



# Comparison of the nutritional composition of five species of water plants in freshwater prawn and crab culture ponds

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## Introduction

➤ Aquatic plants can directly or indirectly provide bait for prawns and crabs. Not only the aquatic plants can be ingested by fresh water prawn and crabs, but also the zooplankton, benthic animals and aquatic insects which earn there living in the plants are suitable animal bait for prawn and crabs.

➤ Prawn and crabs need to undergo multiple molting during the growth process, and aquatic plants can provide them with a hidden place to prevent them from being attacked after molting.

➤ Understanding the nutritional composition of aquatic plants can provide a reference for the rational planting of aquatic plants in ponds. *Potamogeton maackianus*, *Potamogeton pusillus* L, *Potamogeton crispus* L, *Myriophyllum spicatum* L, *Alternanthera philoxeroides* are common aquatic plants in freshwater culture ponds of China, but the nutritional composition of these aquatic plants is unclear.

➤ Therefore, the main purpose of this study was to investigate the nutritional composition of *Potamogeton maackianus*, *Potamogeton pusillus* L, *Potamogeton crispus* L, *Myriophyllum spicatum* L and *Alternanthera philoxeroides*.

## Materials and Methods

### Sample collection

Each kind of aquatic plants was randomly sampled from three aquaculture ponds, and about 1 kg of fresh aquatic plants were randomly sampled in each pond, weeds were removed and washed, and then transported to Shanghai Ocean University for sample analysis.

### Nutrient composition determination

| Amino acids | Proximate composition | Total carotenoids | Fatty acids |
|-------------|-----------------------|-------------------|-------------|
| √           | √                     | √                 | √           |

## Results

### Proximate composition

Comparison of proximate composition and total carotenoid of four aquatic plants for pond-reared shrimps and crabs based on the wet weight (dry weight)

| Items                       | <i>Potamogeton maackianus</i>                | <i>Potamogeton pusillus</i> L.                | <i>Potamogeton crispus</i>                   | <i>Alternanthera philoxeroides</i>            | <i>Myriophyllum spicatum</i> L.                |
|-----------------------------|--|---|--|---|--|
| Moisture/%                  | 86.03±0.46 <sup>a</sup>                      | 86.38±0.11 <sup>a</sup>                       | 92.85±0.03 <sup>b</sup>                      | 88.83±2.23 <sup>a</sup>                       | 88.05±0.16 <sup>a</sup>                        |
| Crude protein/%             | 2.64±0.18 <sup>c</sup> (18.88 <sup>b</sup> ) | 2.60±0.04 <sup>c</sup> (19.08 <sup>b</sup> )  | 1.12±0.08 <sup>a</sup> (15.60 <sup>a</sup> ) | 2.73±0.33 <sup>c</sup> (24.44 <sup>c</sup> )  | 1.86±0.19 <sup>b</sup> (15.48 <sup>b</sup> )   |
| Crude lipid/%               | 0.82±0.03 <sup>c</sup> (5.87 <sup>ab</sup> ) | 0.85±0.03 <sup>c</sup> (6.23 <sup>ab</sup> )  | 0.38±0.01 <sup>a</sup> (5.26 <sup>a</sup> )  | 0.77±0.10 <sup>c</sup> (6.89 <sup>b</sup> )   | 0.63±0.06 <sup>b</sup> (5.27 <sup>a</sup> )    |
| Crude fiber/%               | 1.75±0.04 <sup>b</sup> (12.51 <sup>a</sup> ) | 2.05±0.03 <sup>c</sup> (15.07 <sup>b</sup> )  | 1.37±0.07 <sup>a</sup> (19.23 <sup>c</sup> ) | 1.71±0.09 <sup>b</sup> (15.27 <sup>b</sup> )  | 2.02±0.18 <sup>c</sup> (16.95 <sup>b</sup> )   |
| Ash/%                       | 1.56±0.01 <sup>c</sup> (11.19 <sup>b</sup> ) | 1.68±0.02 <sup>d</sup> (12.33 <sup>c</sup> )  | 1.08±0.00 <sup>a</sup> (15.07 <sup>d</sup> ) | 2.14±0.02 <sup>e</sup> (19.20 <sup>e</sup> )  | 1.19±0.01 <sup>b</sup> (9.93 <sup>a</sup> )    |
| Total sugar/%               | 4.91±0.03 <sup>d</sup> (35.16 <sup>c</sup> ) | 3.69±0.04 <sup>b</sup> (27.07 <sup>a</sup> )  | 2.33±0.04 <sup>a</sup> (32.58 <sup>b</sup> ) | 4.42±0.11 <sup>c</sup> (39.57 <sup>d</sup> )  | 4.96±0.02 <sup>d</sup> (41.48 <sup>c</sup> )   |
| Total carotenoids/(mg/100g) | 2.95±0.63 <sup>c</sup> (21.10 <sup>b</sup> ) | 2.01±0.03 <sup>ab</sup> (14.76 <sup>a</sup> ) | 1.46±0.09 <sup>a</sup> (20.44 <sup>b</sup> ) | 2.56±0.09 <sup>bc</sup> (22.94 <sup>b</sup> ) | 2.13±0.07 <sup>ab</sup> (17.86 <sup>ab</sup> ) |

