



MSc Departmental Seminar 6001

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Green Extraction and Quantitative Analysis of Selected Nutraceuticals in *Saccharina latissima* from the North Atlantic

Escalating global demand for sustainable and nutritious food sources has spurred research into underutilized marine vegetables such as sugar kelp (*Saccharina latissima*). Sugar kelp found widely in temperate and northern oceans is nutritionally rich, providing vitamins, minerals, and antioxidants essential for optimal human health.

In this work, fat soluble vitamins A, E, and K, along with the carotenoid fucoxanthin were identified as nutraceutical targets in *S. latissima*. A robust high performance liquid chromatography-time of flight mass spectrometry (HPLC-TOF-MS) was developed for simultaneous analysis of these four analytes. The influence of various parameters (e.g., *flow rate, capillary voltage, drying gas flow rate and nebulizer pressure*) on the MS response were systematically investigated employing design of experiment (DOE). Factors were screened using factorial design, then optimized for signal intensity via a Central Composite and Box-Behnken design. The resulting method effectively separated all targets within 10 minutes with detection limits ranging from 0.37 µg/L to 7.55 µg/L. Scalable environmentally-friendly sample preparation methods (i.e., blanching, freezing, freeze-drying, or pulverization with blade-style food grinder) combined with microwave-assisted extraction (using methanol and tested at 90, 100, and 120 °C) were evaluated to assess efficiency in enhancing the yields of lipophilic nutraceuticals compared to extraction from unprocessed sugar kelp. Results indicated that microwave-assisted extraction at 100 °C for 5 minutes was most effective for pulverized samples and those with no pretreatment; while freeze-drying followed by extraction at 120 °C was optimal. For blanched and frozen kelp, extraction at 120 °C yielded significantly higher amounts of fat-soluble vitamins.

Using these methods, the extractable content of vitamins and fucoxanthin were analyzed in sugar kelp from Maine, Nova Scotia and Newfoundland. The Newfoundland kelp showed higher levels of vitamin K and fucoxanthin, whereas Maine kelp was superior with respect to vitamin E content. The potential commercial applications of these findings include the development of kelp-based supplements and functional foods, which can offer health benefits while promoting sustainability in food resources. This research underscores the potential of optimized extraction methods and precise analytical techniques to enhance the utilization of sugar kelp as a nutrient-rich food source.