Chemical composition of *Sargassum* and *Padina* -marine algae and their *In Vitro* effect on water quality of fishpond

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Abstract: The chemical analysis of *Sargassum aquifolium* and *Padina boergesenii* macro-algae were determined besides evaluating their impact on fish water quality. Fresh algal samples were collected from the National Institute of Oceanography and Fisheries in Egypt during winter-spring. Moisture, total protein, lipids, carbohydrates, fibers, and ash levels were determined. The effect of macro-algae on the water quality of a high ammonia content solution was studied in triplicate with three treatments utilizing seawater containing ammonia of 0.428 ppm and the algae were added daily for successive days: The first treatment was supplied with 0.25 g of the dried *S. aquifolium* per day, the second treatment was supplied with 0.25 g *P. boergesenii* per day, and the third tank served as a control. Regarding the influence of macro-algae on NH_3 concentration, the *S aquifolium* group demonstrated the lowest significant value on the first day, followed by *P. boergesenii*. There was a significant negative correlation between NH_4 and salinity, and a positive correlation between NH_3 and NH_4, with all treatments showing a clear correlation between NH_3 and pH, providing valuable insights into the potential impacts of algae on fish habitats.

Keywords: *Sargassum*, *Padina*, macro-algae, water quality.

INTRODUCTION

The global production of seaweeds has tripled from 10.6 million tons in 2000 to 32.4 million tons in 2018 (ACTION, 2020). The production of macroalgae is currently approximately 35 million tons in 2020 (FAO, 2022). Of the total seaweed harvest, farmed seaweeds account for 97.1% of the crop, while wild-collected seaweeds account for 2.9%, and about 99% of it is directly eaten as food (Dillehay *et al.,* 2008). Food supplements, feed additives, cosmetics, medicines, fertilizers, and energy generation are just a few of the commercial applications for macroalgae. They are also employed as notably integrated multi-trophic aquaculture (IMTA), primary producers and feed additives in aquaculture. The brown macroalga genus (Sargassum) occurs in warm and temperate seas (Cheang *et al.,* 2008) and its beds provide essential environments for marine creatures, microalgae, and other seaweeds (Komatsu *et al.,* 2014). It also has long been commercially significant as human food and medicine, with potential uses in fertilizer (Kumari *et al.,* 2013), animal feed, and bioactive chemical extraction (Milledge *et al.,* 2016). *Sargassum* spp. is a source of bioactive chemicals and functional ingredients that may be employed as entire seaweed or as individual components in food and feed applications (Balboa *et al.,* 2022) with high antioxidant effects (Arguelles and Sapin, 2020). *Padina* is a brown seaweed in the Dictyotaceae family, with 43 species recognized (Kumar and Sudha, 2012). It grows in tropical and subtropical seas (Rajamani *et al.,* 2015) which is an essential source of mannitol and iodine. Phenolic compounds in Padina play a crucial role in food color, nutritional quality (Fleurence and Levine, 2016), and antioxidant activity (Kumar and Sudha, 2012). The partial substitution or inclusion of different percentages of macro-algae into the diet of fish showed promising results improving productive parameters in fish (i.e., growth rates), stimulating the appetite, enhancing tonicity beside fish health, as well as exhibiting antimicrobial and immune-stimulant properties (Afonso and da Silva Mouga, 2019) At the same time that provide oxygen to seawater via photosynthesis, improve the respiration of cultivated animals, and are considered the most important component of the marine food chain because they are primary producers. Worldwide fish production in 2018 was predicted to be 179 million tons with aquaculture contributing approximately 82 million tons and accounting for 46% of overall production FAO (2020). The use of algae in aquaculture adds many benefits to the water used by improving the environmental and nutritional status (El-Sayed *et al.,* 2010), Kim, (2011) has stated that a variety of macroalgae species are extremely beneficial in their systems, lowering phosphate (PO_4) and nitrate (NO_3) levels and providing food for herbivores. Gani *et al.* (2016) suggested that algae cultivation combined with aquaculture or co-cultivation methods saves energy, space, chemicals, and money while improving water quality in terms of dissolved oxygen (DO), total organic carbon (TOC), ammonia, phosphate, nitrite, nitrate, and other parameters. The current work was conducted aiming at the evaluation of the potential effect of macroalgae addition on the water quality of fishponds.