Notes: Values in the same column without the same superscript letters are significantly different (P<0.05). The data in parentheses represents the nutrient content calculated by the dry weight of the water plants, and the dry weight and wet weight data were independently analyzed statistically.

## Results

### Fatty acids

Fatty acid composition of five aquatic plants for pond-reared shrimps and crabs (%)

| Fatty acid    | <i>Potamogeton maackianus</i> | <i>Potamogeton pusillus</i> L. | <i>Potamogeton crispus</i> | <i>Alternanthera philoxeroides</i> | <i>Myriophyllum spicatum</i> L. |
|---------------|-------------------------------|--------------------------------|----------------------------|------------------------------------|---------------------------------|
| C14:0         | 2.60±0.15 <sup>c</sup>        | 2.06±0.04 <sup>bc</sup>        | 2.00±0.11 <sup>b</sup>     | 1.30±0.04 <sup>a</sup>             | 1.35±0.73 <sup>abc</sup>        |
| C15:0         | 0.18±0.04 <sup>c</sup>        | 0.15±0.01 <sup>bc</sup>        | 0.19±0.01 <sup>c</sup>     | 0.08±0.00 <sup>a</sup>             | 0.14±0.00 <sup>b</sup>          |
| C16:0         | 23.36±2.23 <sup>b</sup>       | 19.16±0.39 <sup>a</sup>        | 22.98±0.35 <sup>b</sup>    | 18.68±0.75 <sup>a</sup>            | 21.12±2.11 <sup>ab</sup>        |
| C17:0         | 0.60±0.05 <sup>d</sup>        | 0.53±0.00 <sup>c</sup>         | 0.76±0.02 <sup>c</sup>     | 0.18±0.02 <sup>a</sup>             | 0.41±0.05 <sup>b</sup>          |
| C18:0         | 4.28±0.21 <sup>d</sup>        | 3.51±0.08 <sup>c</sup>         | 3.78±0.16 <sup>c</sup>     | 2.67±0.19 <sup>b</sup>             | 2.27±0.34 <sup>a</sup>          |
| C20:0         | 0.79±0.09 <sup>d</sup>        | 0.62±0.01 <sup>cd</sup>        | 0.45±0.03 <sup>bc</sup>    | 0.24±0.05 <sup>a</sup>             | 0.37±0.18 <sup>ab</sup>         |
| C22:0         | 0.98±0.02 <sup>b</sup>        | 0.64±0.05 <sup>a</sup>         | 0.59±0.06 <sup>a</sup>     | 1.24±0.05 <sup>c</sup>             | 0.45±0.21 <sup>a</sup>          |
| C23:0         | 0.36±0.10                     | 0.34±0.02                      | 0.38±0.03                  | 0.27±0.01                          | --                              |
| C24:0         | 1.27±0.09 <sup>b</sup>        | 1.12±0.08 <sup>b</sup>         | 1.12±0.10 <sup>a</sup>     | 3.61±0.10 <sup>c</sup>             | 0.86±0.25 <sup>a</sup>          |
| SFA           | 34.70±2.06 <sup>b</sup>       | 27.97±0.54 <sup>a</sup>        | 31.88±0.34 <sup>b</sup>    | 28.28±0.44 <sup>a</sup>            | 26.93±2.29 <sup>a</sup>         |
| C16:1         | 1.93±0.09 <sup>d</sup>        | 1.01±0.05 <sup>b</sup>         | 1.50±0.19 <sup>c</sup>     | 0.77±0.08 <sup>a</sup>             | 1.32±0.10 <sup>c</sup>          |
| C17:1n7       | 0.50±0.04                     | 0.49±0.04                      | 0.37±0.03                  | --                                 | 0.44±0.38                       |
| C18:1n9       | 4.83±0.56 <sup>b</sup>        | 4.41±0.22 <sup>ab</sup>        | 6.33±1.04 <sup>c</sup>     | 5.15±0.58 <sup>b</sup>             | 3.42±0.42 <sup>a</sup>          |
