

Enzymatic indican for low-impact blue denim dyeing

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Indigo is the well-known dye that gives rise to the characteristic and desired washed-out blue denim look. It has been used since ancient times when it was extracted from plants.¹ When the demand exploded with the industrial revolution, the industry turned to a more convenient production of the dye. The chemical synthesis is based on aniline, which is petroleum-derived, suspected carcinogenic, and has high acute toxicity². Due to the intrinsic properties of indigo, the dye is reduced to its soluble counterpart *leuco*-indigo to dye the denim (Fig. 1A). This chemical process involves a strong reducing agent at high pH to retain the soluble dye in the dyeing vat, in a process with large environmental footprint. Fortunately, an enzymatic alternative has been established where the water-soluble glycoside-protected indoxyl can be used as the dyeing agent through enzymatic deprotection by glucosidase activity or photolytic cleavage^{3,4} (Fig. 1B). The main drawback to this method is the availability of Indican and therefore we are exploring a biocatalytic approach which involves a 5-step enzymatic cascade to Indican from the biobased building blocks. We work continuously with sustainability and economic assessments (LCA and TEA) to improve our processes, and will present the project's current stage, including technical maturity, economic, and environmental performance.

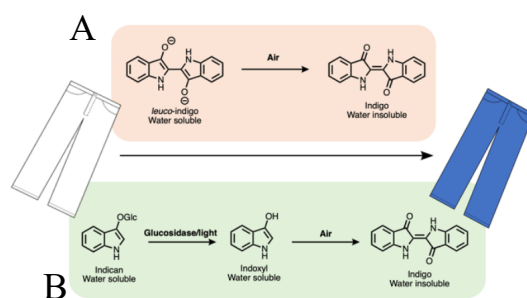


Figure 1, A) Indigo based dyeing. B) Indican-based dyeing

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