(1):34-43. doi: 10.1016/j.intimp.2014.04.009. Epub 2014 Apr 24. PubMed PMID: 24768528.

[382]Margret RJ, Kumaresan S, Ravikumar S. A preliminary study on the anti-inflammatory activity of methanol extract of Ulva lactuca in rat. J Environ Biol. 2009 Sep;30(5 Suppl):899-902. PubMed PMID: 20143726.

[383]Neelakandan Y, Venkatesan A. Antinociceptive and anti-inflammatory effect of sulfated polysaccharide fractions from Sargassum wightii and Halophila ovalis in male Wistar rats. Indian J Pharmacol. 2016 Sep-Oct;48(5):562-570. PubMed PMID: 27721544; PubMed Central PMCID: PMC5051252.

[384]Kim DH, Kim ME, Lee JS. Inhibitory effects of extract from G. lanceolata on LPS-induced production of nitric oxide and IL-1β via down-regulation of MAPK in macrophages. Appl Biochem Biotechnol. 2015 Jan;175(2):657-65. doi: 10.1007/s12010-014-1301-8. Epub 2014 Oct 24. PubMed PMID: 25342257.

[385]Kang JY, Khan MN, Park NH, Cho JY, Lee MC, Fujii H, Hong YK. Antipyretic, analgesic, and anti-inflammatory activities of the seaweed Sargassum fulvellum and Sargassum thunbergii in mice. J Ethnopharmacol. 2008 Feb 28;116(1):187-90. PubMed PMID: 18079077.

[386]Lin YY, Lin SC, Feng CW, Chen PC, Su YD, Li CM, Yang SN, Jean YH, Sung PJ, Duh CY, Wen ZH. Anti-Inflammatory and Analgesic Effects of the Marine-Derived Compound Excavatolide B Isolated from the Culture-Type Formosan Gorgonian Briareum excavatum. Mar Drugs. 2015 Apr 27;13(5):2559-79. doi: 10.3390/md13052559. PubMed PMID: 25923315; PubMed Central PMCID: PMC4446594.

[387]Ribeiro NA, Abreu TM, Chaves HV, Bezerra MM, Monteiro HS, Jorge RJ, Benevides NM. Sulfated polysaccharides isolated from the green seaweed Caulerpa racemosa plays antinociceptive and anti-inflammatory activities in a way dependent on HO-1 pathway activation. Inflamm Res. 2014 Jul;63(7):569-80. doi: 10.1007/s00011-014-0728-2. Epub 2014 Mar 16. PubMed PMID: 24632998.

[388]Hwang PA, Hung YL, Chien SY. Inhibitory activity of Sargassum hemiphyllum sulfated polysaccharide in arachidonic acid-induced animal models of inflammation. J Food Drug Anal. 2015 Mar;23(1):49-56. doi: 10.1016/j.jfda.2014.05.004. Epub 2014 Oct 29. PubMed PMID: 28911445.

[389]Lajili S, Deghrigue M, Bel Haj Amor H, Muller CD, Bouraoui A. In vitro immunomodulatory activity and in vivo anti-inflammatory and analgesic potential with gastroprotective effect of the Mediterranean red alga Laurencia obtusa. Pharm Biol. 2016 Nov;54(11):2486-2495. Epub 2016 Apr 20. PubMed PMID: 27096253.

[390]Matta, CBB, Cavalcante-SilvaLHA, Araújo-Júnior JX, MirandaGEC, Bastos KX, Souza JCF, Barbosa-Filho JM, SantosBVO, Alexandre-MoreiraMS. Antinociceptive and Anti-inflammatory Effects of Caulerpa kempfii (Caulerpaceae). Rev. Virtual Quim 2015;7 (2):730-743.

[391]Rodrigues JA, Vanderlei ES, Silva LM, Araújo IW, Queiroz IN, Paula GA, Abreu TM, Ribeiro NA, Bezerra MM, Chaves HV, Lima V, Jorge RJ, Monteiro HS, Leite EL, Benevides NM. Antinociceptive and anti-inflammatory activities of a sulfated polysaccharide isolated from the green seaweed Caulerpa cupressoides. Pharmacol Rep. 2012;64(2):282-92. PubMed PMID: 22661177.

[392]Frost I, Van Boeckel TP, Pires J, Craig J, Laxminarayan R. Global Geographic Trends in Antimicrobial Resistance: The Role of International Travel. J Travel Med. 2019 May 22. pii: taz036. doi: 10.1093/jtm/taz036. [Epub ahead of print] PubMed PMID: 31115466.

[393] Dixit A, Kumar N, Kumar S, Trigun V. Antimicrobial Resistance: Progress in the Decade since Emergence of New Delhi Metallo-β-Lactamase in India. Indian J Community Med. 2019 Jan-Mar;44(1):4-8. doi: 10.4103/ijcm.IJCM_217_18. PubMed PMID: 30983704; PubMed Central PMCID: PMC6437806.