| C18:1n7       | 1.26±0.08 <sup>b</sup>        | 1.17±0.01 <sup>b</sup>         | 1.61±0.13 <sup>c</sup>     | 0.60±0.13 <sup>a</sup>             | 1.21±0.18 <sup>b</sup>          |
| C20:1n9       | 0.75±0.35                     | 0.37±0.01                      | --                         | 0.37±0.16                          | 0.99±0.00                       |
| C22:1n9       | 0.51±0.09                     | 0.36±0.00                      | --                         | --                                 | --                              |
| C24:1n9       | 0.66±0.39                     | 0.93±0.10                      | 0.73±0.02                  | --                                 | --                              |
| MUFA          | 10.21±0.64 <sup>cd</sup>      | 8.72±0.40 <sup>bc</sup>        | 10.63±1.26 <sup>d</sup>    | 7.05±1.07 <sup>ab</sup>            | 6.45±1.11 <sup>a</sup>          |
| C18:2n6 (LA)  | 15.29±0.92 <sup>a</sup>       | 16.47±0.12 <sup>a</sup>        | 15.90±0.14 <sup>a</sup>    | 27.00±0.85 <sup>b</sup>            | 29.30±1.09 <sup>c</sup>         |
| C18:3n3 (LNA) | 22.27±1.40 <sup>a</sup>       | 36.04±0.42 <sup>c</sup>        | 30.33±0.51 <sup>b</sup>    | 32.19±1.29 <sup>b</sup>            | 31.06±2.48 <sup>b</sup>         |
| C20:2n6       | 0.55±0.03                     | 0.23±0.01                      | --                         | 0.31±0.08                          | 0.55±0.39                       |
| C20:4n6 (ARA) | 0.74±0.12 <sup>ab</sup>       | 0.84±0.04 <sup>c</sup>         | 0.43±0.06 <sup>a</sup>     | 0.39±0.21 <sup>a</sup>             | 0.63±0.18 <sup>ab</sup>         |
| C20:5n3 (EPA) | 1.77±0.25 <sup>b</sup>        | 0.84±0.14 <sup>a</sup>         | 0.84±0.13 <sup>a</sup>     | 0.54±0.12 <sup>a</sup>             | 0.82±0.29 <sup>a</sup>          |
| C22:6n3 (DHA) | 0.97±0.21 <sup>c</sup>        | 0.66±0.13 <sup>b</sup>         | 0.56±0.09 <sup>ab</sup>    | 0.71±0.18 <sup>bc</sup>            | 0.33±0.11 <sup>a</sup>          |
| PUFA          | 41.42±1.70 <sup>a</sup>       | 55.00±0.19 <sup>c</sup>        | 47.94±0.71 <sup>b</sup>    | 61.15±1.54 <sup>d</sup>            | 62.69±3.39 <sup>d</sup>         |
| n-3PUFA       | 25.02±1.15 <sup>a</sup>       | 37.53±0.18 <sup>c</sup>        | 31.61±0.55 <sup>b</sup>    | 33.44±0.98 <sup>b</sup>            | 32.31±2.69 <sup>b</sup>         |
| n-6PUFA       | 16.40±0.55 <sup>ab</sup>      | 17.47±0.07 <sup>b</sup>        | 16.33±0.18 <sup>a</sup>    | 27.70±0.57 <sup>c</sup>            | 30.48±0.87 <sup>d</sup>         |
| n-3/n-6       | 1.52±0.02 <sup>c</sup>        | 2.15±0.01 <sup>c</sup>         | 1.94±0.03 <sup>d</sup>     | 1.23±0.01 <sup>b</sup>             | 1.06±0.07 <sup>a</sup>          |
| HUFA          | 3.48±0.58 <sup>b</sup>        | 2.34±0.31 <sup>a</sup>         | 1.70±0.28 <sup>a</sup>     | 1.64±0.53 <sup>a</sup>             | 1.79±0.35 <sup>a</sup>          |
| DHA/EPA       | 0.55±0.04 <sup>a</sup>        | 0.748±0.03 <sup>b</sup>        | 0.78±0.03 <sup>b</sup>     | 1.32±0.094 <sup>c</sup>            | 0.42±0.11 <sup>a</sup>          |
| ARA/EPA       | 0.42±0.01 <sup>a</sup>        | 1.02±0.13 <sup>b</sup>         | 0.60±0.04 <sup>ab</sup>    | 0.69±0.21 <sup>ab</sup>            | 0.89±0.57 <sup>ab</sup>         |

