Some Like It Hot: Naturally-Dyed Hot Yoga Apparel

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Contextual Review and Concept: Yoga is a discipline that emerged on the Indian subcontinent thousands of years ago, with the earliest origins recorded in Vedic texts (c. 1200 BCE) and more formalized written accounts in the *Yoga Sutras of Patanjali* (c. 500 CE). While there are eight limbs of yoga, the Western world is most familiar with *asana*, also known as *Hatha Yoga*, which is the physical practice of yoga *asanas* (body postures). Over the past 50 years, numerous forms of *Hatha Yoga*—from Vinyasa, Yin, Moksha, Ashtanga, Anusara, Kripalu, Iyengar, to Bikram—have grown in popularity in the West. It was estimated that approximately 15 million U.S. Americans practiced hatha yoga in 2008, a number that increased to 24.5 million in 2015 and is projected to grow to 55 million in 2020 (Statista 2018: para 3). As the number of yoga practitioners in the United States continues to grow, so too will the demand for apparel that meets the needs of yoga *asana* practice. Researchers have found that yoga practitioners are demanding for more sustainable active wear (Jason 2014; Park 2016). This is a challenge for practitioners of hot yoga because the room is typically heated to 105F/40C and 40% relative humidity. This results in profuse sweating; therefore, natural fibers like cotton and linen are rendered impractical because they retain water weight rather than wick moisture away from the body. This design was conceptualized to meet both the needs and sustainability desires of hot yoga practitioners. Without abandoning synthetic fibers, this design sought to improve the sustainability of hot yoga clothing in two ways: (1) by using natural dyes from plants to color the textiles, and (2) by creating a design that used a minimal amount of fabric and could incorporate fabric scraps to reduce waste.

Hot yoga, sometimes referred to as Bikram Yoga, was developed by Bikram Choudhury and brought to the United States in the 1970s (Bikram 1978). Previous research found that Bikram Yoga practitioners developed a, "newfound comfort with, and love for, their bodies," after long periods of consistent yoga practice (Green 2014: 9); furthermore, practitioners changed how they dressed because of "greater bodily acceptance" and began wearing much smaller outfits to yoga classes (Green 2014: 9). In another study on mobility and comfort of Bikram yoga apparel, researchers found that practitioners preferred garments should be tight-fitting because "loose silhouettes were not considered appropriate for this exercise due to unintended exposure when practicing poses" (Doty, Li, Guria, Park, & Green 2017). These previous findings informed the design of this garment, which accommodates necessary coverage of breasts, buttocks, and genitalia in a range of different postures. Different postures affect body dimensions (Doty, et. al 2017); therefore, the challenge was to provide appropriate coverage while ensuring minimal fabric use.

Process, Technique, and Execution: Design of the textile was the starting point of the garment. A 25% 4-way stretch jersey knit fabric with fiber content of 80% Nylon and 20% Lycra Spandex was selected for its elasticity and potential for dyeing. Nylon is the only synthetic fiber that is easily dyed with plant matter using a simple pre-mordant bath of aluminum sulfate (at 12% weight of fiber). In addition, nylon is often used in swimwear because it has a low water absorption rate (making it ideal for the profuse sweating that occurs in hot yoga); furthermore, it is a very strong fiber that is abrasion resistant, easy to wash, lightweight, and lustrous (Miah et al. 2016). To make the textiles more sustainable, a contact dyeing technique was used (Kadolph and Casselman 2004; Haar 2015). In this technique, also sometimes called eco-printing, plant matter was bundled within a pre-mordanted textile (aluminum sulfate pre-mordant at 12% weight of fiber) and steamed; therefore, less water was used in the dyeing process while maximizing color extraction. This method of dyeing has the potential to result in more intense colors and be less labor intensive than immersion dyeing techniques (Kadolph and Casselman 2004: 19). After the fabric was pre-mordanted it was cut into two pieces and designed with two different contact dyeing techniques: the first piece was bundled with an assortment of Hopi dye sunflower seeds that were grown by the designer in the University's natural dye garden; and the second piece was bundled with the petals of Diva Dahlias (purple) and Clearview Daniel Dahlias (yellow), both procured from a local flower farm. After the textile was bundled, it was steamed for two

hours and after cooling, was opened and washed with a pH neutral soap.