[394] Lu WJ, Lin HJ, Hsu PH, Lai M, Chiu JY, Lin HV. Brown and Red Seaweeds Serve as Potential Efflux Pump Inhibitors for Drug-Resistant Escherichia coli. Evid Based Complement Alternat Med. 2019 Jan 1;2019:1836982. doi: 10.1155/2019/1836982. eCollection 2019. PubMed PMID: 30713568; PubMed Central PMCID: PMC6332956.

[395] Alves C, Silva J, Pinteus S, Gaspar H, Alpoim MC, Botana LM, Pedrosa R. From Marine Origin to Therapeutics: The Antitumor Potential of Marine Algae-Derived Compounds. Front Pharmacol. 2018 Aug 6;9:777. doi: 10.3389/fphar.2018.00777. eCollection 2018. Review. PubMed PMID: 30127738; PubMed Central PMCID: PMC6089330.

[396] Besednova N, Zaporozhets T, Kuznetsova T, Makarenkova I, Fedyanina L, Kryzhanovsky S, Malyarenko O, Ermakova S. Metabolites of Seaweeds as Potential Agents for the Prevention and Therapy of Influenza Infection. Mar Drugs. 2019 Jun 22; 17(6). pii: E373. doi: 10.3390/md17060373. Review. PubMed PMID: 31234532; PubMed Central PMCID: PMC6627559.

[397] Pérez MJ, Falqué E, Domínguez H. Antimicrobial Action of Compounds from Marine Seaweed. Mar Drugs. 2016 Mar 9;14(3). pii: E52. doi: 10.3390/md14030052. Review. PubMed PMID: 27005637; PubMed Central PMCID: PMC4820306.

[398] Walsh PJ, McGrath S, McKelvey S, Ford L, Sheldrake G, Clarke SA. The Osteogenic Potential of Brown Seaweed Extracts. Mar Drugs. 2019 Feb 28; 17(3). pii: E141. doi: 10.3390/md17030141. PubMed PMID: 30823356; PubMed Central PMCID: PMC6470556.

[399] Jacobsen C, Sørensen AM, Holdt SL, Akoh CC, Hermund DB. Source, Extraction, Characterization, and Applications of Novel Antioxidants from Seaweed. Annu Rev Food Sci Technol. 2019 Mar 25;10:541-568. doi: 10.1146/annurev-food-032818-121401. Epub 2019 Jan 23. PubMed PMID: 30673506.

[400] Chakraborty K, Dhara S. First report of substituted 2H-pyranoids from brown seaweed Turbinaria conoides with antioxidant and anti-inflammatory activities. Nat Prod Res. 2019 Mar 5:1-11. doi: 10.1080/14786419.2019.1578761. [Epub ahead of print] PubMed PMID: 30835545.

[401] Farasat M, Khavari-Nejad RA, Nabavi SM, Namjooyan F. Antioxidant Activity, Total Phenolics and Flavonoid Contents of some Edible Green Seaweeds from Northern Coasts of the Persian Gulf. Iran J Pharm Res. 2014 Winter; 13(1):163-70. PubMed PMID: 24734 068; PubMed Central PMCID: PMC3985267.

[402] Silva J, Alves C, Freitas R, Martins A, Pinteus S, Ribeiro J, Gaspar H, Alfonso A, Pedrosa R. Antioxidant and Neuroprotective Potential of the Brown Seaweed Bifurcaria bifurcata in an in vitro Parkinson's Disease Model. Mar Drugs. 2019 Feb 1; 17(2). pii: E85. doi: 10.3390/ md17020085. PubMed PMID: 30717087; PubMed Central PMCID: PMC 6410415.

[403] Cho SH, Kang SE, Cho JY, Kim AR, Park SM, Hong YK, Ahn DH. The antioxidant properties of brown seaweed (Sargassum siliquastrum) extracts. J Med Food. 2007 Sep;10(3):479-85. PubMed PMID: 17887942.

[404] Pinteus S, Silva J, Alves C, Horta A, Fino N, Rodrigues AI, Mendes S, Pedrosa R. Cytoprotective effect of seaweeds with high antioxidant activity from the Peniche coast (Portugal). Food Chem. 2017 Mar 1;218:591-599. doi: 10.1016/j.foodchem.2016.09.067. Epub 2016 Sep 10. PubMed PMID: 27719954.

[405] Sivagnanam SP, Yin S, Choi JH, Park YB, Woo HC, Chun BS. Biological Properties of Fucoxanthin in Oil Recovered from Two Brown Seaweeds Using Supercritical CO2 Extraction. Mar Drugs. 2015 May 29;13(6):3422-42. doi: 10.3390/md13063422. PubMed PMID: 26035021; PubMed Central PMCID: PMC4483637.