MATERIALS AND METHODS

Experiment 1:

Algae Samples: Fresh algal samples of *Sargassum aquifolium* and *Padina boergesenii* (Fig. 1) were collected from the National Institute of Oceanography and Fisheries (NIOF); Hurghada District, Red Sea Governorate, Egypt (27 o 17\ 13\\ N and longitudes 33° 46\ 21\\ E) with a salinity of 44 ppt during winter-spring (June, 2021). Both algae were identified according to

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Aleem (1978). The collected algal samples were cleaned using seawater to remove impurities, rinsed with tap water, and sun-dried (shade-dried) for five days. The dried samples were then powdered in a mixer grinder and stored at -4 ºC until use (Negm *et al*., 2021).

Fig. 1: a- *Sargassum aquifolium* and b- *Padina boergesenii*

Chemical analyses: The collected algae were analyzed (on a dry weight basis) for determination of some nutritional values including moisture, total protein, fats, carbohydrates, fibers, and ash content. The chemical composition of the samples was determined according to. the adopted methods by AOAC (2005). The moisture content was performed under controlled conditions at 105 *°C* to drive out all free moisture. The percentage of moisture content of the original sample was calculated using the original wet weight and the ultimate dry weight (AOAC, 2005). Total protein content was determined based on the Kjeldahl method. Distillation was performed using a Vapodest 20s Distillation unit, Protein was calculated as total nitrogen (T.N) x 6.25 (Ma and Zauzag, 1942). Total lipids content was determined using the Soxhlet extraction method (AOAC, 2005) using n-hexane: isopropanol solvent mixture (3:2, v:v). Total carbohydrates were spectrophotometrically estimated according to by phenol sulfuric method (Dubois *et al*., 1951). The crude fiber was determined according to the method described by Helrich, 1990). Samples were ashed by burning in a muffle furnace (Vulcan, USA) at 500 *°C* / 6hrs. The obtained ash was dissolved and quantitatively transferred using 2.0N HCl to define volume and then filtrated over ashless filter paper which will be ready to determine the ash fraction (minerals). Minerals including K, Ca and Na, were determined by Flame Emission spectrophotometer, while Fe, Zn, Cu, Mn, Pd, Cd, Co, Ni, Mg, and Se were measured by Atomic Absorption spectrophotometry (Chapman and Pratt, 1962).

Experiment 2:

***In vitro* evaluation of algae on water quality:** The experiment was designed in triplicate with three treatments using a 15 L capacity tanks containing 10 L of seawater (Ammonia of 0.428 ppm and salinity of 44.25 ppt) and the algae were added daily for successive days which were divided as follows: The first treatment was supplied with 0.25 g/L of the dried macroalgae *S. aquifolium* per day, the second treatment was supplied with 0.25 g/L *P. boergesenii* macroalgae per day, and the third tank served as a negative control without any addition of algae. The concentration of the used algae (15%) in the *In-vitro* trial was calculated based on the feeding 4.5% weight of the fish (3.6 g weight) and then multiplied by 10 (fish no. of each aquarium). The water quality parameters were measured according to APHA (1998). They include Oxidation-reduction potential (ORP); temperature, salinity, acid reaction (pH), and dissolved oxygen (DO). Parameters were measured using portable apparatus (HI 9829) Multi parameters, Hanna Instruments Inc., Woonsocket, Rhode Island, 02895, USA. Ammonia (NH_3) was spectrophotometrically determined (1100 Techocomp UV/Visible Spectrophotometer) according to the phenate method (Koroleff, 1976) at 630 nm.

RESULTS

Experiment 1:

Chemical composition of Sargassum aquifolium and *Padina boergesenii* : In this context, Table (1) summarizes the bio-nutritional content of *Sargassum aquifolium* and *Padina boergesenii* in terms of moisture, protein, fat, carbohydrate, and fibers. Biochemical analysis of the two used algae revealed that *Sargassum aquifolium* is relatively higher in moisture content (6.6%) compared with *Padina boergesenii* (5.8%); but it is not a perishable product, where it was still fresh and flavorful during long process (3 days) in the cool box. In contrast, protein content of *P. boergesenii* was higher (8.73%) as compared with those of *S. aquifolium* (5.90%). The total carbohydrate content of the *S. aquifolium* was 37.30%. On the other hand, the carbohydrate content of *P. boergesenii* was 31.89%. The fiber content was 7.30 and 10.18% of *S. aquifolium* and *Padina boergesenii*, respectively. In the current study, the minerals content (Table 2) revealed that *Sargassum* spp. has a substantial content of minerals such as nitrogen, potassium, sodium, calcium, magnesium, iron, zinc, copper and manganese. The principal mineral content of *S. aquifolium* in this study was Magnesium (1.18%), which was the most abundant element in the seaweed, followed by nitrogen 0.94%, potassium 0.75%, calcium 0.72%, and sodium 0.48%). The studied *P. boergesenii*, on the other hand, had a composition of (Nitrogen 1.40%, which was the most prevalent element in the seaweed, followed by Magnesium 0.91%, Calcium 0.82%, Sodium 0.72%, and Potassium 0.33%) correspondingly.

