THESIS

RESEARCH AND DEVELOPMENT OF AYURVASTRA ACTIVEWEAR

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ABSTRACT

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This study integrates materials testing and consumer marketing analysis to establish the foundation for a sustainable activewear brand designed to enhance comfort and alleviate mild physical discomfort. Guided by a modified Design Thinking (DT) framework, the research is organized into three phases: *Understand, Explore,* and *Materialize*. The *Understand* phase examines current challenges in sustainable textiles and identifies emerging consumer needs in the activewear sector. The *Explore* phase encompasses comprehensive materials testing, design development informed by expert feedback, and a consumer survey assessing responses to sustainability-, health benefits-, and innovation-focused marketing messages. Finally, the *Materialize* phase synthesizes findings to inform future product and brand development.

The results offer insights into the feasibility of using naturally dyed and bio-based textiles in performance apparel, reveal consumer preferences for sustainability and health-oriented design, and evaluate consumer responses to varied messaging conditions. By addressing both material functionality and consumer perception, this study provides multidimensional guidelines for advancing sustainable activewear that aligns with contemporary environmental and health values.

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INTRODUCTION

Archaeological evidence suggests that the medicinal use of herbs dates back as far as 60,000 years in present-day Iraq, with similar practices documented in ancient Chinese and Sumerian texts from 8,000 and 5,000 years ago, respectively (Pan et al., 2014). Many traditional cultures have long relied on plant-based remedies to treat and prevent illness; however, Western or "conventional" medicine has often been more skeptical of the efficacy of such treatments.

Ayurvastra, derived from the Sanskrit words for life and clothing, represents a unique intersection of traditional medicine and sustainable fashion. This practice incorporates medicinal herbs, fruits, and plants directly into textile fibers through natural dyeing processes, allowing clothing to serve as both functional apparel and therapeutic support. Reported benefits of Ayurvastra include improved skin health, stress reduction, and enhanced holistic well-being (Tiwari, 2024). Beyond its medicinal potential, Ayurvastra embodies principles of environmental sustainability, cultural continuity, and spiritual mindfulness, fostering an elevated awareness of personal and environmental health (Tiwari, 2024).

The relevance of such methods is particularly significant today, as more than 50 million U.S. adults experience daily pain (Axon & Maldonado, 2023). Among these, 79% report back pain, 68% experience discomfort in the upper body, and 79% suffer from pain in the lower extremities (Axon & Maldonado, 2023). The International Association for the Study of Pain defines pain as "an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage." For many, pain serves as a barrier to maintaining physical activity, underscoring the importance of clothing that supports movement rather than exacerbates discomfort. In addition to conventional pain management techniques such as self-care, nutrition, and moderate exercise, the use of naturally dyed activewear with

potential anti-inflammatory or analgesic properties may provide a safe, noninvasive strategy to enhance physical comfort during activity.

Despite growing interest in sustainable apparel, most activewear brands fail to address consumer needs for both comfort and pain relief. Therefore, the overarching objective of this research is to investigate how integrating natural dyes into sustainable textiles can simultaneously address comfort, functionality, and health. The study seeks to explore how such innovations can support consumers who experience mild physical discomfort while promoting overall well-being.

More specifically, this research combines materials testing and consumer marketing analysis to establish the foundation for an Ayurvastra-inspired activewear line that may offer anti-inflammatory or analgesic benefits. By examining the functional performance of naturally dyed textiles, this work aims to assess the commercial viability of naturally dyed fibers in activewear applications. The project involves developing a line of Ayurvastra-inspired activewear designed for women aged 18–40 and evaluating consumer responses through an online experimental survey. The results will identify which aspects of the brand messaging (such as sustainability, health benefits, or innovation) most strongly influence purchase intention and engagement, thereby informing effective marketing strategies and reducing advertising costs in future brand development.

This research employs a modified Design Thinking (DT) model to guide the exploration of natural dyes with medicinal benefits and their potential application in sustainable activewear. Using a DT framework ensures that the study remains user-centered, practical, and responsive to consumer needs (Brown, 2009). DT also promotes creativity and innovation through its iterative nature, allowing ideas to evolve and improve through continuous refinement and feedback. The

structured, yet flexible, framework, comprising the stages *Empathize, Define, Ideate, Prototype,* and *Test,* provides a systematic approach that accommodates emerging insights throughout the research process. Moreover, DT's emphasis on prototyping and testing ensures that the study's outcomes are both evidence-based and applicable to real-world design and product development contexts.

Figure 1

Visual of the Modified Design Thinking (DT) Methods and Activities Used in this Study

This research utilized a modified DT model consisting of three primary phases: *Understand*, *Explore*, and *Materialize* (Figure 1). The activities and methods applied in this study are organized within these categories to reflect a systematic and iterative approach to sustainable design development.

The *Understand* phase involves analyzing current issues related to natural dyes in apparel and introducing the framework for the online experimental testing. This phase is divided into two

components: *Define* and *Empathize.* Under *Define*, the researcher (a) examines key sustainability challenges within the textile industry, (b) provides an overview of natural fibers and natural dyes with medicinal properties along with their reported physiological benefits, and (c) outlines the relevance and application of online experimental testing. The *Empathize* stage focuses on identifying specific challenges faced by individuals who engage in low- to moderate-intensity physical activities, offering insight into existing gaps in activewear functionality and market needs.

The *Explore* phase centers on designing and evaluating new textile innovations by integrating sustainable, natural dyes with medicinal properties into activewear and assessing their performance. This phase includes three subcomponents: *Ideate Methods – Material Testing; Ideate Methods – Design;* and *Ideate Methods – Buying Intention Toward Sustainability, Health, or Innovation Messaging.* Each component addresses a distinct aspect of the investigation, from dye and material testing to design development and the implementation of the experimental survey assessing consumer perceptions.

