BAB V
KESIMPULAN DAN SARAN

5.1 Kesimpulan

Kesimpulan yang dapat diambil berdasarkan penelitian yang telah dilakukan adalah sebagai berikut.

1. Ekstraksi norbixin dari biji kesumba keling terbaik didapatkan pada kondisi operasi dengan pemanasan pada temperatur 60 ℃ dan konsentrasi pelarut NaOH 0,5 M selama 5 jam.
2. Semakin besar temperatur, konsentrasi pelarut NaOH, dan waktu ekstraksi maka konsentrasi dan kandungan zat warna norbixin hasil ekstraksi semakin banyak.
3. Penggunaan mordan menghasilkan pewarnaan dengan nilai *color strength* dan *color fastness* terhadap air juga detergen yang lebih baik dibandingkan dengan tanpa penggunaan mordan, dengan mordan terbaik yaitu tunjung.
4. Penggunaan mordan tunjung pada pewarnaan dengan hasil ekstraksi biji kesumba keling menghasilkan ferro tanat yang mempengaruhi hasil *color coordination* (memberikan warna coklat gelap).
5. Penggunaan konsentrasi zat warna yang semakin besar pada pewarnaan menghasilkan *color strength* yang semakin baik namun *color fastness* yang semakin buruk akibat semakin banyaknya zat warna yang menempel pada permukaan kain, namun tidak seluruhnya mampu membentuk ikatan yang baik pada kain akibat berlebihnya zat warna, sehingga mudah terlepas.

5.2 Saran

Saran yang dapat diberikan penulis untuk kedepannya adalah sebagai berikut.

1. Kain katun yang digunakan dapat dianalisis dengan pengujian serat terlebih dahulu guna mengetahui kandungan serat.

2. Perbandingan pewarnaan dari ekstrak biji kesumba keling dengan jenis dan metode mordan yang berbeda (*pre*, *simultaneous*, *post*) dapat dilakukan.

DAFTAR PUSTAKA

Acevedo-Rodríguez, P. (1996). Flora of St. John U.S. Virgin Islands. In *Memoirs of the New York Botanical Garden*.

Adeyanju dkk. (2001). Extraction of Indigo Dye (Powdered Form) from The Leaf of Iindigofera tinctoria. 2QU Duncan Science Company.

Affinity. (2020). Aluminum Sulfate Composition and Uses. Affinity Chemical.

Alves dkk. (2006). Recovery of norbixin from a raw extraction solution of annatto pigments using colloidal gas aphrons (CGAs), In *Separation and Purification Technology*, 48, 208-213.

Arora dkk. (2017). Rainbow of Natural Dyes on Textiles Using Plants Extracts: Sustainable and Eco-Friendly Processes. In *Green and Sustainable Chemistry*.

Ayu dkk. (2018). Total Anthocyanin Content and Identification of Anthocyanidin from Plectranthus Scutellarioides (L.) R. Br Leaves. In *Research Journal of Chemistry and Environment*.

Broadbent, Arthur D. (2001). Basic Principles of Textile Coloration. Society of Dyers and Colourists.

Chakraborty, J. N. (2014). *Fundamentals and Practices in Colouration of Textiles*, 2nd Edition, Woodhead Publishing India Pvt Ltd, New Delhi.

Clark, M. (2011). Fundamental principles of dyeing. In *Handbook of Textile and Industrial Dyeing: Principles, Processes and Types of Dyes* (Vol. 1).

Colour Index International. (1987). 3rd Edition (3rd Revision). Society of Dyers & Colourists and AATCC.

Dean, J.R. (2009). *Extraction Technique in Analytical Science*. Wiley. A John Wiley and Sons, Ltd. Publication. United Kingdom.

Dike dkk. (2016). Phytochemical and Proximate Analysis of Foliage and Seed of Bixa orellana Linn. Covenant University.

Douglas (2012). *Design and Analysis of Experiments*. John Wiley. New York.

Duke, J. A. (1981). *Handbook of Legumes of World Economic Importance*. Plenum Press. New York.

Finar, I. L. (1975). *Organic Chemistry Volume 1*, 6th Edition. Longman Group Limited. London.

Giridhar dkk. (2013) A Review on Anatto Dye Extraction, Analysis and Processing – A Food Technology Perspective, New Delhi.

Giusti, M. M. dan Wrolstad, R. E. (2001). *Current Protocols in Food Analytical Chemistry*, John Wiley & Sons, Inc.

Gregory, P. (2003). Metal Complexes as Speciality Dyes and Pigments, In *Comprehensive Coordination Chemistry II*.