Table (1): Biochemical analysis (%) of *Sargassum aquifolium* and *Padina boergesenii*

Alga	N	K	Na	Ca	Mg	Fe	Zn	Cu	Mn
	Macro minerals (%)					Trace minerals (ppm)			
S. aquifolium	0.94	0.75	0.48	0.72	1.18	2592.9	13.81	140.7	6365.5
P. boergesenii	1.40	0.33	0.72	0.82	0.91	1469.9	8.59	242.7	1108.5

Table (2): Ash fraction of *Sargassum aquifolium* and *Padina boergesenii*

Alga	F.W (g)	Moist. (%)	D.W (g)	Prot. (%)	Oil (%)	CHO (%)	Fiber (%)
S. aquifolium	845	6.60	93.40	5.90	4.0	37.30	7.30
P. boergesenii	875	5.80	94.20	8.73	2.0	31.89	10.18

F.W= fresh weight, Moist= moisture, D.W= dry weight, Prot. = protein and CHO= carbohydrates

Experiment 2.

Effect of the *S. aquifolium* and *P. boergesenii* macro-algae on aquaculture water quality: Table (3) shows the effect of adding 0.25 $g.d^{-1}$ of the dried macroalgae (*S. aquifolium* and *P. boergesenii*) for three successive days on 10 liters of aquaculture water tank which has a higher concentration of un-ionized ammonia (0.428 $mg.l^{-1}$ NH_3) and its effect on some other water quality parameters such as (NH_3, NH_4, ORP, Temperature, Salinity, pH and DO) comparing with the control tank. On day zero, there was no significant difference between the treatments, although the temperature in the *P. boergesenii* tank was the highest at 21.18 ^oC. Regarding the effect of macroalgae on NH_3 concentration, there was no significant difference between the different treatments at day zero, while a gradual decrease from zero to the 3rd day was observed in the control group (0.428, 0.318, 0.228 then 0.222 $mg.l^{-1}$). The opposite pattern was observed in the other treatments. Concerning the first-day effect between the different treatments, the *S. aquifolium* (0.171$mg.l^{-1}$) group showed the lowest significant *(P<0.01)* value, followed by *P. boergesenii.* On the second day*, S. aquifolium continue* to have the lowest significant *(P<0.01)* value. On the other hand, *P. boergesenii* had the highest significant *(P<0.01)* value. On the third day, the lowest value was recorded in the control group, followed by *S. aquifolium.* The Oxidation Reduction Potential (ORP) which reflects the reduction potential of water. While the ORP value of day zero was the same for the three groups, its value on the first day was the highest significant (P<0.01) value among treatments in the *P. boergesenii* (107.10 mV) followed *by S. aquifolium (*106.40 mV). But the ORP measurement of control (103.50 mV) was the lowest significant (P<0.01) value between treatments. Then the ORP measurement showed a gradual decline in the three groups on days two and three. The ORP on the third-day record of *P. boergesenii* (53.80 mV) was the highest significant (P<0.01) value between treatments. In contrast, the ORP parameter value of *S. aquifolium* was 36.60 mV which was considered the lowest significant (P<0.01) value between treatments. During the experimental period and regarding temperature, the *P. boergesenii* group revealed the highest significant value (P<0.01) all over the experimental days. Additionally, the other treatments showed an increase in the temperature during day one then followed by fluctuation on day 3. As for the measured salinity during the experimental period, the *P. boergesenii* group revealed the highest significant value (P<0.01) all over the experimental days, However, the other treatments all over the experimental days showed a gradual increase with values of control and *S. aquifolium* no significant difference among them. The measured pH values revealed that all the treatments had no significant changes in pH values between zero and the first day. On the second day, the control had the highest significant (P<0.01) pH value, followed by the other treatments; the same trend was found on day three of the experiment. While the DO value on day zero was the same for all three groups, there was a significant difference (P<0.01) between treatments as the DO value in the control group was the highest, followed by *S. aquifolium* and finally *P. boergesenii* across the three consecutive days of the experiment. The associations between macroalgae (*S. aquifolium* and *P. boergesenii*) and some water quality measures (*in vitro* experiment) are shown in Table (4). In all three treatments, there was a highly significant positive correlation between NH_3 and NH_4. In the control group, there was a positive connection between NH_4 and ORP, which was reversed in the other treatments. Furthermore, there was a strong negative link between NH_4 and salinity, which turned into a positive association in the other treatments. A direct relationship between NH_3 and pH was seen in all treatments, which was significant in both algal treatments but not in the control group.

