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Comparison of *Ulva lactuca* and *Ulva clathrata* as ingredients in *Litopenaeus vannamei* feeds

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Abstract

Ulva lactuca and *Ulva clathrata* are marine green algae belonging to genera *Ulva*. These algae have a lot of nutrient such as protein, carbohydrates, lipids, pigments and others. These nutrient can be used to improve the growth performance and health of Shrimps. Several studies have shown that *U. lactuca* and *U. clathrata* have antifungal, antibacterial, antiviral activities. One of popular shrimp among people of the world is *Litopenaeus vannamei*. So that, this review article aims to comparing the effect of *U. lactuca* and *U. clathrata* as ingredients in *L. vannamei* juvenile feeds. This review also summarizes a literature survey of the nutritional content and antimicrobial activity of *U. lactuca* and *U. clathrata*.

Keywords: *Ulva lactuca*, *Ulva clathrata*, *Litopenaeus vannamei*, growth, health

1. Introduction

Shrimps is one of popular seafood commodity among people of the world. The global trade of shrimp achieve 5.10 million tons in 2019 ^[1] and estimate at USD 28 billion per year ^[2]. Five major shrimps producing regions are China, India, Indonesia, Vietnam, and Thailand. The major shrimps consuming regions are United States of America, China, Europe, and Japan. Shrimps becoming popular worldwide because they contain a lot of nutrient such as mineral (calcium, zinc, iodine), vitamin D, vitamin B3, protein, and fatty acids ^[1].

Among all shrimp's commodities, *Litopenaeus vannamei* is one of popular species to be consumed. High price, easy cultivated, and fast growing shrimps make this species popular to be cultivated. Price of *L. vannamei* in Indonesia is Rp 70.000/kg ^[3]. Vannamei shrimp were introduction to Asian regions in 1978, and commercially into Mainland China and Taiwan Province of China in 1996, followed by most of the other coastal Asian countries in 2001 ^[4]. Although are easy to be cultivated but there are some challenge such as disease, quality and cheap feed stock availability ^[5]. So that, discovering new alternative feed ingredient with a lot of nutrient, low cost and antimicrobial activities should be done.

Ulva is one of algae genus with a lot of nutrient and antimicrobial activities. *U. lactuca* and *U. clathrata* are member of *Ulva* genus which can be used as feed ingredient because of their nutrition content. Some researchers have been conducted to learn about the effect of *U. lactuca* and *U. clathrata* to *L. vannamei* growth and health ^[6, 7]. So that, this article aims to describe the nutritional content of *U. lactuca* and *U. clathrata* and their effects on growth and health of *L. vannamei*.

2. *Ulva lactuca* and *Ulva clathrata*

Ulva lactuca is bright green algae which can be black or white when dry. This algae live in marine water at high and low intertidal zone at depths of 75 feet or more. It lives free floating but can be found attached to rocks and shells by a holdfast. Size of *U. lactuca* is 6 inches-2 feet. It has flat, thin, broad, rounded or oval leaves. It can be used as bioindicator species because this algae can grows well in polluted water ^[8]. *U. lactuca* contains protein, lipid, carbohydrate, fibre ^[9], secondary metabolite and others ^[10].

Ulva clathrata is light green marine algae. It can be found in Indo-Pacific, Atlantic Ocean, and the Mediterranean at depths between 0-29 m. It can be found attached to solid substrates like rocks or floating. Its thalli is branched and hair like hollow filaments ^[11], cylindrical or slightly flat. Ranges of size from 20-80 mm with a thread width of 1-3 mm ^[12]. High nutrition content made this algae can be used for used for human consumption, animal feed, and fertilizer ^[12].

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3. Chemical Composition of *Ulva lactuca* and *Ulva clathrata*

Ulva lactuca and *Ulva clathrata* contains various nutrients such as protein, carbohydrate, fat, vitamins, fibre, and minerals [9, 13]. The amino acids contained include aspartic acid, glutamic acid, serine, histidine, glycine, lysine, leucine, isoleucine, phenylalanine, valine, methionine, tyrosine, alanine, arginine, threonine [13, 14]. They also have a lot of secondary metabolites namely phenolics, saponins, flavonoids, alkaloids, steroids [10, 15]. Minerals in *U. lactuca* are sodium, calcium, potassium, phosphorus, iron [9]. Minerals in *U. clathrata* are calcium, iron, copper, zinc [13]. Pigments contained in *U. lactuca* include chlorophyll a, chlorophyll b, neoxanthin, dinoxanthin, anteraxanthin [16]. While the pigments in *U. clathrata* include xanthophylls, carotenoids [13]. The chemical composition of *U. lactuca* and *U. Clathrata* can be seen in the table below.

