
Article:
Blackburn, RS orcid.org/0000-0001-6259-3807 (2019) Editorial: 2018 BioColours conference. Coloration Technology, 135 (1). pp. 3-4. ISSN 1472-3581

https://doi.org/10.1111/cote.12389

2018 BioColours Conference

Richard S. Blackburn

Sustainable Materials Research Group, School of Design, University of Leeds LS2 9JT, UK.

The beautiful medieval town of Breda in the Netherlands was the location of the 2018 BioColours Conference, which was enhanced by the wonderful warm, sunny weather that lasted the two days of the conference, May 28-29. The conference was hosted by Avans University of Applied Sciences and the topics focused on were:

- Green building blocks for colorants and green synthesis to (new) colorants
- Bioprospecting of colorants or additives for colorants
- Biorefinery of colorants
- Industrial and commercial application and use of biobased colorants
- Performance improvement of colorants by the use of additives and
- Environmental aspects of colorants

Professor Thomas Bechtold from University of Innsbruck, a 2017 recipient of the Gold Medal from the Society of Dyers and Colourists, gave the opening keynote lecture. After introducing the research of the School of Textile Chemistry and Textile Physics at the satellite institute in Dornbirn, Austria, he discussed the required elements of standardisation, technology, quality, and of course costs, before natural dyes could be reintroduced into a commercial textile dyeing supply chain. He also discussed biotechnological approaches, applications of fungi and marine organisms, and colorants from food wastes (e.g. coffee). Another waste product that was discussed by Professor Bechtold was bark from wood-processing industries, which is available in considerable amounts in Europe. Polyphenolic components can be collected by hot water extraction from the bark waste and extracted compounds have been successfully applied as colorants in textile dyeing operations. A full paper on this topic is included in this Special Issue entitled “Extraction of polyphenolic substances from bark as natural colorants for wool dyeing” [1]. Professor Bechtold proposed that the application areas that were most suited currently to the use of ‘biocolours’ were food coloration, packaging, hair dyeing, and cosmetics, as these high value applications were generally the most suitable for the current relatively high costs associated with these colorants, compared to the costs of textile dyes. An excellent introduction, which set the tone for the rest of the conference.

The following session, entitled “Bioprospecting and biorefinery of colorants”, began with a lecture from Professor Dorian Derksen from The Centre of Expertise Biobased Economy, the Netherlands, on the development of a biorefinery that could ultimately lead to biobased textile dyes from European madder (Rubia tinctorum L.) root; despite the cost implications of using bio-derived

colorants for textiles (as discussed by Prof. Bechtold), R. tinctorum is one example where large-scale production could lead to economically viable possibilities. Professor Derksen discussed the problem that some components from R. tinctorum (lucidin, rubiadin, ibericin) are known carcinogens, which was confirmed with an Ames test – not everything in nature is safe, in fact many compounds are not. Her research team had developed a step-wise extraction method to remove these components using enzymatic and solid-phase extraction. The development of the full biorefinery is ongoing.

Robert Pott from Stellenbosch University, South Africa, discussed the natural food colorants trend, particularly the recent use of phycocyanin, a proteinaceous pigment from Spirulina spp. blue-green algae. Dr Pott outlined that various cell disruption methods exist that cause the lysis of the cyanobacterial cells and release the phycocyanin, but discussed that methods have significant drawbacks, such as cost, difficulty in scale-up, bacterial contamination, or risk of degrading the protein. In work also presented in this special issue entitled "The release of the blue pigment phycocyanin through the calcium-aided cytolysis of live Spirulina sp." [2], he explained that an alternative method for cell disruption had been developed at Stellenbosch University, which is based on the use of Ca^{2+} ions that lyse live Spirulina biomass, releasing phycocyanin at a range of concentrations over varying time periods, paving the way for the development of a novel bioprocess for the industrial production of the biological pigment.

Riikka Räisänen, University of Helsinki, discussed the use of fungal colorants, with a particular focus on Cortinarius species. Despite the fact that fungal-derived natural dyes have been used more rarely than plant-based dyes, she explained that a whole spectrum of colours can be obtained from fungi and Cortinarius species produce a significant number of different anthraquinonoid colorants (6% dry weight), the most abundant being emodin and dermocybin. It was demonstrated that these dyes could be used in disperse dyeing of PET and PA without dispersing agents. A full paper entitled "Fungal colorants in applications – focus on Cortinarius species" [3] features in this Special Issue.

Other notable presentations on day one included research from Laurent Dufossé, at The Université de la Réunion, France, who discussed microorganisms as sources of biobased colorants using fungi, work by Monica Nunes of Instituto de Biologia Experimental e Tecnológica, Portugal, on microencapsulating carotenoid pigments from Dunaliela salina using polysaccharides, and research from Anna Cardoso, from The Centre for Nanotechnology and Smart Materials, Portugal, on aqueous extraction of colorants from peppermint and globe artichokes.

The warm weather was perfect for the conference dinner on the evening following the first day's lecture, and delegates enjoyed a delightful outdoor barbecue with networking into the late evening.