Han dkk. (2008). The Dyeability of Silk Fabrics with Annatto. Gyeongsang National University.

Hidayat, A. A. N. (2018). *Pemerintah Bidik 10 Industri Tekstil Pencemar Sungai Citarum*, https://bisnis.tempo.co/read/1064636/pemerintah-bidik-10-industri-tekstil-pencemar-sungai-citarum (diakses April 2020).

Hidayat dan Rahmawati, (2020), Sektor TPT Masih Tumbuh 15%, Ekspor Tekstil Turun 2,87& Tahun Lalu, https://industri.kontan.co.id/news/sektor-tpt-masih-tumbuh-15-ekspor-tekstil-mencapai-us-129-miliar-tahun-lalu (diakses April 2020).

Hidayati dkk. (2017). Pemanfaatan Limbah Daun Dan Kulit Mangrove (Rhizophora Mucronata) Sebagai Bahan Pewarna Alami Pada Kain Batik Di Pesisir Semarang. Universitas Diponegoro.

Humphrey, J. L. dan G. E. Keller. (1997). *Separation Process Technology*, McGraw-Hill, New York, USA.

Jung, J. S. (2017). Dyeing Properties and Functionality of Cotton and Silk Dyed with Fermented Indigo and Fresh Indigo. In *Proceedings of Academic World 72nd International Conference.*

Kakhia, T.I. (2015). Dyes, Colors & Pigments, http://tarek.kakhia.org (diakses Februari 2020).

Kang, Henry R. (2006). *Computational Color Technology*. Spie Press, Bellingham, Washington USA.

Kant, R. (2012). Textile Dyeing Industry an Environmental Hazard. SciRes. India.

Kementerian Perindustrian Republik Indonesia. (2019). Lampaui 18 Persen, Industri Tekstil dan Pakaian Tumbuh Paling Tinggi. https://kemenperin.go.id/artikel/20666/Lampaui-18-Persen,-Industri-Tekstil-dan-Pakaian-Tumbuh-Paling-Tinggi (diakses April 2020).

Kementerian Perindustrian Republik Indonesia. (2019). Tumbuh Positif, Industri Masih Kontributor Terbesar Ekonomi Hingga 19 Persen.

https://kemenperin.go.id/artikel/20908/Tumbuh-Positif,-Industri-Masih-Kontributor-Terbesar-Ekonomi-Hingga-19-Persen (diakses April 2020).

Khoo dkk. (2017). Anthocyanidins and Anthocyanins: Colored Pigments as Food, Pharmaceutical Ingredients, and The Potential Health Benefits. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5613902/ (diakses Februari 2020).

Konczak, I. dan Zhang, W. (2004). Anthocyanins—More Than Nature's Colours. In *Journal of biomedicine & biotechnology*.

Kong dkk. (2003). Analysis and Biological Activities of Anthocyanins. In *Phytochemistry Volume 69*.

Kumari, S. (2012). *Synthesis,* Characterization and Optical Properties of Rare Earth – Transition Metal Based Environmentally Friendly Red and Yellow Pigments. National Institute for Interdisciplinary Science and Technology.

Kurniasari dan Maharani. (2015). Pembuatan Komposit Kitosan Alumina Sebagai Agen Fiksasi Zat Warna Rodamin B Pada Kain Katun. Universitas Surabaya.

Lestari, D. W. dan Satria, Y. (2019). The Utilization of Kudo Bark (Lannea coromandelica) as The Source of Natural Dye in Dyeing of Silk Batik. In *Proceeding Indonesian Textile Conference.*

Mauliza, I. N. dan Putri, V. P. (2019). Dekoksi sebagai Alternatif Pembuatan Zat Warna Indigo Tarum Areuy (Marsdenia Tinctoria) dan Peranannya terhadap Pewarnaan Serat Berbahan Dasar Selulosa, In *Jurnal Kimia dan Pendidikan Kimia UNS.*

Metivier dkk. (1980). Solvent Extraction of Anthocyanins from Wine Pornace, In *Journal of Food Science.*

Mettler Toledo AG. (2019). UV/VIS Spectrophotometry Fundamentals and Applications.

Moiz dkk. (2009). Study the effect of metal ion on wool fabric dyeing with tea as natural dye. King Saud University.

Moldoveanu, Serban dan Victor David. (2015). Solvent Extraction.

Mondal, P., Baksi, S., & Bose, D. (2017). Study of environmental issues in textile industries and recent wastewater treatment technology, In *World Scientific News*, *61*(2), 98–109.