Table (3): In vitro evaluation of dried macroalgae on some water quality

Days		Day0		Day1		Day2		Day3	
Parameters	Treatments	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error
NH_3	Control	0.428	0.001	0.318^{a}	0.000	0.228^{b}	0.000	0.222^{c}	0.002
	Sargassum	0.427	0.001	0.171^{c}	0.000	0.205^{c}	0.000	0.273^{b}	0.001
	Padina	0.428	0.001	0.223^{b}	0.001	0.276^{a}	0.001	0.368^{a}	0.000
NH_4	Control	7.250	0.004	8.360^{a}	0.049	5.990^{b}	0.004	5.830^{c}	0.020
	Sargassum	7.238	0.003	4.520^{c}	0.020	5.423^{c}	0.092	7.180^{b}	0.012
	Padina	7.247	0.005	5.113^{b}	0.006	6.327^{a}	0.012	7.340^{a}	0.008
ORP	Control	67.067	0.047	103.500^{c}	0.041	63.500^{c}	0.082	45.600^{b}	0.159
	Sargassum	67.003	0.039	106.400^{b}	0.041	74.200^{a}	0.041	36.600^{c}	0.122
	Padina	67.000	0.000	107.100^{a}	0.041	70.800^{b}	0.041	53.800^{a}	0.065
Temp	Control	20.293^{b}	0.002	20.290^{b}	0.029	19.800^{b}	0.020	19.930^{c}	0.007
	Sargassum	20.310^{b}	0.004	20.520^{b}	0.073	19.880^{b}	0.012	20.180^{b}	0.008
	Padina	21.183^{a}	0.006	22.750^{a}	0.037	22.670^{a}	0.053	23.860^{a}	0.012
Salinity	Control	44.250	0.020	43.213^{b}	0.027	44.373^{b}	0.010	44.833^{b}	0.006
	Sargassum	44.250	0.020	43.210^{b}	0.016	44.053^{c}	0.018	44.880^{b}	0.037
	Padina	44.256	0.002	44.130^{a}	0.016	45.040^{a}	0.016	45.960^{a}	0.012
pH	Control	8.167	0.062	7.970	0.008	8.070^{a}	0.012	8.020^{a}	0.008
	Sargassum	8.223	0.088	8.003	0.047	7.980^{b}	0.008	7.980^{b}	0.008
	Padina	8.200	0.041	7.970	0.012	7.960^{b}	0.008	7.873^{c}	0.006
DO	Control	4.757	0.045	3.780^{a}	0.037	4.090^{a}	0.024	4.760^{a}	0.008
	Sargassum	4.747	0.084	3.583^{b}	0.006	3.327^{b}	0.029	2.910^{b}	0.016
	Padina	4.740	0.020	3.290^{c}	0.004	2.063^{c}	0.014	2.560^{c}	0.004

Means with a different superscript letter within the same column are significantly differ at ($P<0.01$)