Finally, the *Materialize* phase encompasses the execution of final design decisions and the subsequent evaluation of research outcomes. This phase is divided into *Implement – Material Testing; Implement – Design;* and *Implement – Buying Intention Toward Sustainability, Health, or Innovation Messaging.* These sections detail the finalized design outcomes, a description of the material testing results, and the analyses of the online experiment embedded in a survey, collectively representing the culmination of the DT framework within this study.

CHAPTER 1 - UNDERSTAND: DEFINE AND EMPATHIZE

In the first phase of the DT model, this section provides the necessary background to define the research problem and establish current market needs. It examines key issues related to dyes and materials in the textile industry, with particular attention to the potential benefits of natural dyes containing medicinal properties. Additionally, it offers a concise overview of online survey design and highlights the value of incorporating expert testimonials into the design process to inform development and validate findings.

1.1 Define

Sustainability remains a critical concern in the textile industry. Each year, approximately 90 billion articles of clothing are sold, many of which are produced using non-biodegradable synthetic materials, excessive water resources, and processes that generate substantial carbon emissions (Zhang et al., 2022). Although the global activewear market is projected to exceed $450 billion by 2028, the availability of high-performing sustainable alternatives remains limited (Smith, 2024). Current sustainable options often suffer from restricted color and style ranges (compared to unsustainable industry leaders such as Lululemon) and compromised functionality, including poor shape retention, transparency issues, and substandard quality despite premium pricing.

In addition to these functional challenges, many sustainable activewear brands rely on recycled polyester, often sourced from plastic bottles. While recycled polyester is frequently marketed as an eco-friendly material, it can still release harmful chemicals that may be absorbed through the skin, raising concerns about potential long-term health effects. As consumers grow more conscious of the environmental and health impacts of synthetic textiles, the demand for genuinely sustainable and non-toxic alternatives continues to increase. Social influence plays a key role in shaping these sustainability-driven choices, as individuals' decisions are guided by

the norms, identities, and expectations of others (White et al., 2019), suggesting that both material innovation and social dynamics are central to fostering meaningful behavioral change in the activewear market.

1.1.1 Define - Textiles

Harmful Chemicals in Fabrics and Dyes. The shift from harmful fabrics and synthetic dyes to more sustainable and naturally derived alternatives has accelerated in recent years. This trend can be attributed to the growing awareness among consumers regarding the detrimental effects of the textile industry on both environmental and human health, particularly among those in close proximity to manufacturing sites. Research has shown that synthetic materials such as polyester and chemical dyes like Azo dyes are carcinogenic and may contribute to cancer, organ damage, and skin irritation, among other health concerns.

For instance, in 2017, researchers from Harvard University conducted a study involving 684 Alaska Airlines employees who developed chemical sensitivities and a range of symptoms, including rashes, itchy eyes, blurred vision, sinus congestion, and respiratory distress, after receiving new uniforms. Subsequent testing revealed that the uniforms contained hazardous substances such as tributyl phosphate, lead, arsenic, cobalt, antimony, toluene, hexavalent chromium, and dimethyl fumarate (McNeely et al., 2017). Similarly, a 2023 investigation by the Center for Environmental Health in California detected bisphenol A (BPA) levels up to 19 times higher than the state's safety limit in apparel from major brands including Nike, Athleta, Hanes, Champion, and New Balance (Wicker, 2023).

Beyond direct human exposure, millions of tons of textile waste, including effluent from synthetic dyes, continue to enter ecosystems, posing significant risks to water and food supplies (Che & Yang, 2022). Consequently, the application of natural dyes with medicinal properties has

gained increasing attention for their potential to offer health benefits, biodegradability, environmental compatibility, and therapeutic value (Che & Yang, 2022).

Overview of Medicinal Dye Properties & Bioavailability. Phytochemicals are plant-based bioactive compounds produced by plants as a defense against environmental stressors such as insects, ultraviolet radiation, and disease, and are categorized according to their chemical structure (Kumar et al., 2023). These compounds have demonstrated antioxidant, antimicrobial, and antiviral properties, among others, and have been shown to regulate gene transcription, enhance immune response, and protect against various cancers (Kumar et al., 2023).

While most research on phytochemicals focuses on their effects within a dietary context, emerging studies suggest that these compounds may also be absorbed through the skin (Alonso et al., 2014). However, the limited bioavailability of phytochemicals remains a major barrier to effective percutaneous (through-the-skin) absorption. Bioavailability refers to the proportion of a compound that exerts an active effect after entering systemic circulation. Because the skin acts as a natural barrier against external substances, phytochemicals face challenges in penetrating, permeating, and being reabsorbed. Nevertheless, small quantities may traverse the skin's layers and enter the bloodstream, depending on specific chemical and molecular characteristics (Alonso et al., 2014).

Many beneficial phytochemicals are concentrated in parts of plants, herbs, and fruits not typically consumed, such as rinds, seeds, and pulp, which are often used in natural dye production (Saparbekova et al., 2023). Consequently, dyes derived from these "food waste" materials may contain higher concentrations of active compounds while simultaneously reducing agricultural and food industry by-products (Saparbekova et al., 2023). Using these by-products to

dye textiles not only minimizes waste but may also confer health benefits through limited skin absorption.

Dr. Shruti Tiwari of Parul University conducted three case studies examining individual experiences with herbal-dyed garments, illustrating the potential therapeutic effects of natural dyes with medicinal properties. In the first case, a 32-year-old woman with allergy-prone skin regularly wore neem- and turmeric-infused garments and reported significant improvements in skin condition. The second participant, a 40-year-old male executive with self-reported high stress levels, wore peppermint- and lavender-infused garments during work and leisure, noting calming effects and improved focus. The third participant, a 50-year-old woman with acute arthritis, wore madder- and turmeric-infused garments, both known for anti-inflammatory properties, and experienced reduced joint stiffness and discomfort. She stated, “I can't express how much Ayurvastra has improved my daily life. Living with arthritis is challenging, but these garments have become my ally. The natural healing properties make a tangible difference, and I'm grateful for the relief they bring” (Tiwari, 2024).

