UNIVERSITI TEKNOLOGI MARA

NATURAL DYES FROM SARGASSUM SP. EXTRACTED USING SUPERCRITICAL CARBON DIOXIDE AND ITS APPLICATION ON SILK COLORATION

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PhD

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Natural dyes for textile coloration have become one of the main alternatives in promoting sustainable textiles due to its biodegradability and non-toxic properties. Seaweed extract from *Sargassum sp.* became the highlight of this study due to their unique characteristic and abundance of availability in Malaysia. The modern extraction of *Sargassum sp.* was carried out using supercritical CO_2 (SC-CO_2) with optimisation on the process was done via Response Surface Methodology (RSM). The main parameters for SC-CO_2 extraction were pressure and temperature with response to yield of extracts. The optimized extraction conditions that gave the optimal product yield of 0.27% were at 4500 psi and 65°C. Characterisation of the extracts using UV-Vis showed the presence of chlorophyll at maximum absorption spectrum (λ max) of 410 nm and carotenoids at 673 nm and these pigments are responsible for the color of the seaweeds. LCMS results confirmed the presence of fucoxanthin and chlorophyll A that were responsible for the major compounds in *Sargassum sp*. In addition, GCMS results showed the presence of fucosterol, pentadecanoic acid, ergosterol and methyl 9-octadecenoate which are the source of anti-oxidant, anti-inflammatory and antifungal and these properties became added values for seaweed dyes. Dyeing of silk fabrics were done with combination of several mordants using pre-mordanting and simultaneous mordanting technique. The colors of the dyed silk fabrics were specifically measured for color coordinates, color strength and fastness properties to washing, perspiration, crocking and light according to MS ISO standards. The results showed good to excellent fastness properties except for light fastness which gave quite low ratings. Nevertheless, the introduction of biomordants such as lemon and acetic acid were able to encounter the low lightfastness issue. The result of color strength (K/S) for all dyed samples produced parallel trends due to the identical origin of the dye source. The highest K/S value goes to silk fabrics mordanted with ferrous sulphate followed by silk fabrics mordanted with cinnamon both in simultaneous mordanting method. In contrast, the lowest K/S was from silk fabrics mordanted with chitosan followed by silk fabrics mordanted with alum both in pre-mordanting method. The results of color strength and color fastness properties of both biomordants and synthetic mordants were comparable with each other. In fact, the use of biomordants promote green sustainable textile coloration. This research has made a significant influence to provide the latest revolution in natural dyes extraction method and at the same time provide an alternative income for local seaweeds as the source of natural dyes.

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