Table 1: Proximate Analysis of *U. lactuca* and *U. clathrata*

Composition	<i>U. lactuca</i>	<i>U. clathrata</i>
Crude Protein (% dw)	19.34 ± 0.2	20.1 ± 0.1
Crude fat (% dw)	3.46 ± 0.1	2.2 ± 0.1
Ash (% dw)	44.1 ± 0.1	27.5 ± 0.2
Dietary fibre	25.81 ± 0.2	40.6 ± 3.0
reference	[17]	[13]

Table 2: Amino Acids Content of *U. lactuca* and *U. clathrata* (g/100 g protein)

Amino acid	<i>U. lactuca</i>	<i>U. clathrata</i>
Aspartic acid	12.3 ± 0.9	11.14 ± 0.08
Threonine	4.7 ± 0.0	4.59 ± 0.10
Serine	5.9 ± 0.0	4.69 ± 0.27
Glutamic acid	9.0 ± 0.5	12.8 ± 0.32
Proline	5.3 ± 0.6	2.85 ± 0.03
Glycine	10.7 ± 0.6	5.8 ± 0.04
Alanine	14.2 ± 0.4	8.64 ± 0.05
valine	6.2 ± 0.0	5.55 ± 0.10
Methionine	1.6 ± 0.1	1.56 ± 0.01
Tyrosine	2.1 ± 0.1	1.79 ± 0.06
cysteine	0.4 ± 0.4	1.99 ± 0.03
Isoleucine	3.7 ± 0.0	3.26 ± 0.08
Leucine	6.7 ± 0.1	4.99 ± 0.04
Phenylalanine	4.0 ± 0.0	4.41 ± 0.04
lysine	4.2 ± 0.1	3.61 ± 0.10
Histidine	1.8 ± 0.1	0.98 ± 0.01
Arginine	3.6 ± 0.3	6.21 ± 0.10
Reference	[18]	[13]

Table 3: Fatty acid content of *U. lactuca* and *U. clathrata* (%)

Fatty acid groups	<i>U. lactuca</i>	<i>U. clathrata</i>
SFA	47.90	43.7 ± 1.1
MUFA	40.63	25.1
PUFA	12.86	31.2
HUFA	5.5	10.4
Reference	[19]	[20]

Table 4: Minerals content of *U. lactuca* and *U. clathrata* (mg/kg dw)

Mineral	<i>U. lactuca</i>	<i>U. clathrata</i>
Iron	228.6	4172
Copper	5.7	13.80
Calcium	1892	18800
Zinc	42.16	16.66
cadmium	0.27	1.32
chromium	0..87	0.80
nickel	5.51	5.72
Reference	[21]	[13]

4. *Ulva lactuca* and *Ulva clathrata* As Antimicrobial Agent

Secondary metabolites content of *U. lactuca* and *U. clathrata* have antimicrobial activities. Organic extract of *U. lactuca* grown in natural sea water and artificial sea water show antimicrobial activities against *Bacillus cereus*, *Bacillus subtilis*, *Staphylococcus aureus*, *Micrococcus luteus*, *Serratia marcescens*, *Klebsiella pneumoniae* [22]. 3-O-β-D glucopyranosyl-stigmasta-5, 25-dien in *U. lactuca* has topical antiinflammatory activity [23]. *U. clathrata* also show antimicrobial activities against *Klebsiella* sp, *S. aureus*, and *Pseudomonas aeruginosa* [24]. Ulvan extracted from *U. clathrata* show antiviral effect to paramyxovirus [25].

5. Effect of *Ulva lactuca* and *Ulva clathrata* as ingredients of *Litopenaeus vannamei* feed

U. lactuca and *U. clathrata* have been shown to have a positive effect to *L. vannamei*. Provision *U. clathrata* in juvenile *L.vannamei* diet for 28 days showed that this algae had a positive effect on growth performance [7]. This algae also enhances the reproductive performance of *L. vannamei* [26]. Provision *U. lactuca* in juvenile *L.vannamei* diet for 28 days also showed that this alga had a positive effect on growth performance [6]. Besides that, polysaccharide extract from *U. lactuca* can enhance the phagocytic activity of the *L. vannamei* [27]. The comparison of *U. lactuca* and *U. clathrata* on growth performance of *L. vannamei* can be seen on table 5.

Table 5: The comparison of *U. lactuca* and *U. clathrata* on growth performance of *L. vannamei* can be seen

Parameter	<i>U. lactuca</i>	<i>U. clathrata</i>
Initial weight (g)	0.3	1.59
Final Weight (g)	2.15	4.79
Weight gain (%)	613	203
FCR	1.19	1.78
FC	2.22	5.71
Survival Rate (%)	90	95
Reference	[6]	[7]

6. Conclusion

In conclusion, *U. lactuca* and *U. clathrata* contains various nutrients such as protein, amino acids, carbohydrates, lipids, pigments and others. *U. lactuca* and *U. clathrata* may produce compounds that have antiviral and antibacterial activity for *L. vannamei*. So that, *U. lactuca* and *U. clathrata* can be used as alternative feed ingredients.

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