These case studies underscore the therapeutic potential of plant-based dyes in apparel and align with this project’s objective: to develop functional, sustainable activewear that delivers tangible health benefits. By integrating insights from these findings, this research seeks to design a collection that enhances wearer comfort and well-being through the medicinal properties of natural dyes.

Fabrics & Substrates. Most cellulosic fibers demonstrate strong dye retention because of the chemical bonds formed between the cellulose molecules and the natural pigment compounds found in plant-based dyes (Thakker & Sun, 2022). Beyond their dye affinity, many cellulosic materials are well-suited for athletic and sportswear garments due to their

breathability, soft hand, and moisture-wicking capabilities. However, certain structural characteristics, particularly their limited elasticity and poor shape retention, can hinder their performance in high-mobility applications, which is why few activewear products are composed exclusively of cellulosic fibers.

In contrast, the protein fiber merino wool possesses inherent qualities that make it highly suitable for activewear. The interlocking protein molecules within wool fibers provide natural elasticity, allowing the material to stretch and return to its original shape (Dyes and Dyeing Polar versus Nonpolar Compounds, 2016). Wool is both hydrophobic, repelling liquid water on its surface, and hygroscopic, meaning it can absorb up to one-third of its weight in water vapor while remaining dry to the touch. Additional characteristics such as odor resistance, breathability, and softness further enhance its desirability for performance apparel. Moreover, merino wool is easy to care for, as it can sometimes be machine-washed and tumble-dried. Conveniently, natural dyes also bond effectively to wool fibers because of the presence of ionized acidic and basic groups that serve as receptors for the charged molecules within natural dyes (Lin et al., 2022).

Dye Material. Based on the background research, two natural dyes were selected for this study: indigo (Indigofera tinctoria) and madder (Rubia tinctorum). The indigo plant contains indirubin, a compound known to inhibit the production of certain pro-inflammatory cytokines (proteins that bind to cell receptors and trigger swelling, redness, and irritation), thereby reducing inflammation-related damage (Qi-yue et al., 2020). In addition to its anti-inflammatory effects, indirubin demonstrates antioxidative, antibacterial, antiviral, immunomodulatory, and antitumor properties, and has been investigated as a therapeutic agent for conditions such as acute promyelocytic leukemia, psoriasis, and ulcerative colitis (Qi-yue et al., 2020).

Similarly, the madder plant contains anthraquinones (AQs), a class of phytochemical compounds recognized for their hemostatic, antioxidant, and antibacterial properties (Nam et al., 2017). Among these, alizarin, a primary anthraquinone extracted from Rubia tinctorum, has been traditionally used in Chinese medicine for its notable anti-inflammatory effects (Mu et al., 2023).

1.1.2 Define – Buying Intention Toward Sustainable, Heath Benefits, or Innovation Messaging Online Survey

In the final *Define* stage of the DT model, this study introduces one of its key methodological components: a consumer survey designed to examine purchase intention toward messaging emphasizing sustainability, health benefits, or innovation. This method was employed to determine whether the proposed activewear brand concept effectively resonates with potential consumers. The background, rationale, and importance of this experimental survey design are outlined here, while detailed descriptions of the survey's procedures, measures, and analyses are provided in the sections *Ideate Methods – Buying Intention Toward Sustainable, Health Benefits, or Innovation Messaging Online Survey* and *Implement – Buying Intention Toward Sustainable, Health Benefits, or Innovation Messaging Online Survey.*

According to Ball (2019), surveys are a valuable tool for collecting large quantities of high-quality data on specific research questions from a targeted population. They enable the measurement of consumer interest, consideration, and behavioral intention, which together can be used to predict purchase likelihood (Gunawan et al., 2023). By quantifying participants' responses to experimental advertising conditions, each emphasizing a distinct theme (sustainability, health benefits, or innovation), this study seeks to understand how consumers process marketing information and form purchase intentions (MacInnis & Jaworski, 1989).

In this research, the survey was applied to assess the effectiveness of email marketing messaging promoting Ayurvastra-inspired activewear products. The data collected provided insight into consumers' perceived purchase intention and engagement with the brand's messaging strategies. This approach ensures that the marketing communication developed for the final collection aligns closely with consumer values and expectations.

1.2 Empathize

In the DT framework, the *Empathize* phase focuses on understanding a specific problem from the perspective of the end user or consumer. In this research, the primary users are activewear consumers who regularly engage in low- to medium-intensity forms of exercise or activities. This section explores existing knowledge from the perspective of expert users, such as yoga instructors, running coaches, and personal trainers, to identify the challenges they encounter with their current activewear. By examining these professional insights, the study aims to uncover user-centered design needs and functional shortcomings that inform the development of improved sustainable activewear solutions.

Consumer Frustrations and Desires for Sustainable Activewear. Through observations and testing of popular activewear on the market, it became evident that both synthetic and sustainable brands present distinct challenges. As discussed in previous sections, fully synthetic activewear poses risks to both human and environmental health. Conversely, while sustainable activewear tends to be healthier and more environmentally responsible, it often underperforms in active settings compared to its synthetic counterparts. Common performance issues include poor elasticity and loss of shape after minimal use, factors that can be both frustrating and potentially hazardous during physical activity. Additionally, sustainable activewear collections typically lack diversity in color and style, often limited to small

assortments in neutral or muted tones. This limited variety may reduce appeal among consumers seeking more expressive or fashion-forward options. Finally, sustainable activewear is frequently priced at a premium due to material sourcing and production methods, which can create cognitive dissonance among consumers who wish to purchase sustainably but struggle to justify the cost of products that underperform functionally.

For sustainable activewear to achieve parity with synthetic alternatives, it must deliver comparable performance while maintaining aesthetic appeal and price transparency. By incorporating insights from expert testimonials, this research captures key consumer frustrations and aspirations for sustainable activewear, informing the development of a collection designed to better align functionality, comfort, and sustainability.