Mozaffari, E. (2018). Alum Mineral and the Importance for Textile Dyeing. In *Current Trends in Fashion Technology & Textile Engineering*, *3*(4), 85–87.

Mualimin, A. A. (2013). Pewarna Alami Batik dari Tanaman Nila (Indigofera) dengan Metode

Pengasaman. Universitas Negeri Semarang.

Nasim dkk. (2018). An Eco-friendly Approach of Cotton Fabric Dyeing with Natural Dye Extracted from Bixa orellana Seeds Employing Different Metallic Mordants. MBSTU.

Nasir, Subriyer, Fitriyanti Fitriyanti, dan Hilma Kamila. (2009). Ekstraksi Dedak Padi Menjadi Minyak Mentah Dedak Padi (Rice-Bran Oil)Dengan Menggunakan Pelarut n-Hexane Dan Ethanol. In *Jurnal Rekayasa Sriwijaya* 18(1):37–44.

Nguyen, P. dan Cin, V. D. (2009). The Role of Light on Foliage Colour Development in Coleus (Solenostemonscutellarioides (L.) Codd). In *Plant Physiology and Biochemistry*.

Orwa dkk. (2009). Agroforestree Database: A Ttree Reference and Selection Guide Version 4.0. http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp (diakses Maret 2020).

Ovando, A. dkk. (2009). Chemical studies of anthocyanins: A review. In *Food Chemistry*, *113*(4), 859–871.

Owen. (1996). *Fundamentals of UV-Visible Spectroscopy*. Hewlett-Packard Company.

Paden. (2009). Antioxidant Capacity and Lipid Characterization of Six Georgia-grown pomegranade cultivars. In *Book Chapter: Kearifan Lokal Bumi Indonesia.*

Paryanto dkk. (2012). Pembuatan Zat Warna Alami dalam Bentuk Serbuk untuk Mendukung Industri Batik di Indonesia. Universitas Sebelas Maret.

Paryanto dkk. (2014). Pembuatan Zat Warna Alami Dari Biji Kesumba Dalam Bentuk Konsentrat Tinggi Untuk Pewarna Makanan. Universitas Sebelas Maret.

Pereira, L. dan Alves, M. (2012). Dyes—Environmental Impact and Remediation.

Pontoh, Julius. (2014). Pengembangan Metode Analisa Warna Gula Aren.

Prabu dkk. (2015). Cleaning Validation and Its Rregulatory Aspects in the Pharmaceutical Industry. In *Developments in Surface Contaminating and Cleaning*, Chapter 5. Willian Andrew Publishing.

Prayudo dkk. (2015). Koefisien Transfer Massa Kurkumin dari Temulawak In *Jurnal Ilmiah Widya Teknik*, Volume 14 No. 1.

PubChem. (2020). Material Safety Data Sheet Kalium Alumunium Sulfat.

Puspita dkk. (2018). Produksi Antosianin dari Daun Miana (Plectranthus scutellarioides) sebagai Pewarna Alami. In *Pro Food (Jurnal Ilmu dan Teknologi Pangan).*

Putri, dkk. (2015). Perbedaan Mordanting Terhadap Hasil Pencelupan Zat Warna Alam Air Limbah Penirisan Getah Gambir Pada Sutera Menggunakan Mordan Tunjung (Feso4).

Research and Markets. (2020). Global Synthetic Dyes Market Outlook, 2020-2030. https://www.globenewswire.com/news-release/2020/02/24/1989226/0/en/Global-Synthetic-Dyes-Market-Outlook-2020-2030.html (diakses April 2020).

Reuhs dan Rounds. (2010). High Performance Liquid Chromatography. In *Food Analysis*, Springer Science+Business Media.

Ridwansyah dkk. (2014). Uji Fotostabilitas Kaolinit-Norbixin Berdasarkan Analisis Spektra Uv-Vis. Universitas Tanjungpura.

Schindler, W. D., & Hauser, P. J. (2004). Chemical Finishing of Textiles, In *Chemical Finishing of Textiles*.

Scotter dkk. (1998*)*. Analysis of Annatto (Bixa orellana) Food Coloring Formulations. 1. Determination of Coloring Components and Colored Thermal Degradation Products by High-Performance Liquid Chromatography with Photodiode Array Detection. American Chemical Society.

Scotter, M. J., Wilson, L. A., Appleton, G. P., & Castle, L. (2000). Analysis of annatto (Bixa orellana) food coloring formulations, 2. Determination of aromatic hydrocarbon thermal degradation products by gas chromatography, In *Journal of Agricultural and Food Chemistry*, *48*(2), 484–488.