DISCUSSION

Seaweeds are macroscopic in structure, naturally available, and can be cultivated in a large region of low tide seashores, they utilize natural nutrients available in the sea for their growth (Sudhakar *et al*., 2019). Furthermore, they are a rich source of important nutrients, making them suitable as feed supplements (Fiedor and Burda, 2014). Moisture is a quality element that provides information about the preservation or shelf life of specific products and has a substantial influence on the stability of food materials (Arguelles and Martinez-Goss, 2021). Generally, protein content of *Sargassum* spp. varied from 3.0 to 11.0%. Of these, 5.33% *of S. hemiphyllum* (Balboa *et al*., 2022); 4.38% of *S. latifolium* (Ibrahim *et al*., 2020); 3.50% of *S. aspirofolium* and 5.31% of *S. muticum* (Fouda *et al*., 2019), and 5.40% of *S. aquifolium* (El-Manawy *et al*., 2019) were reported. According to Dewinta *et al*., (2020), the highest protein levels were attained in the winter and spring, while the lowest protein levels were obtained during the summer. Differences in seaweed species and season time, when the sample was obtained, might impact the lowest protein content of *Sargassum* (Fleurence, 1999). The important nutritional components make both types of marine algae (*N. oculata* and *U. lactuca*) distinct sources of nutritional value, fiber, protein and essential amino acids, especially lysine, threonine and isoleucine in addition to both glutamic and aspartic acid (Huda *et al*., 2023); however, the relatively moderate protein (7.06 %) content of *Enteromorpha* sp. is associated with high carbohydrate content (51.57%) as reported by El-Sayed *et al*. (2017). As for oil content, 4.0 and 2.0% of oil content was obtained from S. aquifolium and *P. boergesenii* biomass, respectively. The content of S. aquifolium was higher than those reported for *S hemiphyllum* (3.06%), *S. aquifolium* (3.1%) by El-Manawy *et al*. (2019), in addition to, *S muticum* (1.6%) (Balboa *et al*., 2016). On the other hand, it was less than that observed for *S. henslowianum* (4.56%) and *S. patens* 6.15% (Wong and Cheung, 2001). The other collected alga *P. boergesenii* resulted 2% of lipid content which was higher than 1.28% *of Padina*

gymnospora (Nazarudin *et al*., 2022), 1.14% of *Padina tetrastomatica* (Manteu *et al*., 2018) and 1.43% of *Padina vickersiae* (Behairy and El-Sayed, 1983). Schmid *et al*. (2014) reported that seaweeds have low amounts of lipids, varying from 0.92 to 5.0 % of their dry weight. Although the lipid content of brown seaweeds is typically lower (0.3–6.0%) (Milledge *et al*., 2014), In colder areas, brown seaweed may have increased lipid content. (Susanto *et al*., 2016). Recorded result of the total carbohydrate content of the *S. aquifolium* was closed to that reported by Fouda *et al*. (2019) and Ibrahim *et al*. (2020) for *S. ilicifolium* (38.72%); *S. aspirofolium* (39.25%), and *S. latifolium*

Table (4): Correlations coefficient between macroalgae and water parameters

Treatment		NH_3	NH_4	ORP	Temp	Salinity	pH	DO
Control	NH_3	1	0.639**	0.369	0.853**	-.369	.476	.200
	NH_4		1	.924**	.883**	-.928-**	-.162	-.508-*
	ORP			1	.642**	-.998-**	-.314	-.792-**
	Temp				1	-.649-**	.081	-.069
	Salinity					1	.340	.778**
	pH						1	.428
	DO							1
S. aquifolium	NH_3	1	.833**	-.455	.068	.497	.683**	.731**
	NH_4		1	-.862-**	-.163	.876**	.377	.239
	ORP			1	.441	-.995-**	-.011	.260
	Temp				1	-.469	.130	.333
	Salinity					1	.039	-.207
	pH						1	.783**
	DO							1
P. boergesenii	NH_3	1	.922**	-.765-**	-.365	.217	.502*	.553*
	NH_4		1	-.953-**	-.063	.554*	.203	.189
	ORP			1	-.144	-.739-**	.029	.111
	Temp				1	.768**	-.933-**	-.792-**
	Salinity					1	-.660-**	-.645-**
	pH						1	.839**
	DO							1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

