

2-METHYLTETRAHYDROFURAN AS A BIO-BASED SOLVENT FOR FLAXSEED (*Linum usitatissimum*) OIL EXTRACTION

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Abstract

Industrial extraction of seed oil using hexane has raised significant environmental and human health concerns. 2-Methyltetrahydrofuran (2-MeTHF) stands out as a promising sustainable bio-based alternative. It is a renewable solvent derived from agricultural byproducts. 2-MeTHF exhibits physical properties favorable for oil extraction, including a low boiling point (80°C) for efficient solvent recovery and a high affinity for lipids. Similarly, the global demand for functional seeds like flaxseed (*Linum usitatissimum* L.) oil is rising, driven by its applications in the food, nutraceutical, and industrial sectors. Flax holds strategic and economic importance for the Russian Federation, which stands as one of the world's foremost producers of flaxseed. Based on this, investigating sustainable extraction methods and solvent for flaxseed oil holds both scientific and industrial relevance. Thus, this study investigates 2-MeTHF as a sustainable alternative to hexane for flaxseed oil extraction.

Keywords

2-MeTHF, Protein, Extraction, Oil seed, Biobased, Green solvents, Flax

2-МЕТИЛТЕТРАГИДРОФУРАН В КАЧЕСТВЕ РАСТВОРИТЕЛЯ НА БИОЛОГИЧЕСКОЙ ОСНОВЕ ДЛЯ ЭКСТРАКЦИИ ЛЬНЯНОГО МАСЛА (*Linum usitatissimum*)

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Аннотация

Промышленная экстракция масла из семян с использованием гексана вызвала серьезные опасения по поводу состояния окружающей среды и здоровья человека. 2-метилтетрагидрофуран (2-МеТНФ) является перспективной альтернативой на биологической основе. Это возобновляемый растворитель, получаемый из побочных продуктов сельского хозяйства. 2-МеТНФ обладает физическими свойствами, благоприятными для экстракции масла, включая низкую температуру кипения (80°C) для эффективного извлечения растворителя и высокое сродство к липидам. Аналогичным образом, растет мировой спрос на функциональные семена, такие как льняное масло (*Linum usitatissimum* L.), что обусловлено их применением в пищевой, нутрицевтической и промышленной отраслях. Лен имеет стратегическое и экономическое значение для Российской Федерации, которая является одним из ведущих мировых производителей льняного семени. Исходя из этого, изучение экологически чистых методов экстракции и растворителя для льняного масла имеет как научное, так и промышленное значение. Таким

образом, в данном исследовании рассматривается 2-МеТНФ как устойчивая альтернатива гексану для экстракции льняного масла.

Ключевые слова

2-МеТНФ, Белок, Экстракция, Масличные семена, На биологической основе, Зеленые растворители, Лен

Flaxseed (*Linum usitatissimum* L.) oil has long been recognized as a valuable agricultural commodity with diverse applications spanning the food, nutraceutical, pharmaceutical, and industrial sectors [1]. The oil is particularly prized for its exceptionally high content of omega-3 fatty acids, particularly α -linolenic acid, which confers significant health benefits including anti-inflammatory effects, cholesterol reduction, and decreased risk of cardiovascular disease [2]. However, the recovery of oil from oilseeds like flaxseeds is dominated by solvent extraction using n-hexane. However, its use is increasingly controversial due to significant environmental and health concerns. Furthermore, its classification as a hazardous air pollutant and its derivation from non-renewable petroleum sources underscores the urgent need for safer, bio-based alternatives that align with the principles of green chemistry [3]. 2-methyltetrahydrofuran (2-MeTHF) is a genuine bio-based solvent, produced by the hydrogenation of furfural derived from renewable agricultural residues such as corn cobs and sugarcane bagasse [4]. Its physicochemical properties are highly advantageous for oil extraction: it exhibits a similar polarity profile to hexane, a higher boiling point (80°C) that facilitates solvent recovery. The application of 2-MeTHF for the extraction of several seed oil remains largely unexplored. Given the high concentration of oxidatively sensitive PUFAs in flaxseed oil, the choice of solvent is critical not only for yield but also for preserving oil quality and maximizing the retention of its associated bioactive molecules. Therefore, a investigation into the performance of 2-MeTHF for flaxseed oil extraction is warranted.

The primary objective of this study to evaluate the efficiency of 2-MeTHF as a bio-based solvent for extracting oil from flaxseed, comparing it directly with conventional hexane.

- (i) evaluate and compare the oil extraction yields achieved with 2-MeTHF versus conventional hexane
- (ii) assess the quality of the extracted oil and
- (iii) the viability of scaling this method for industrial application

This study is expected to demonstrate that 2-MeTHF can achieve comparable or superior extraction efficiency to hexane while yielding a high-quality flaxseed oil rich in valuable components. This could sever as a fundamental study in determining if 2-MeTHF represents a viable and superior green alternative for producing high-quality flaxseed oil.

Literature

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