Notes: The fatty acids with less than 0.3 % were not presented in the table; Values in the same line without the same superscript letters are significantly different; SFA: Total saturated fatty acids; MUFA: Total mono-unsaturated fatty acid; LA: Linoleic acid; LNA: Linolenic acid; ARA: Arachidonic acid; DHA: Docosahexaenoic acid; EPA: Eicosapentaenoic acid; PUFA: Total poly-unsaturated fatty acid(C18:2n6+ C18:3n3+ C20:2n6+ C20:4n6+ C20:5n3+ C22:6n3); HUFA: Total long chain poly-unsaturated fatty acid(C20:4n6+ C20:5n3+ C22:6n3); "--": undetectable.

### Amino acids

Contents and compositions of amino acids of five aquatic plants for the pond farming of freshwater shrimps and crabs based on the wet weight

| Amino acids   | <i>Potamogeton maackianus</i> | <i>Potamogeton pusillus</i> L. | <i>Potamogeton crispus</i> | <i>Alternanthera philoxeroides</i> | <i>Myriophyllum spicatum</i> L. |
|---------------|-------------------------------|--------------------------------|----------------------------|------------------------------------|---------------------------------|
| Isoleucine    | 1.33±0.02 <sup>c</sup>        | 1.22±0.01 <sup>d</sup>         | 0.57±0.02 <sup>a</sup>     | 1.12±0.03 <sup>c</sup>             | 0.72±0.04 <sup>b</sup>          |
| Leucine       | 2.51±0.03 <sup>c</sup>        | 2.20±0.03 <sup>d</sup>         | 1.05±0.03 <sup>a</sup>     | 2.01±0.05 <sup>c</sup>             | 1.33±0.03 <sup>b</sup>          |
| Lysine        | 1.17±0.01 <sup>d</sup>        | 0.94±0.01 <sup>b</sup>         | 0.39±0.01 <sup>a</sup>     | 1.52±0.03 <sup>c</sup>             | 0.99±0.04 <sup>c</sup>          |
| Methionine    | 0.54±0.02 <sup>c</sup>        | 0.52±0.04 <sup>c</sup>         | 0.24±0.00 <sup>a</sup>     | 0.44±0.03 <sup>b</sup>             | 0.29±0.01 <sup>a</sup>          |
| Cysteine      | 1.58±0.39 <sup>b</sup>        | 2.15±0.64 <sup>b</sup>         | 0.33±0.05 <sup>a</sup>     | 1.24±0.25 <sup>ab</sup>            | 0.47±0.02 <sup>a</sup>          |
| Phenylalanine | 1.58±0.03 <sup>c</sup>        | 1.37±0.02 <sup>d</sup>         | 0.64±0.02 <sup>a</sup>     | 1.22±0.03 <sup>c</sup>             | 0.84±0.01 <sup>b</sup>          |
| Tyrosine      | 1.25±0.04 <sup>d</sup>        | 0.97±0.01 <sup>c</sup>         | 0.48±0.01 <sup>a</sup>     | 1.01±0.02 <sup>c</sup>             | 0.68±0.01 <sup>b</sup>          |
| Threonine     | 1.35±0.02 <sup>c</sup>        | 1.19±0.03 <sup>d</sup>         | 0.55±0.02 <sup>a</sup>     | 1.09±0.02 <sup>c</sup>             | 0.70±0.02 <sup>b</sup>          |
| Valine        | 1.83±0.02 <sup>c</sup>        | 1.59±0.02 <sup>d</sup>         | 0.76±0.02 <sup>a</sup>     | 1.37±0.04 <sup>c</sup>             | 0.98±0.01 <sup>b</sup>          |
| Tryptophan    | 0.42±0.04 <sup>c</sup>        | 0.37±0.04 <sup>c</sup>         | 0.20±0.02 <sup>a</sup>     | 0.41±0.01 <sup>c</sup>             | 0.29±0.01 <sup>b</sup>          |