1.3 Research Questions

Given the multifaceted nature of this study, the following research questions were developed to examine the relationships between material performance, design strategy, and consumer purchase intention within the context of this sustainable activewear collection:

- **RQ1: Material Testing:** Are madder and indigo natural dyes sufficient in terms of colorfastness to perspiration, laundering, and crocking for activewear applications?
- **RQ2: Design:** How can qualitative insights from trend research and expert feedback be integrated to guide silhouette development and performance features in this activewear collection?
- **RQ3: Advertising Conditions:**
    - **RQ3a:** Does purchase intention differ significantly across the three advertising conditions?

- **RQ3b:** How do views on sustainable activewear influence consumers' purchase intention across different message framing in the advertising conditions (sustainability, health benefit, innovation)?
- **RQ3c:** How does pain level influence consumers' purchase intention across different message framing in the advertising conditions (sustainability, health benefit, innovation)?

CHAPTER 2 - EXPLORE: IDEATE METHODS

Explore represents the second major phase of the DT process. This section outlines the methods used in the study, detailing the procedures for the dyeing process, design development, and survey testing approach. Prior to data collection with human subjects, Institutional Review Board (IRB) approval was obtained to ensure ethical compliance.

2.1 Ideate Methods – Material Testing

The fabric substrate selected for all material testing comprised a 67% merino wool, 29% Tencel, and 4% elastane blend (170 gsm), sourced from the Canadian supplier Simplifi Fabric, a retailer specializing in eco-conscious and organic textiles. The material features a four-way stretch construction, providing enhanced flexibility and comfort suitable for activewear applications. As mentioned in *1.1.1 Define – Textiles*, Merino wool, derived from the Merino breed of sheep, is renowned for its exceptionally fine, soft fibers that offer natural thermoregulation and comfort. Unlike conventional worsted wool, which is produced from long, combed fibers to create a smooth and tightly woven texture, merino wool's porous structure allows for efficient moisture management (Simplifi Fabric, n.d.). Its fibers consist of microscopic scales that enable the transport of sweat and moisture vapor away from the skin, thereby

reducing the clammy sensation often associated with post-exercise perspiration. In contrast, synthetic fabrics lack this inherent porosity, making merino-based blends particularly advantageous for high-performance, breathable apparel (Simplifi Fabric, n.d.).

Dye Process. For the dyeing process, guidelines from the Maiwa School of Textiles were followed (The Maiwa Guide to Natural Dyes, n.d.). Maiwa (n.d.), a Canadian firm established in 1986, specializes in the production of natural dyes and collaborates closely with Indian artisans to preserve and disseminate traditional dyeing techniques for over 30 high-quality natural dyes (Maiwa: Our Story, n.d.).

Following Maiwa's (n.d.) protocols, scouring and mordanting were performed prior to dyeing. Scouring involved using a pH-neutral dish soap to remove natural oils, waxes, and any manufacturing residues from the fabric. A pH-neutral detergent was selected to prevent fiber damage or pH imbalance that could interfere with dye absorption. This step improved fiber cleanliness and absorbency, enabling more uniform dye uptake. Mordanting was then carried out using alum (potassium aluminum sulfate), a widely used, relatively non-toxic mordant that forms coordination bonds between the dye molecules and the fibers. Mordanting enhances both colorfastness and vibrancy, ensuring that the dyes adhere more permanently and resist fading. Table 1 provides the basic instructions for dyeing merino wool with madder (Rubia tinctorum) and indigo (Indigofera tinctoria), while Figure 3 in the *Materialize: Implement – Material Testing* section depicts the final procedures for scouring, mordanting, and dyeing used in this study.

Table 1

Suggested Maiwa School of Textiles Dye Process for Madder and Indigo Dyes

	Madder (*Rubia tinctorium*) Suggested Process	**Indigo (*Indigofera tinctoria*) Suggested Process**

Scouring	For each 450g (1 pound) of goods add 5 ml (1 teaspoon) orvus paste soap. Heat gently to 60º C (140º F) for approximately 1 hour. Turn gently but do not agitate Allow fiber to cool down slowly and then rinse in warm water.	
Mordanting	Dissolve the alum in very hot water in a non-reactive container. Add the dissolved chemicals to the dye kettle with enough warm water 45º C (110º F) to cover the fiber when it is added - usually a 30:1 ration of water to fiber. Stir well. Add the scoured, wet fiber. Over 30-45 minutes bring the temperature up to 90º C (195ºF) Just under simmer for wool and 85ºC (185ºF) for silk. Rotate the yarn or fabric frequently so the alum is evenly distributed. Hold for one hour, gently turning the fiber regularly. Let cool in the bath for 20 minutes. Remove the fiber from the mordant bath. Rinse well in cool water and allow to hang evenly over a non-reactive rod (stainless steel, plastic) until it stops dripping. Store the yarn or cloth in a damp white cloth for 24-48 hours. Keep it damp during this entire period.	
Weight of Fiber x Percent = Weight of Dyestuff (Dry)	(Suggested 50% WOF for Medium Red) .5lb (8 oz) Madder needed	75g (2.5 oz) Indigo needed (Using madder pulp as reducing agent) * 75 g (2.5 oz) calx (calcium hydroxide) also needed
Temperature	About 180ºF	About 100 -110°F
Process/Notes	Add dye material to dye pot and cover with water. After water reaches ideal temperature, add fibers, and continue cooking for 1-2 hours. Temperature should not exceed 160ºF to avoid dull color. Spent madder pulp will be used as a reducing agent for an indigo vat.	Fill pot with warm water/hot tap water. Fill slowly and avoid adding air to the water. Add the ingredients. Once vat is made, stir the vat gently. Stir again a few minutes later. Repeat three or four times. The vat will form a bronzy surface. Wait ten to twenty minutes after stirring to let the sediment fall to the bottom of the vat before dyeing.