[406] Saravana PS, Cho YJ, Park YB, Woo HC, Chun BS. Structural, antioxidant, and emulsifying activities of fucoidan from Saccharina japonica using pressurized liquid extraction. Carbohydr Polym. 2016 Nov 20; 153:518-525. doi: 10.1016/j.carbpol.2016.08. 014. Epub 2016 Aug 7. PubMed PMID: 275 61524.

[407] Athiperumalsami T., Rajeswari V.D., Poorna S.H., Kumar V., Jesudass L.L. Antioxidant activity of seagrasses and seaweeds. Bot. Mar. 2010;53:251–257. doi: 10.1515/BOT.2010.032.

[408] Kar K, Sahoo SS, Kar B, Naik SK, PANDA PC. "Antioxidant Activity Of Halophila Ovalis And Halophila Beccarii (Hydrocharitaceae): Two Important Seagrass Species Of Chilika Lagoon, India". Asian Journal of Pharmaceutical and Clinical Research, Vol. 12, no. 3, Feb. 2019, pp. 136-40.

[409] Ammar HH, Hafsa J, Le Cerf D, Bouraoui A, Majdoub H. Antioxidant and gastroprotective activities of polysaccharides from the Tunisian brown algae (*Cystoseira sedoides*). Journal of the Tunisian Chemical Society , 2016 , 18 , 80 -88.

[410] Mhadhebi L, Laroche-Clary A, Robert J, Bouraoui A. Antioxidant, anti-inflammatory,

and antiproliferative activities of organic fractions from the Mediterranean brown seaweed Cystoseira sedoides. Can J Physiol Pharmacol. 2011 Dec;89(12):911-21. doi: 10.1139/y11-093. Epub 2011 Nov 24. PubMed PMID: 22115493.

[411] Murugan K, Iyer VV. Differential growth inhibition of cancer cell lines and antioxidant activity of extracts of red, brown, and green marine algae. In Vitro Cell Dev Biol Anim. 2013 May;49(5):324-34. doi: 10.1007/s11626-013-9603-7. Epub 2013 May 4. PubMed PMID: 23645467.

[412] Lee JW, Seok JK, Boo YC. Ecklonia cava Extract and Dieckol Attenuate Cellular Lipid Peroxidation in Keratinocytes Exposed to PM10. Evid Based Complement Alternat Med. 2018 Mar 6;2018:8248323. doi: 10.1155/2018/8248323. eCollection 2018. PubMed PMID: 29692858; PubMed Central PMCID: PMC5859842.

[413] Athukorala Y, Kim KN, Jeon YJ. Antiproliferative and antioxidant properties of an enzymatic hydrolysate from brown alga, Ecklonia cava. Food Chem Toxicol. 2006 Jul;44(7):1065-74. Epub 2006 Mar 3. PubMed PMID: 16516367.

[414] Dong X, Bai Y, Xu Z, Shi Y, Sun Y, Janaswamy S, Yu C, Qi H. Phlorotannins from Undaria pinnatifida Sporophyll: Extraction, Antioxidant, and Anti-Inflammatory Activities. Mar Drugs. 2019 Jul 24; 17(8). pii: E434. doi: 10.3390/md17080434. PubMed PMID: 31344874.

[415] Mesripour A, Rabian N, Yegdaneh A. The effect of different partitions of seaweed Sargassum plagyophylum on depression behavior in mice model of despair. J Complement Integr Med. 2019 May 24. pii: /j/jcim.ahead-of-print/jcim-2018-0207/jcim-2018-0207.xml. doi: 10.1515/jcim-2018-0207. [Epub ahead of print] PubMed PMID: 31125315.

[416] Farmer MA, Leja A, Foxen-Craft E, Chan L, MacIntyre LC, Niaki T, Chen M, Mapplebeck JC, Tabry V, Topham L, Sukosd M, Binik YM, Pfaus JG, Mogil JS. Pain reduces sexual motivation in female but not male mice. J Neurosci. 2014 Apr 23;34(17):5747-53. doi: 10.1523/JNEUROSCI.5337-13.2014. PubMed PMID: 24760835; PubMed Central PMCID: PMC3996207.

[417] Mahadevan K. Seaweeds: a sustainable food source, In: Sirpa Sarlio. Towards Healthy and Sustainable Diets: Perspectives and Policy to Promote the Health of People and the PlanetSpringerBriefs in Public Health. Publisher: Springer, 2018 ISBN3319742043, 9783319742045

[418] Roby Jose Ciju. Seaweeds as Vegetables. Publisher: AGRIHORTICO, 2019.