| EAA           | 13.57±0.21 <sup>e</sup>       | 12.51±0.76 <sup>d</sup>        | 5.21±0.05 <sup>a</sup>     | 11.44±0.44 <sup>c</sup>            | 7.28±0.01 <sup>b</sup>          |
| Aspartate     | 2.89±0.04 <sup>c</sup>        | 2.42±0.03 <sup>c</sup>         | 1.27±0.03 <sup>a</sup>     | 2.24±0.05 <sup>b</sup>             | 2.51±0.01 <sup>d</sup>          |
| Serine        | 1.57±0.01 <sup>c</sup>        | 1.28±0.01 <sup>d</sup>         | 0.59±0.02 <sup>a</sup>     | 1.06±0.02 <sup>c</sup>             | 0.76±0.01 <sup>b</sup>          |
| Glutamate     | 3.35±0.03 <sup>d</sup>        | 2.70±0.03 <sup>c</sup>         | 1.33±0.03 <sup>a</sup>     | 3.59±0.10 <sup>c</sup>             | 1.97±0.01 <sup>b</sup>          |
| Glycine       | 1.86±0.03 <sup>c</sup>        | 1.54±0.02 <sup>d</sup>         | 0.73±0.02 <sup>a</sup>     | 1.28±0.03 <sup>c</sup>             | 0.99±0.03 <sup>b</sup>          |
| Alanine       | 1.71±0.02 <sup>c</sup>        | 1.46±0.02 <sup>d</sup>         | 0.72±0.02 <sup>a</sup>     | 1.36±0.03 <sup>c</sup>             | 0.95±0.02 <sup>b</sup>          |
| Histidine     | 0.53±0.01 <sup>d</sup>        | 0.43±0.01 <sup>c</sup>         | 0.19±0.01 <sup>a</sup>     | 0.58±0.01 <sup>c</sup>             | 0.38±0.01 <sup>b</sup>          |
| Arginine      | 1.43±0.02 <sup>d</sup>        | 1.31±0.03 <sup>c</sup>         | 0.61±0.01 <sup>a</sup>     | 1.35±0.01 <sup>c</sup>             | 0.90±0.01 <sup>b</sup>          |
| Proline       | 1.33±0.01 <sup>c</sup>        | 1.13±0.02 <sup>d</sup>         | 0.56±0.02 <sup>a</sup>     | 1.05±0.02 <sup>c</sup>             | 0.71±0.01 <sup>b</sup>          |
| NEAA          | 14.67±0.15 <sup>d</sup>       | 12.30±0.14 <sup>c</sup>        | 6.00±0.16 <sup>a</sup>     | 12.48±0.29 <sup>c</sup>            | 9.18±0.01 <sup>b</sup>          |
| TAA           | 28.24±0.06                    | 24.81±0.90 <sup>c</sup>        | 11.21±0.21 <sup>a</sup>    | 23.93±0.73 <sup>c</sup>            | 16.45±0.01 <sup>b</sup>         |
| EAA/TAA       | 0.48±0.01 <sup>b</sup>        | 0.50±0.01 <sup>c</sup>         | 0.46±0.01 <sup>b</sup>     | 0.48±0.01 <sup>b</sup>             | 0.44±0.01 <sup>a</sup>          |

Notes: Values in the same line without the same superscript letters are significantly different; EAA means total essential amino acids; NEAA means total no-essential amino acids; TAA means total amino acids.

## Conclusion

- The *Potamogeton maackianus* and *Potamogeton pusillus* L have higher nutritional value.
- The nutritional quality of different water plants in this study are different and there are certain complementarities, and the choice of aquatic plants should be based on its nutritional quality, prawn and crab preferences and environmental factors.