Septiana. (2009). Sintesis Metil Ester dari Limbah Industri Produksi Margarin sebagai Bahan Baku Surfaktan Dietanolamida dengan Katalis Padatan Asam (y-Al_2O_3/SO4) dan Katalis Padatan Basa (K_2CO_3/y-Al_2O_3). Universitas Indonesia.

Shenai, V. A. (1987). *Chemistry of Dyes and Principles of Dyeing*, 3rd Edition. Sevak Publications.

Shimo, S. S. dan Smriti, S. A. (2015). Color Co-Ordinates and Relative Color Strength of Reactive Dye Influenced by Fabric GSM and Dye Concentration. In International Journal of Research in Engineering and Technology.

Singh, H. B., & Bharati, K. A. (2014). *Handbook of Natural Dyes and Pigments*.

Smith, J. dan Wallin, H. (2006). Annatto Extracts (Chemical and Technical Assessment).

Suhartati, T. (2017). *Dasar-dasar Spektrofotometri UV-VIS dan Spektrometri Massa untuk Penentuan Struktur Senyawa Organik*, Bandar Lampung.

Suryanto, Heru. (2016). Review Serat Alam : Komposisi, Struktur Dan Sifat Mekanis. *ResearchGate* (October):1–14.

Taylor, C. (2000). *The Kingfisher Science Encyclopedia*. Kingfisher.

Thermo Fisher Scientific. (2011). Safety Data Sheet Indigo.

TMIC. (2020). Showing Compound Norbixin (FDB014600). FooDB

Treybal, R.E. (1980) *Mass Transfer Operation,* Mc. Graw-Hill Kogakusha Ltd, Tokyo.

Uddin, Mohammad Gias. (2015). Extraction of Eco-Friendly Natural Dyes from Mango Leaves and Their Application on Silk Fabric. In *Textiles and Clothing Sustainability* 1–9.

Vankar, Padma S. (2000). Chemistry of Natural Dyes. In *Resonance* 5(10):73–80.

Vankar, Padma S., Dhara Shukla, Samudrika Wijayapala, and Asish Kumar Samanta. (2017). Innovative Silk Dyeing Using Enzyme and Rubia Cordifolia Extract at Room Temperature. In *Pigment and Resin Technology* 46(4):296–302.

Vankar, Padma S. (2016). Natural Dyes for Textile. In *Journal of Chemical Information and Modeling* (Vol. 53, Issue 9).

VCC Lab. (2016). Showing Compound Anthocyanins.

Vilar dkk. (2014). Traditional Uses, Chemical Constituents, and Biological Activities of Bixa orellana L.: A Review. Hindawi.

Vuorema, A. (2008). Reduction and Analysis Methods of Indigo.

Wenner, N. (2017). The Production of Indigo Dye from Plants, In *Fibershed*, 1–13.

WHO. (2019). *The International Pharmacopoeia*, 9th Edition.

Wulandari dan Faudi. (2017). Pengaruh Suhu, pH, Waktu Hidrolisis, dan Konsentrasi H2SO4 terhadap Kadar Glukosa yang Dihasilkan dari Limbah Kulit Kakao. Universitas Muhammadiyah Surakarta.

Yemirta. (2003). Isolasi Senyawa Bixin dari Biji Kesumba (Bixa Orellanna L.) In *Bulletin Penelitian.*

Yunelia, I.. (2019). Pemanfaatan Sumber Daya Hayati untuk Industri Masih Rendah. https://www.medcom.id/pendidikan/news-pendidikan/Wb7L9pak-pemanfaatan-sumber-daya-hayati-untuk-industri-masih-rendah (diakses April 2020).

Yusuf, M.. (2018). *Handbook of Renewable Materials for Coloration and Finishing*, John Willey and Sons.

Zaman dkk. (2018). An Eco-friendly Approach of Cotton Fabric Dyeing with Natural Dye Extracted from Bixa orellana Seeds Employing Different Metallic Mordants. Bangladesh.

Zhang, Qing Wen, Li Gen Lin, and Wen Cai Ye. (2018). Techniques for Extraction and

Isolation of Natural Products: A Comprehensive Review. In *Chinese Medicine (United Kingdom)* 13(1):1–26.

Zolkepli, Z. dkk. (2015). Efficiency enhancement of cocktail dye of Ixora coccinea and Tradescantia spathacea in DSSC. In *Journal of Biophysics, 2015*.

Zollinger, H. (2003). *Color Chemistry: Synthesis, Properties and Applications of Organic Dyes and Pigments*, 3rd Edition. Wiley-VCH.