



Direct liquefaction of *Dunaliella tertiolecta* for bio-oil in sub/supercritical ethanol–water

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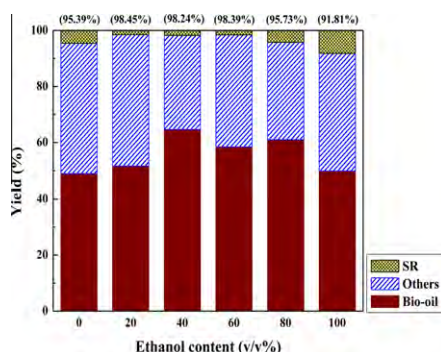
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HIGHLIGHTS

- ▶ Bio-oil was produced by liquefaction of *Dunaliella tertiolecta* in sub/supercritical ethanol–water.
- ▶ The ethanol and water showed synergistic effects on the direct liquefaction of *D. tertiolecta*.
- ▶ XPS and SEM were used to verify the liquefaction behavior of *D. tertiolecta* and its solid residue.
- ▶ A plausible reaction mechanism of the main chemical component in *D. tertiolecta* is proposed.
- ▶ The optimal *D. tertiolecta* conversion was 98.24%, with a maximum bio-oil yield of 64.68%.

GRAPHICAL ABSTRACT

The bio-oil preparation by direct liquefaction of microalgae (*Dunaliella tertiolecta*) was carried out with sub/supercritical ethanol–water mixture as the medium in a batch autoclave with high temperature and high pressure. The results indicated that ethanol and water showed synergistic effects on the direct liquefaction of *D. tertiolecta*. The optimal *D. tertiolecta* conversion was 98.24%, with a maximum bio-oil yield of 64.68% in the sub/supercritical ethanol–water mixture at a reaction temperature of 593 K, with a holding time of 30 min, a ratio of the material to reaction medium of 1:10, and an ethanol volume fraction of 40% (v/v).



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ABSTRACT

This paper presents bio-oil preparation by direct liquefaction of *Dunaliella tertiolecta* (*D. tertiolecta*) with sub/supercritical ethanol–water as the medium in a batch autoclave with high temperature and high pressure. The results indicated that ethanol and water showed synergistic effects on direct liquefaction of *D. tertiolecta*. The maximum bio-oil yield was 64.68%, with an optimal *D. tertiolecta* conversion of 98.24% in sub/supercritical ethanol–water. The detailed chemical compositional analysis of the bio-oil was performed using an EA, FT-IR, and GC–MS. The empirical formulas of the bio-oil obtained using the ethanol–water co-solvent (40%, v/v) and sole water as the reaction medium were $\text{CH}_{1.52}\text{O}_{0.14}\text{N}_{0.06}$ and $\text{CH}_{1.43}\text{O}_{0.23}\text{N}_{0.09}$, with calorific values of 34.96 and 29.80 MJ kg^{-1} , respectively. XPS and SEM results showed that ethanol–water is a very effective reaction medium in the liquefaction. A plausible reaction mechanism of the main chemical component in *D. tertiolecta* is proposed based on our results and the literatures.

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