Drying	Directly after the dyeing process, gently wash in lukewarm water without soap. Allow to dry completely. During this wash you want to remove any dyestuff (powdered madder for example) and ensure the cloth is clean.	Allow cloth to oxidize either in the air or in water, then hang out of the light and permit the item to fully oxidize while drying. A final rinse is done with a solution of weak vinegar (15 ml (1 tablespoon) of vinegar per liter (quart) of water) and left to hang dry again.

Colorfastness to Perspiration. Fastness is defined as a textile's ability to maintain its color without fading. In the Colorfastness to Perspiration (AATCC TM15, 2021) test, the fastness of the dyed textiles to the effects of acid perspiration is examined. This is to simulate the effects of human perspiration on the dyed substrate as compared with a nondyed substrate. In this study, assessing the dye's resistance to perspiration was essential to determine its durability and stability under conditions that simulate activewear use. Since such garments are typically worn during physical activity involving sweat, evaluating colorfastness ensures the material's suitability for performance-oriented applications. According to the American Association of Textile Chemists and Colorists (AATCC) (2021) guidelines, both the dyed and nondyed substrates are wet with an acid perspiration solution, and a fixed mechanical pressure is applied. The substrates are then dried slowly at a moderately higher temperature. Once dry, the textiles are evaluated for color change and color transfer.

Colorfastness to Crocking: Crockmeter. Colorfastness to crocking (AATCC TM8, 2022) is designed to analyze the amount of color that is transferred from the surface of the dyed material to another material by rubbing. In this study, assessing the dyed material's resistance to rubbing under both dry and wet conditions was essential to determine its suitability for activewear use. This evaluation ensures that the fabric could withstand friction during movement without tearing, developing holes, or exhibiting unwanted color transfer. In the test, the dyed

material was rubbed with a white crock test cloth under modulated conditions. The color that was transferred from the dye material to the white test cloth was compared with the Gray Scale for Staining, and a grade was assigned.

Colorfastness to Laundering: Accelerated. The colorfastness to laundering test (AATCC TM61, 2020) is utilized for materials that are expected to withstand frequent laundering. In this study, evaluating the dyes' resistance to fading and color transfer during washing was crucial to assess their practicality for everyday use. As consumers typically prioritize ease of care, ensuring that the fabric can be machine-washed without color loss or bleeding aligns with expectations for convenience and garment longevity. The 45-minute test simulates the fabric color loss and surface changes of a textile as a consequence of the detergent solution and abrasive action of typical hand or home launderings. Conditions such as temperature, solution, and abrasive action are controlled to effectively imitate five hand or home launderings.

The results from all three material performance tests collectively provide crucial insight into the feasibility of using naturally dyed substrate for activewear applications. By evaluating the material's colorfastness to perspiration, laundering, and crocking, the study establishes a foundation for understanding the durability and practicality of the dyes under conditions that mimic real-world use. These findings serve as an essential link between the material testing phase and the subsequent design development process, ensuring that aesthetic, functional, and sustainability objectives are aligned.

2.2 Ideate Methods – Design

Expert Testimonials. In this study, **t**he expert testimonial discussions took place early in the design process to inform the initial concepts and directly influenced the number and types of

garments designed. These designs were shaped by discussions with active community experts. Testimonials from industry professionals, such as instructors of yoga, weightlifting, and running, provided insights on pain experienced during exercise, preferred activewear brands and why, perspectives on the need for innovation in the activewear market, and design recommendations for the resulting activewear collection. To access these experts, the researcher used snowball sampling (Parker et al., 2019), after visiting yoga studios, cycling studios, gyms, etc., in the Fort Collins, CO area, and spoke with four experts, representing a range of differing activities. The conversations were conducted informally through casual email exchanges. In addition, notes and key takeaways from each conversation were documented in a research journal to ensure their feedback was clearly captured and incorporated into the garment designs. Expert feedback further provided detailed guidance on functional features and design elements that perform well in activewear.

Trend Research. To support the expert testimonials, the researcher also conducted trend research. Trend research included an examination of popular competitor brands such as Lululemon and Athleta, both of which maintain brick-and-mortar stores, as well as Calia, which is sold exclusively through Dick's Sporting Goods. Additionally, the marketing strategies of SET Activewear were analyzed and informed the design of the marketing email used in the survey. Research involved visiting three physical retail locations and reviewing social media and online advertising for these brands. Please see the *Materialize: Implement – Design* section for the results of the material testing, expert testimonials, and trend research as applied to the design of the Ayurvastra-inspired activewear collection.

Visuals for the collection were developed with the assistance of ChatGPT. First, the researcher created hand technical sketches to synthesize the findings into each activewear piece.

Using ChatGPT, the researcher uploaded each technical sketch to the platform, which rendered these sketches into lifelike product images, and were then refined through an iterative feedback process. The prompts used in ChatGPT are illustrated below in Table 2.