(41.42%). On the other hand, the carbohydrate content of *P. boergesenii* was higher than that reported by El-Manawy *et al*. (2019) and less than that of *P. gymnospora* (36.16%) which determined by Nazarudin *et al*. (2022). Carbohydrates are the most important biochemical ingredient in algae since they provide the energy for the metabolic process (Wells *et al*., 2017). *Sargassum* species are high in sulphated polysaccharides, which serve as a feed attractant. It contains alginates that can improve feed stability (Hashim and Saat, 1992). The fiber content of *S. aquifolium* reached was greater than *S. polycystum* fiber content of 6.52% and *S. oligocystum* fiber content of 6.49% (Manteu *et al*., 2018). While the examined *Padina boergesenii* had a higher fiber content than *Padina vickersiae* (9.75%) and a lesser proportion than *Padina gymnospora* (12.48%) reported by (Behairy and El-Sayed, 1983). Seaweed dietary fibers have been shown to have anti-tumor, anti-mutagenic, antioxidant, and anti-coagulant properties, as well as a significant function in lipid metabolism (Magura, 2015). It was reported that potassium is the most abundant element in the seaweed which reached 4170 mg/100 g dry weight, followed by sodium (3250mg/100g); phosphorus (120 mg/100g), and calcium (66.98 mg/100g) (Peng *et al*., 2012). Magnesium is an important intracellular mineral that is required for numerous physiological processes in the body. It forms a key complex with ATP and plays a key role in several crucial biological processes such as protein synthesis, cell replication, and energy metabolism. Magnesium is an essential intracellular signaling chemical that regulates ion channels, is involved in nerve conduction, proper muscle contraction, potassium transport, and modulates oxidative phosphorylation. Extracellular magnesium is necessary for appropriate nerve transmission, muscle function, and skeletal tissue metabolism. It has an essential effect on the respiratory adaption of freshwater fish (Lall and Kaushik, 2021). The magnesium requirements of most farmed fish species range from 0.4 to 0.6 g. kg^{-1}diet (Lall, 2022). Calcium plays an important role in numerous physiological functions, including muscular contraction, intracellular messaging, and reproduction (Loewen *et al*., 2016). A low

concentration of calcium (0.34 % or less) is required in the diet of carp, red sea bream, tilapia, and chum salmon (Dougall *et al*., 1996). *S. aquifolium* has a trace mineral value content of 6365.46 µg/L for Manganese, followed by iron 2592.87 µg/l, copper 140.65 µg/l, and zinc 13.81 µg/l, whereas *P. boergesenii* has Iron 1469.87 µg/l, Manganese 1108.46 µg/L, Copper 242.65 µg/L, and Zinc 8.59 µg/l Furthermore, Peng *et al*. (2012) cultivated *Sargassum naozhouense* and reported the following trace elements: Iron (147 mg/100 g) was the most abundant trace element, followed by Zn (9.08 mg/100 g), Mn 5.84 mg/100 g, Cu 0.36 mg/100 g, and Cd 0.17 mg/100 g. In addition, they suggested that grown *Sargassum naozhouense* might be utilized as a dietary supplement to meet daily requirements for trace elements (*e.g*., iron, zinc). Manganese plays a significant role in protein and energy metabolism, bone mineralization, glycosaminoglycan synthesis, cellular defense against free radicals, and metabolic regulation (Aschner and Aschner, 2005). The essentiality of Mn in the above biochemical processes is based on its function as an enzyme activator and constituent of several metalloenzymes (Prashanth *et al*., 2015). Many enzymes activated by Mn, it is efficiently absorbed from the diet, but the absorption may be reduced by high levels of phytate (Lall, 2022). Manganese requirements of fish range from 2.5 to 25 $mg.kg^{-1}$ diet (Lall and Kaushik, 2021). Zinc is the second most prevalent trace element, after Fe, and is needed for all cells in most living organisms (Silva *et al*., 2019). The catalytic role of Zn is essential for the biological function of more than 300 enzymes (McCall *et al*., 2000). Zinc is essential for the structural and functional integrity of more than 2000 transcription factors, and almost every signaling and metabolic pathway is dependent on one or more zinc-requiring proteins (Council, 2011). Zn requirements of several fish species showed estimates ranging from 33.5–64.6 mg kg^{-1}. (Lall and Kaushik, 2021). Iron is one of the most investigated essential trace elements and is present in all body cells of vertebrates (Council, 2011). It is essential for the functioning of several biochemical processes, which include the electron transfer reaction, gene regulation, oxygen binding and transport, and cell growth and differentiation regulation. (Lall and Kaushik, 2021). Although fish gills play a key role in Fe acquisition, the uptake is relatively low(Cooper and Bury, 2007). Like other trace elements, the gastrointestinal tract is considered the major route of Fe absorption (Whitehead *et al*., 1996). The uptake of Fe from natural waters is considered low. The Fe requirement reported for certain fish species ranges from 30–170 mg kg^{-1} diet (Bury *et al*., 2003; Lall and Kaushik, 2021). Copper is widely accepted, and Cu is a necessary trace element for the cellular functioning of all living species. Fish absorb Cu through their gills and digestive tract; however, the diet is regarded as a key source of Cu for growth, development, and critical physiological processes (Bury *et al*., 2003). The different contents between the examined macroalgae and other macroalgae in the studies could be explained by considering the seasons, salinity, water turbidity, and temperature. The difference in environmental factors (for example, temperature), nutrients, radiation, tide level, wave motion, shading, a combination of light and oxygen concentration, the reduction of carbon dioxide by photosynthesis, and the degradation of organic matter all have a significant impact on the nutrients transported to the surface water and, as a result, the metabolism of marine algae photosynthesis, reproduction, and growth (Ji *et al*., 2016). Water quality is one of the most pressing issues in aquaculture, whereas ammonia production is a big challenge on fish performance and production. The pH is another essential environmental factor for aquatic plants' metabolism, physiology, chemical processes, growth, and survival (Novakovskaya *et al*., 2020). The DO in mangrove regions is lower than that of the open sea due to the high content of organic matter in mangrove regions (Rashedy *et al*., 2023). The highest median was reported at the location due to the mineralization of ammonia from dead sea grass and oxidation of the organic matter from dead plants and animals associated with mangrove trees at this site (Vasudevan *et al*., 2012). Besides being cultivated for food or supplements, Marine macroalgae can be used to improve water quality. Seaweeds absorb dissolved inorganic nitrogen and phosphorous from sea water (Kim *et al*., 2014). Ammonia is the second critical water quality parameter affecting fish after dissolved oxygen, particularly in intensive culture systems (Datta, 2012). Even in small amounts, ammonia can cause stress, and damage gills and other tissues **(**Francis-Floyd *et al*., 2009). Results indicated different patterns in ammonia levels, whereas adding macro algae reduced ammonia after 24 hours, then ammonia increased with the addition of the algae at the second and third days. This could be explained in the light of that algae had a beneficial effect, but when levels increased, the dead algae increased the organic compounds load at the water, which in turn increased the decomposition and shared in increasing ammonia levels. This confirms that a monitoring routine of levels of algae in the fishponds should be established in aquaculture to prevent increasing ammonia levels from algae decomposition. These results agree with those mentioned by Buchsbaum *et al*. (1991 and Bourguès *et al*. (1996) who demonstrated that macroalgae degrade faster than sea grasses and higher plants, releasing both inorganic nutrients and organic Nitrogen.