The second keynote presentation that opened day two of the conference came from Professor Bodo Wilts from The University of Fribourg, Switzerland, entitled "With or Without pigments: coloration strategies in nature". Professor Wilts discussed the different ways in which nature presents colour to the observer – "it isn't necessarily dyes and pigments that achieve this!" Biophotonics is the study of the sources of colorants in animals, which is often achieved from two materials using nanoscale structures. Animals use colour to indicate poison, for mating and for protection against predators, and often this is achieved with pigments, such as astaxanthin, melanins, ommochromes, pterins, carotenoids. Professor Wilts discussed the ways in which some animals use complex pigmented structures to present colour, for example, the butterfly shown on the cover of this Special Issue uses nanostructured scales of chitin with nanospheroid 'packages' of pigment (the shape of rice grains) to provide colour to its wings; this is in contrast to the flower that same butterfly sits on in the cover image, which contains water-soluble flavonoids in the cells of its petals.

However, structural colour is very different. There is no pigment or dye present, and colour is observed as a result of light interaction with a structured surface, such as hairs or scales, which can be seen in the iridescent colours of beetles (now being mimicked by BASF in novel paints). These are not just flat structures, and nature is able to make 3D structures that can interact with light, and some beetles make a highly complex 3D chitin nanostructure that reflects and scatters over 80% of all light to make a very bright white using only a very thin layer of materials.

The session that followed was entitled "Application and use of biobased colorants" and began with Brecht Demedts, from Cetexbel in Belgium discussing biobased dyes, mordants and auxiliaries from Spirulina for dyeing and functionalizing textiles. They used vacant greenhouses to grow the Spirulina, giving additional business to farmers. Spirulina is a protein that does not adsorb onto fibres, so they used a tannin as a biomordant, which binds the Spirulina to the textile to give coloration. Kate Wells, University of Derby, UK, took a different perspective and how the use of sustainable colours, materials and patterning choice for textiles can have a positive impact on our health and wellbeing. She also discussed William Herschel's experiments with photo-sensitive dyes from natural materials in the 1840s to create artistic prints and how he achieved "solar dyeing" using turmeric.

The next session entitled "Green synthesis of colorants and stabilisation of colorants" began with Frankje de Boer, Utrecht University, Netherlands, discussing edible colloidal colorants from water-insoluble proteins from corn (zein). A full review on this topic will be presented by Frankje de Boer in a later issue of Coloration Technology in 2019. Another presentation by the Dufossé group at Université de La Réunion, France, discussed marine-derived fungi that produce polyketide pigments and how they have optimised fermentation conditions using response surface methodology to achieve high yields of the pigments.

Research from the University of Leeds discussed how sustainable methods have been developed to extract anthocyanin colorants from food waste. Blackcurrant (Ribes nigrum L.) fruit waste, left over after the fruit has been pressed for making Ribena, can be cleanly extracted to produce anthocyanin-rich extracts in high industrial yields [4], which have been demonstrated to be highly effective as both renewable hair colorants [5] and textile dyes. Muhammad Wathon, a PhD student from The University of Leeds, discussed "Extraction of anthocyanins from Aronia melanocarpa skin waste as a sustainable source of natural colorants", which is presented in full in this Special Issue [6], and reported how anthocyanin-rich extracts can also be achieved by extracting waste Aronia berry skins, and how he developed a novel integrated extraction-adsorption process that produced extracts in higher yields, with less hydrolysis of the colorants, in comparison with batch extraction methods.

PhD students also presented a significant number of posters at the conference, and some of these were including in an entertaining oral session where presenters gave 7-minute 'pitches' of their research. The prize for the best poster went to a poster entitled "Comparison of Madder (Rubia tinctorum L.) and Weld (Reseda luteola L.) total extracts and their individual dye compounds regarding their dyeing behaviour, colour and stability towards light"; a full paper by the authors is featured in this Special Issue [7], and reports on the dyeing properties, colour properties and colour stability of natural dyes from madder and weld.

The conference concluded with all delegates agreeing that this inaugural event had been a tremendous success and with the increasing interest in fundamental study, production, and application of biocolours, another conference would be organised in the near future.

References

1. C Fitz-Binder, T Bechtold, Color. Technol. **135** (2019) 33. https://doi.org/10.1111/cote.12378
2. R W M Pott, Color. Technol. **135** (2019) 18. https://doi.org/10.1111/cote.12373
3. R Räisänen, Color. Technol. **135** (2019) 23. https://doi.org/10.1111/cote.12376
4. S Farooque, P M Rose, M Benohoud, R S Blackburn, C M Rayner. J. Agric. Food Chem. **66** (2018) 12265.
5. P M Rose, V Cantrill, M Benohoud, A Tidder, C M Rayner, R S Blackburn. J. Agric. Food Chem. **66** (2018) 6790.
6. M H Wathon, N Beaumont, M Benohoud, R S Blackburn, C M Rayner, Color. Technol. **135** (2019) 6. https://doi.org/10.1111/cote.12385
7. H Willemen, G J P van den Meijdenberg, T A van Beek, G C H Derksen, Color. Technol. **135** (2019) 41. https://doi.org/10.1111/cote.12384