In order to develop the garment design, a yoga practitioner was body-scanned in the full expression of four different yoga postures, including a forward bend, backward bend, side bend, standing splits, and scanned in a neutral standing post. The ability to manipulate and examine the 3-D body scans from different angles aided in the development of patterns that would ensure necessary coverage of genitalia, buttocks, and breasts in all yoga postures. After pattern development the seams were sewn using a Juki 4-thread serger MO 6814S, and seam allowances were flattened against the fabric by using top-stitching on a Juki MF-7823 Coverstitch machine. Topstitching was both functional and added aesthetic interest to the piece.

Aesthetic Properties and Visual Impact: As Kadolp and Casselman noted, "Serendipitous results characterize the contact method of dyeing," making it unpredictable and inconsistent but full of exciting visual possibilities (Kadolph and Casselman 2004: 19). The strong aesthetic qualities of this minimal yoga ensemble began with the textile itself: a pastel but profound color palette of yellows and purples. When used together, complementary colors create more intensity and vibrancy, which was important in this particular dye process where rich colors were more challenging to achieve. Because the fiber content of the fabric is 80% Nylon and 20% Lycra Spandex (and the latter would not take natural dyes), a lighter value was expected overall. The combination of purple and yellow was therefore strategic to create an illusion of greater vibrancy. Because the colors were not at full saturation the use of complementary colors did not create tension or overwhelming afterimage, as can happen with complements at full saturation. Instead, the colors enhance one another and the ghost-like forms from the plant matter.

The yoga top was designed to emphasize the imprints of the Hopi dye sunflower seeds and dahlia petals. The simplicity of the twisted keyhole top ensures that the textile design is highlighted as a prominent aesthetic feature. The top is well-balanced in both color and form: one side is the fabric bundled with Hopi dye sunflower seeds, and the other side is fabric from the petals of dahlias. The small keyhole also adds to the balance by ensuring just the right proportion of revealing and concealing the body. The simple cross-strap back has a functional purpose (connecting to the front side hem and providing support for breasts), while ensuring minimal fabric use.

The shorts are also relatively simple and designed to bring focus to the textile design. The side seam was shifted toward the backside to create shaping over the buttocks. A gusset was designed into the crotch to ensure coverage during postures that involve the standing splits (like standing bow pose – photographed as the side-view), because the length of the crotch expands during splits. In order to highlight the two different fabrics and utilize fabric scraps, a small rectangle was used as decorative patchwork along the model's right buttocks, and an even smaller scrap was used on the left side of the waistband. These color and textile choices ensured balance of color and the illusion of texture that the textile design creates. The form of the design minimizes fabric use while ensuring coverage of necessary parts of the body in various yoga poses; therefore, the garments have been photographed as they would be worn in three different yoga postures to show front, side, and back view (permission to photograph in *asanas* rather than "at attention" was approved prior to submission by design track chair).

Cohesion, Design Contribution, & Innovation: While interest in natural dyes has increased over recent years (Křížová 2015), naturally-dyed design scholarship has been limited to non-athletic apparel. Yoga practitioners differ from other athletes in their commitment to social and ecological issues, like sustainability (Jason 2014; Park 2016). This design makes an innovative contribution to textile design scholarship by experimenting with natural dyes on a nylon-spandex blended fabric. Furthermore, the 3-dimentional design is also an important contribution that has been engineered to specifically meet the needs and desires of hot yoga practitioners (Green 2014; Doty et al. 2017). This design also creates opportunity for future research on the mordanting effect of human sweat on natural dyes over time, the impact of repeated laundering and wear, and development of large-scale industrial processes for contact dyeing with plant matter. With future research, this design would ideally shift from the category of limited production (LP) to mass market (MM) targeted to the growing number of yoga practitioners across the world.

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Image A – Front View (*Tikanasana* – Triangle Pose)

Image B – Back View (*Tadasana* – Tree Pose)

Image C – Side View
(Dandayamana Dhanurasana – Standing Bow Pose)

Image D - Detail