CONCLUSION

The effect of algae species on the ammonia levels in marine water was investigated in the study. The findings indicated that using macro algae as a feed additive led to the reduction of ammonia levels after the first day, however, further addition of macro algae during the second and third days caused a significant elevation in ammonia levels. This shows that while algae may have had some positive effects, their abundance also raised the burden of organic matter in the water, due to their decomposition which increased ammonia levels. It is therefore recommended to set up a regular monitoring routine in aquaculture.

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المستخلص: تم إجراء التحليل الكيميائي للطحالب الكبيرة سرجاسم اكوفوليم و بادينا بورجيسني بالإضافة إلى تقييم تأثيرها على جودة مياه الأسماك. تم جمع عينات الطحالب من المعهد القومي لعلوم المحيطات والمصايد في مصر خلال فصل الشتاء والربيع. تم تحديد مستويات الرطوبة والبروتين الكلي والدهون والكربوهيدرات والألياف والرماد. تمت دراسة تأثير الطحالب الكبيرة على جودة الماء لمحلول يحتوي على نسبة عالية من الأمونيا في ثلاث نسخ مع ثلاث معالجات باستخدام مياه البحر التي تحتوي على أمونيا بنسبة 0.428 جزء في المليون وأضيفت الطحالب يوميًا لمدة أيام متتالية: تم تزويد المعالجة الأولى بـ 0.25 جم من طلحب سرجاسم اكوفوليم المجفف يوميا ، وتم تزويد المعاملة الثانية بـ 0.25 جم من بادينا بورجيسني يوميًا، وتم استخدام الخزان الثالث كعنصر تحكم. فيما يتعلق بتأثير الطحالب الكبيرة على تركيز الأمونيا، أظهرت مجموعة سرجاسم اكوفوليم أدنى قيمة معنوية في اليوم الأول، تليها بادينا بورجيسني. كان هناك ارتباط سلبي كبير بين الأمونيوم والملوحة، ، أظهرت جميع المعالجات وجود علاقة واضحة بين الأمونيا ودرجة الحموضة، مما يوفر رؤى قيمة حول التأثيرات المحتملة للطحالب على موائل الأسماك.