

**UNIVERSITI TEKNOLOGI MARA**

**NATURAL DYE  
FROM *SARGASSUM* SP.  
SEAWEEDS  
AND ENHANCING  
ITS DYEABILITY  
THROUGH  
SURFACE MODIFICATION  
OF TEXTILE SUBSTRATES**

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Thesis submitted in fulfillment  
of the requirements for the degree of  
**Doctor of Philosophy**  
**(Textiles Coloration)**

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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

This study was conducted to determine the percentage crude yield of natural dyes obtained from *Sargassum* sp. seaweed using different solvent and extraction methods as well as to characterise the extracted natural dyes. At the same time, the application of surface modifier of Cetyl trimethyl ammonium bromide (CTAB) and poly(amidoamine) (PAMAM) dendrimer on cotton, silk and polyester fabrics with regards to the zeta potential and the dyeability towards the natural dye extracted from *Sargassum* sp. were explored. Apart from that, the toxicity of the extracted dyes from *Sargassum* sp. seaweed was also examined. The ground powder of dry *Sargassum* sp. was extracted in methanol and acetone solution using maceration and ultrasound. The percentage yield in the form of crude from each extraction procedure was compared. The extracted dye was analysed using UV-vis Spectrophotometer, FTIR and Q-TOF LCMS to determine the compounds present. Prior to dyeing, the cotton, silk and polyester fabrics were treated with CTAB and PAMAM dendrimer as surface modifiers. Zeta potential of these surface-modified fabrics was then measured using a SurPASS Electrokinetic Analyzer. Exhaustion dyeing with simultaneous mordanting using vinegar, alum and iron was carried out on the untreated and treated fabrics. The dyeing was executed at 85<sup>0</sup>C for 40, 60 and 80 minutes. Later, cytotoxicity and neurotoxicity tests were performed on the natural dyes in the form of liquid and dyed silk fabrics, respectively. Fibroblast cells from mouse embryonic cells and cell lines from SH-SY5Y were used to investigate the cytotoxicity test. Neuro-like cells obtained from retinoic acid-treated SH-SY5Y were used to conduct neurotoxicity test. MTS assay method was carried out to the entire cells to evaluate the toxicity of the dye. The highest percent yield was obtained from maceration procedure with methanol at 60<sup>0</sup>C for 48 hours. The extracted fucoxanthin and chlorophyll compounds from *Sargassum* sp. were successfully applied as natural dyes for dyeing cotton, silk and polyester fabrics. The zeta potential of the surface-modified fabrics gave less negative charges in comparison with untreated fabrics thus improve their dyeability as well as % exhaustion and K/S values. The fastness properties of the dyed fabrics gave ratings from good to excellent except light fastness which was rated as poor. Toxicity tests confirmed that the extracted dye is toxic-free. Thus, it can be suggested that the natural dyes from *Sargassum* sp. extract is suitable to be used for textile dyeing.

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