[419] Philippines. Ministry of Natural Resources. Guide to Philippine Flora and Fauna, Volume 1Guide to Philippine Flora and Fauna, Natural Resources Management Center (Filipinas). Publisher: Natural Resources Manegement Center, Ministry of Natural Resources: University of the Philippines, 1986ISBN9711026198, 9789711026196

[420] Liu X, Wang S, Cao S, He X, Qin L, He M, Yang Y, Hao J, Mao W. Structural Characteristics and Anticoagulant Property In Vitro and In Vivo of a Seaweed Sulfated Rhamnan. Mar Drugs. 2018 Jul 20;16(7). pii: E243. doi: 10.3390/md16070243. PubMed PMID: 30037033; PubMed Central PMCID: PMC6070894.

[421] Adrien A, Bonnet A, Dufour D, Baudouin S, Maugard T, Bridiau N. Anticoagulant Activity of Sulfated Ulvan Isolated from the Green Macroalga Ulva rigida. Mar Drugs. 2019 May 14;17(5). pii: E291. doi: 10.3390/md17050291. PubMed PMID: 31091758; PubMed Central PMCID: PMC6562387.

[422] Mendes Marques ML, Presa FB, Viana RLS, Costa MSSP, Amorim MOR, Bellan DL, Alves MGCF, Costa LS, Trindade ES, Rocha HAO. Anti-Thrombin, Anti-Adhesive, Anti-Migratory, and Anti-Proliferative Activities of Sulfated Galactans from the Tropical Green Seaweed, Udotea flabellum. Mar Drugs. 2018 Dec 21;17(1). pii: E5. doi: 10.3390/md17010005. PubMed PMID: 30577590; PubMed Central PMCID: PMC6356399.

[423] Jiao G, Yu G, Zhang J, Ewart HS. Chemical structures and bioactivities of sulfated polysaccharides from marine algae. Mar Drugs. 2011 Feb 8;9(2):196-223. doi: 10.3390/md9020196. Review. PubMed PMID: 21566795; PubMed Central PMCID: PMC3093253.

[424] Carvalhal F, Cristelo RR, Resende DISP, Pinto MMM, Sousa E, Correia-da-Silva M. Antithrombotics from the Sea: Polysaccharides and Beyond. Mar Drugs. 2019 Mar 16;17(3). pii: E170. doi: 10.3390/md17030170. Review. PubMed PMID: 30884850; PubMed Central PMCID: PMC6471875.

[425] He X, Zang J, Liao P, Zheng Y, Lu Y, Zhu Z, Shi Y, Wang W. Distribution and Dietary Predictors of Urinary Phthalate Metabolites among Pregnant Women in Shanghai, China. Int J Environ Res Public Health. 2019 Apr 16; 16(8). pii: E1366. doi: 10.3390/ijerph16081366. PubMed PMID: 30995748; PubMed Central PMCID: PMC6518169.

[426] Gomes DL, Melo KRT, Queiroz MF, Batista LANC, Santos PC, Costa MSSP, Almeida-Lima J, Camara RBG, Costa LS, Rocha HAO. In Vitro Studies Reveal Antiurolithic Effect of Antioxidant Sulfated Polysaccharides from the Green Seaweed Caulerpa cupressoides var

flabellata. Mar Drugs. 2019 Jun 1; 17(6). pii: E326. doi: 10.3390/md17060326. PubMed PMID: 31159355; PubMed Central PMCID: PMC6628234.

[427] Kang JI, Kim SC, Han SC, Hong HJ, Jeon YJ, Kim B, Koh YS, Yoo ES, Kang HK. Hair-Loss Preventing Effect of Grateloupia elliptica. Biomol Ther (Seoul). 2012 Jan;20(1):118-24. doi:10.4062/biomolther.2012.20.1.118. Pub Med PMID: 24116284; PubMed Central PMCID: PMC3792195.

[428] Machado LP, Matsumoto ST, Jamal CM, da Silva MB, Centeno Dda C, Colepicolo Neto P, de Carvalho LR, Yokoya NS. Chemical analysis and toxicity of seaweed extracts with inhibitory activity against tropical fruit anthracnose fungi. J Sci Food Agric. 2014 Jul; 94(9):1739-44. doi: 10.1002/jsfa.6483. Epub 2013 Dec 18. PubMed PMID: 24255023.

[429] El Amrani Zerrifi S, Tazart Z, El Khalloufi F, Oudra B, Campos A, Vasconcelos V. Potential control of toxic cyanobacteria blooms with Moroccan seaweed extracts. Environ Sci Pollut Res Int. 2019 May;26(15):15218-15228. doi: 10.1007/s11356-019-04921-9. Epub 2019 Mar 29. PubMed PMID: 30927222.

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