Table 2

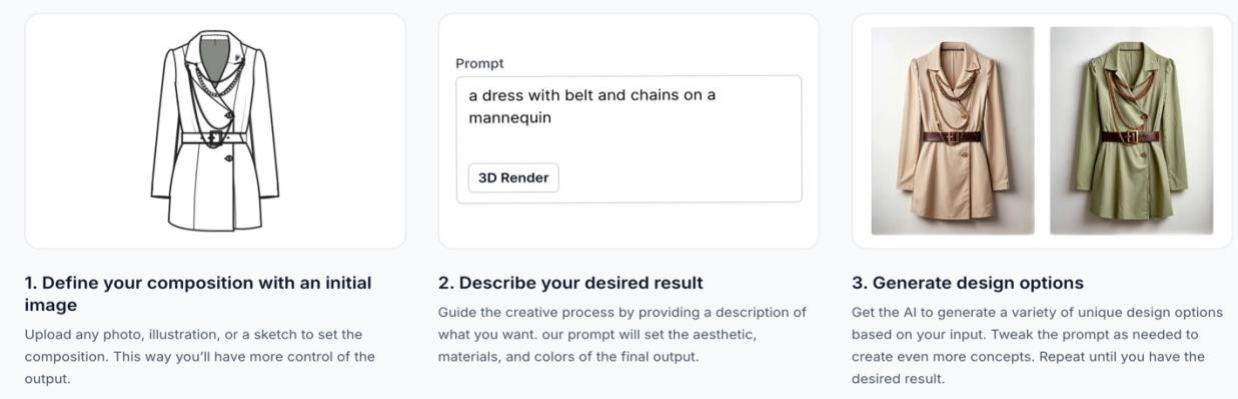
ChatGPT Design Iteration Prompts

	1st Prompt	2nd Prompt	3rd Prompt
Madder Design	"can you create a realistic rendering of this activewear set from the head to the feet - the sports bra should be light red, and the straps ONLY should be dark red. the leggings should be light red. the stripes down both sides should be dark red."	"can you make the waistband on the sports bra light red too?"	"not quite - here is the image again. can you also show the whole body, down to the feet?"
Indigo Design	"can you also do a realistic rendering of this image? no person necessary. the band on the sports bra should be dark blue, and the rest of the sports bra should be light blue. the waistband on the leggings and the part of the leggings from the knee to the ankle should be dark blue, while the space between the waistband and the knee should be light blue. the pocket on the left side of the legging just below the hip should also be dark blue.	"can you remove the dark blue on the straps of the sports bra and make that light blue. can you also remove the dark blue stripe down the side of the leggings? please keep the band on the lower part of the bra and the waistband dark blue and the pocket on the leggings dark blue."	"can you make the waistband in the sports bra thicker and darker blue?"

Figure 2 represents a ***general*** AI- design process, illustrating the realism possible through this technology. The results of the ChatGPT visuals of the Ayurvastra activewear collection are presented in the *Materialize: Implement – Design* section. Once the product images were finalized, they were incorporated into three distinct email marketing designs. Each email was identical in layout and visuals, differing only in brand messaging to align with the assigned experimental condition. The following section provides a detailed description of the survey and experimental design used to evaluate consumer responses to these marketing materials.

Figure 2

Example Photo Depicting AI Generated Clothing Design



2.3 Ideate Methods – Online Survey

Survey Design. A quantitative survey design was employed using an online survey to examine consumer responses to sustainable activewear marketing. The study utilized a between-subjects experimental design, in which participants were randomly assigned to view one of three marketing message scenarios.

Procedure. To assess the effectiveness of messaging focused on sustainability, health benefits, and innovation, three email marketing mock-ups were developed, each promoting an Ayurvastra-inspired activewear collection. All mock-ups were visually identical, with the messaging as the only variable manipulated across the advertising conditions. The survey questions are organized in Table 3. Please see the Appendix for the Qualtrics survey with the three marketing emails.

- Condition 1 emphasized **sustainability**, highlighting the use of natural fibers and dyes. The text in the email advertisement read: "Hey there, Earth-lover - Ready to upgrade your workout wardrobe and feel good about it? Ad Astra Yoga is redefining activewear with a fresh, eco-friendly twist. Our pieces are crafted from a soft, breathable merino wool and cotton blend and dyed using organic, low-impact indigo

and madder dyes—so you can move freely while supporting the planet. These natural dyes aren't just stunning—they're gentle on your skin and kind to the environment. Say goodbye to synthetic fabrics and harsh chemicals, and hello to a more sustainable you. Whether you're flowing through yoga or running errands, Ad Astra's got you covered in organic comfort that doesn't compromise style. Join the movement—where sustainability meets performance."

- Condition 2 focused on **health benefits**, describing the potential medicinal, anti-inflammatory, and analgesic properties of the dyes. The text in the email advertisement read: "Hey there, wellness warrior - Ready to upgrade your workout wardrobe and feel better in it? Ad Astra Yoga is redefining activewear with a fresh, science-backed twist. Our pieces are crafted from a soft, breathable merino wool and cotton blend and dyed using organic, low-impact indigo and madder dyes—chosen for their natural properties that may reduce inflammation and potentially alleviate pain as you move. Say goodbye to synthetic fabrics and harsh chemicals, and hello to mindful movement. Whether you're flowing through yoga or running errands, Ad Astra's got you covered in comfort that supports your well-being. Join the movement—where health meets performance."
- Condition 3 centered on **innovation**, underscoring the novelty and uniqueness of the dyeing process and materials. The text in the email advertisement read: "Hey there, trailblazer - Ready to upgrade your workout wardrobe and feel the future of fabric? Ad Astra Yoga is reimagining activewear with a fresh, groundbreaking twist. Our pieces are engineered from a soft, breathable merino wool and cotton blend and dyed using organic, low-impact indigo and madder dyes—so you can move freely in next-

gen comfort. These innovative dyes aren't just stunning—they're smart for your skin and the planet. Say goodbye to outdated synthetics and hello to reimagined performance. Whether you're flowing through yoga or running errands, Ad Astra's got you covered in engineered comfort that doesn't compromise style. Join the movement—where innovation meets wellness."

Participants were randomly assigned to view one of these three advertising conditions using Qualtrics' randomizer feature (*Randomizer,* 2025). After viewing the assigned scenario, participants completed survey items assessing their purchase intention and perceptions of the product's attributes. The target sample size was approximately 75 participants ($n \approx 25$ per condition).

Measures. Survey scales were adapted and modified from Nam, Dong, and Lee's (2017) *Expectations of Green Sportswear* construct to evaluate participants' views of sustainable activewear. The items, previously validated for reliability, were measured on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The researcher adapted each construct to assess four dimensions of consumer perception, appearance, functionality, operating characteristics compared to non-sustainable activewear, and durability. For instance, the original item *"The green sportswear will have good functional performance"* was modified to *"Sustainable activewear will have good functional performance."*

In addition, to evaluate participants' engagement and reactions to the marketing material itself, items measured visual engagement, messaging engagement, and appeal of product design after viewing the assigned email. These items were assessed using five-point Likert scales ranging from 1 (strongly disagree) to 5 (strongly agree) and 1 (not at all) to 5 (very much), depending on the wording of the question. Participants were also provided with an open-ended

response option for each item to elaborate on their impressions, allowing for richer qualitative insights into their attitudes and reasoning.

