Supporting Information

Estimation of Chitin and Protein Contents during the Isolation of Chitin from Shrimp Head Waste

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Mathematic Derivation

The proposed equations:

$$P = \frac{(Nt \cdot Cq + K - 100) \cdot Cp}{(Cq - Cp)} \qquad \textbf{Equation (1)}$$

and

$$Q = \frac{(Nt \cdot Cp + K - 100) \cdot Cq}{(Cp - Cq)} \qquad \textbf{Equation (2)}$$

Were deducted following this reasoning:

Given that crustacean shells are mainly composed of chitin (Q), protein (P), inorganic matter (I), lipid compounds (L) and water (W);

$$P + Q + I + L + H = 100\% \qquad \textbf{Equation (A)}$$

Could be expressed, if any other compound that could be present is neglected.

Grouping the compounds that not contain nitrogen:

$$K = I + L + W \qquad \textbf{Equation (B)}$$

Then:

$$P + Q + K = 100\% \qquad \textbf{Equation (C)}$$

If the total nitrogen content in crustacean shells (Nt) is given by:

$$Nt = Np + Nq$$ **Equation (D)**

Where Np is the nitrogen content of protein, and Nq is the nitrogen content of chitin and there are related to the protein (P) and chitin (Q) content by:

$$P = Np \cdot Cp$$ **Equation (E)**

$$Q = Nq \cdot Cq$$ **Equation (F)**

Where Cp and Cq are conversion coefficients that relate the mass fraction of nitrogen with protein and chitosan respectively. Then:

$$Nt = \frac{P}{Cp} + \frac{Q}{Cq}$$ **Equation (G)**

From this substitute for P or Q from Equation (c) and solve in the respective form and rearrange

E.g., Substitute for Q from Equation (c).

$$Nt = \frac{P}{Cp} + \frac{(100 - K - P)}{Cq}$$ **Equation (H)**

Solve for P:

$$P = \frac{Nt \cdot Cp \cdot Cq + K \cdot Cp - 100 \cdot Cp}{(Cq - Cp)}$$ **Equation (I)**

After rearranging Equation (1) is obtained. Similarly, substituting for P from equation (c) in Equation (g) solving for Q and rearranging the Equation (2) is achieved.

Error Analysis

Being P = *f*(Nt, I, L, W) and considering Nt, and the K components (I, L and W) as independent variables. Using the most probable error expression, the error of the protein estimation as standard deviation (S_P) could be defined:

$$S_P = \sqrt{\left(\frac{\partial P}{\partial Nt}\right)^2_{I,L,W} S_{Nt}^2 + \left(\frac{\partial P}{\partial I}\right)^2_{Nt,L,W} S_I^2 + \left(\frac{\partial P}{\partial L}\right)^2_{Nt,I,W} S_L^2 + \left(\frac{\partial P}{\partial W}\right)^2_{Nt,I,L} S_W^2}$$ **Equation (J)**

Resolving the partial derivatives using Equation 1 then:

$$S_P = \sqrt{\left(\frac{Cq \cdot Cp}{(Cq - Cp)}\right)^2 \cdot S_{Nt}{}^2 + \left(\frac{Cp}{(Cq - Cp)}\right)^2 \cdot S_I^2 + \left(\frac{Cp}{(Cq - Cp)}\right)^2 \cdot S_L{}^2 + \left(\frac{Cp}{(Cq - Cp)}\right)^2 \cdot S_W{}^2}$$ **Equation (K)**

Where $S_X{}^2$ is the variance of the respective measurement

The error for the chitin (Q) estimation is deducted similarly.

$$S_Q = \sqrt{\left(\frac{Cp \cdot Cq}{(Cp - Cq)}\right)^2 \cdot S_{Nt}{}^2 + \left(\frac{Cq}{(Cp - Cq)}\right)^2 \cdot S_I^2 + \left(\frac{Cq}{(Cp - Cq)}\right)^2 \cdot S_L{}^2 + \left(\frac{Cq}{(Cp - Cq)}\right)^2 \cdot S_W{}^2}$$ **Equation (L)**

In simplified form:

$$S_P = \frac{Cp \cdot \sqrt{Cq^2 \cdot S_{Nt}{}^2 + S_I^2 + S_L{}^2 + S_W{}^2}}{(Cq - Cp)}$$ **Equation (M)**

$$S_Q = \frac{Cq \cdot \sqrt{Cp^2 \cdot S_{Nt}{}^2 + S_I^2 + S_L{}^2 + S_W{}^2}}{(Cp - Cq)}$$ **Equation (N)**

Note: Cp and Cq are considered as empirical constants, even when could be adjusted by measurements of specific characteristics (nitrogen content in protein or degree of acetylation in chitin) for each studied matter.