Importantly, the survey asked participants to indicate their purchase intention after viewing the advertisement. Purchase intention was measured using a single 5-point Likert scale assessing the likelihood of purchasing the product after viewing it. This purchase intention score served as the dependent variable in subsequent statistical analyses used to evaluate differences across experimental conditions and relevant covariates.

Pain level was also measured using a single 5-point Likert scale assessing the degree to which respondents experience physical pain or discomfort during physical activity or exercise. This variable was included in the analyses as both a predictor and moderating factor to examine how pain levels may influence purchase intention and responses to the different advertising conditions.

Finally, the survey included a brief demographic questionnaire to contextualize the findings and allow for secondary analyses of subgroup differences. Participants were asked to report their age, race/ethnicity, occupation, income level, and state of residence. These variables were included to help determine whether demographic characteristics may influence purchase intention.

Participant Recruitment. Survey participants were recruited using a combination of convenience, snowball, and purposive sampling methods to effectively reach the target demographic. Initially, individuals known to the researcher who met the inclusion criteria were invited to participate and encouraged to share the survey with others fitting the same demographic profile. Subsequent recruitment efforts expanded outreach to the local Fort Collins yoga community, a population relevant to the study's focus on activewear and wellness-related

behaviors. A final recruitment phase included distribution to women previously interviewed for expert testimonials who were encouraged to share the survey within their personal and professional networks, and members of the Colorado State University campus community. The survey remained open for approximately four weeks, allowing time for participant engagement and dissemination through community networks.

The sample targeted female participants aged 18–40 years who had purchased activewear at least once in the past six months. This demographic was selected due to its established engagement with premium and functional apparel products (Chi et al., 2021). Exclusion criteria included participants outside the age range, those who had not purchased activewear in the past six months, and those who did not identify as female. Participants who did not meet these criteria were automatically screened out through Qualtrics' survey logic and excluded from analysis.

Although not used as an exclusion criterion, participants were also asked whether they experience mild pain or discomfort during physical activity to provide contextual insight into how health-related experiences might influence responses to the marketing messages.

Table 3

Overview of Purchase Intention Toward Sustainable, Heath, or Innovation Messaging Online Survey Questions

	Question	**Possible Responses**
Screening	Have you purchased activewear at least once in the last six months?	– Yes – No
	Demographic questions regarding age and gender will also be considered screening questions	
Physical Activity	Please select all the activities/exercises you engage in:	– Yoga – Cycling – Running – Pilates – Barre – Weightlifting

		– I do not engage in physical activities – Other (Please Specify) [text entry]
	How many times a week do you engage in these activities/exercises?	– 0 times a week – Between 1 & 3 times a week – More than 3 times a week
	I experience physical pain or discomfort while engaging in these activities/exercises.	1-Strongly Disagree 2-Disagree 3-Neutral 4-Agree 5-Strongly Agree
Demographics	Which race or ethnicity best describes you? (Please choose only one.)	– American Indian or – Alaskan Native – Asian / Pacific Islander – Black or African American – Hispanic – White / Caucasian – Multiple ethnicity/ Other (please specify)
	Please select your gender:	– Male – Female – Other – Prefer not to say
	What year were you born?	[text entry]
	What is total combined household income? Please check the box that applies.	– $25,000 or less – $25,001 to $50,000 – $50,001 to $75,000 – $75,001 to $100,000 – $100,000 to 125,000 – $125,001 to 150,000 – $150,001 to 200,000 – Greater than $200k
	What is your occupation?	[text entry]
	In what state do you reside?	[text entry]
Purchase Intention	I liked this advertisement.	1-Strongly Disagree 2-Disagree 3-Neutral 4-Agree 5-Strongly Agree
	After seeing this ad, I am likely to purchase this product.	1-Strongly Disagree 2-Disagree 3-Neutral 4-Agree 5-Strongly Agree

Data Analysis. Data analysis proceeded in three stages. First, quantitative survey data were analyzed using descriptive statistics, including means and standard deviations, to

summarize participants' responses and identify central tendencies and variability across key variables. Categorical survey variables (e.g., occupation, geographic location, race/ethnicity, and income) were analyzed using frequency and percentage distributions to describe the proportion of participants within each category and to identify patterns or differences across groups.

Second, qualitative data through open-ended survey responses were analyzed using a qualitative descriptive approach. Responses were read in full and coded for recurring themes and patterns to capture key ideas and representative sentiments. Given the brevity of responses, analysis focused on identifying common keywords and summarizing overarching trends (Elo & Kyngäs, 2008). Third, inferential statistics were conducted to examine relationships and differences among variables.

ANOVA. A one-way analysis of variance (ANOVA) was used to test the main effects of the experimental manipulation. The survey followed a 1 (DV: purchase intention) × 3 (IV: message condition: sustainability, health benefit, innovation) design. The ANOVA examined whether there were statistically significant differences in mean purchase intention scores among the three advertisement message conditions (Laerd Statistics, 2016).

ANCOVA. To further refine these comparisons and account for potential covariates, three one-way analyses of covariance (ANCOVAs) were conducted. The first ANCOVA included demographic variables (age, occupation, income, state, and race/ethnicity) as covariates to statistically control for individual differences that might influence purchase intent. The second ANCOVA included views of sustainable activewear as a covariate to assess whether variation in the purchase intention scores across conditions could be accounted for after adjusting for participants' understanding of sustainability concepts. Additionally, pain level was included in a

final ANCOVA as an exploratory variable to understand whether self-reported physical pain during physical activity influenced purchase intention or moderated responses to the advertising message conditions. This analysis allowed for examination of whether individuals experiencing higher pain levels responded differently to specific message framings (e.g., health benefit vs. sustainability focus).

ANCOVA was selected as the most appropriate analytic approach because it allows for comparison of mean differences across categorical experimental conditions while statistically controlling for continuous or quasi-continuous covariates (Field, 2018; Tabachnick & Fidell, 2019). This method reduces error variance and provides a more precise estimate of the effect of message condition on purchase intent by isolating the influence of demographic, knowledge-based, and experiential (pain-related) factors. Together, these analyses provided a more nuanced understanding of how individual characteristics and message framing interact to shape consumer purchase intention.

CHAPTER 3 - MATERIALIZE: IMPLEMENT RESULTS

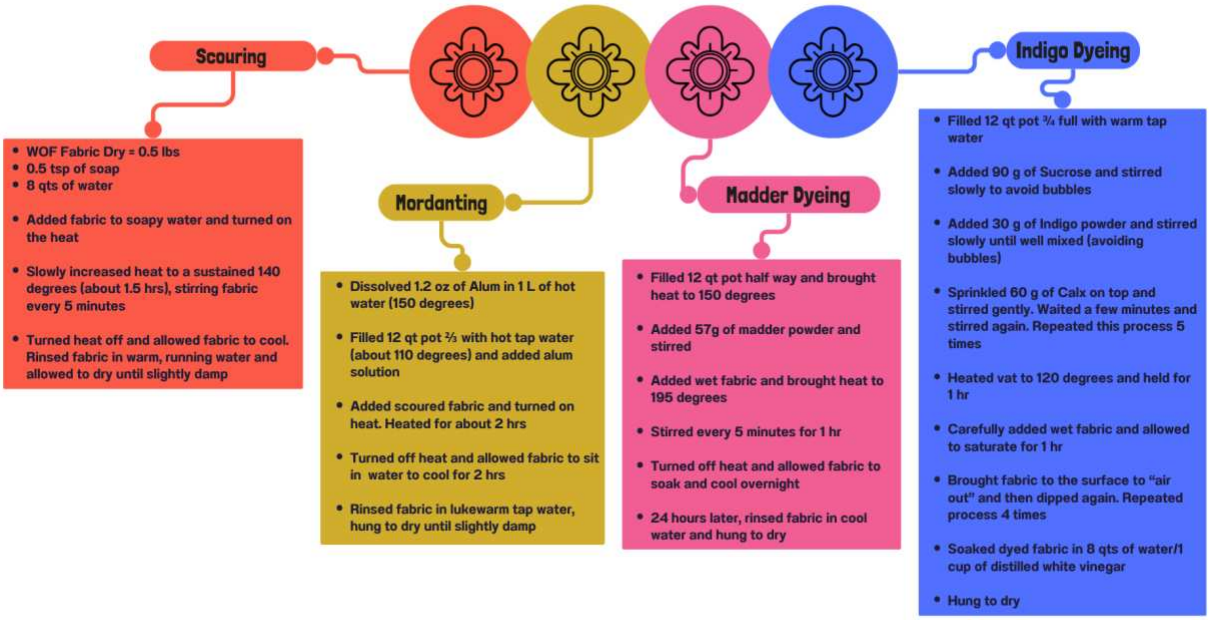
The *Materialize* section of this research was developed from the successful completion of the *Understand* and *Explore* phases. This section offers a detailed account of the materials dyeing process and testing results, design outcomes, and findings from the online survey. Due to the complexity of this multifaceted project, a brief discussion follows each results section. A comprehensive discussion is presented after the *Materialize* section to connect the individual findings and highlight their broader implications for the Ayuvastra-inspired activewear collection.

3.1 Implement – Material Testing

Dye Process Results. The dyeing process followed a systematic, multi-stage approach based on established natural dyeing protocols (The Maiwa Guide to Natural Dyes, n.d.). First, the scouring stage involved cleansing the wool fabric with a mild soap solution heated gradually to 140°F to remove oils, waxes, and residues, ensuring optimal dye absorption. Next, during mordanting, the fabric was treated with an alum solution heated to approximately 150°F, allowing the mordant to bond with the fibers and improve dye adhesion and colorfastness. Following this preparation, the fabric underwent two distinct dyeing processes: madder dyeing and indigo dyeing. For the madder bath, powdered madder root was dissolved in water and heated to 195°F, with the fabric stirred regularly before being left to soak overnight to achieve deep, even coloration. The indigo vat required a reduction process using sucrose and calx to create a dye solution, which was maintained at 120°F. The fabric was repeatedly immersed and oxidized ("aired out") to develop the characteristic blue tone. After dyeing, all samples were rinsed, neutralized in a vinegar solution when necessary, and air-dried. This structured process ensured the development of stable, vibrant, and naturally derived colorations suitable for textile testing. Figure 3 below depicts the scouring, mordanting, and dye processes used in more detail.

Figure 3

Scouring, Mordanting, and Dye Processes Used



Dye Process Discussion. Overall, the dyeing process was successful, as both the madder and indigo dyes produced vivid and saturated colors. Minor unevenness in dye distribution was observed on the fabric surface, which may be attributed to the limited vat size relative to the quantity of material dyed. Utilizing a larger dye bath or ensuring greater agitation during immersion could potentially improve color uniformity in future applications. However, this slight irregularity did not appear to influence the subsequent colorfastness or performance testing of the dyed fabrics, and the results obtained are considered representative of the overall dyeing outcome.

Colorfastness to Perspiration Results. The results of the Colorfastness to Perspiration (AATCC TM15, 2021) test indicated that both the madder- and indigo-dyed fabrics exhibited little to no color transfer onto adjacent fabrics. The indigo sample showed slight transfer onto the multi-fiber fabric, most notably the nylon fibers, corresponding to a rating of 4-5 on the Gray

Scale for Staining. The dyed fabric swatches themselves demonstrated minimal fading, with both receiving a rating of 4-5 on the Gray Scale for Color Change.

	Indigo	Madder
Dyed, Untested Samples		
Colorfastness to Perspiration (AATCC TM15, 2021)		

Colorfastness to Perspiration Results Discussion. The results of the Colorfastness to Perspiration (AATCC TM15, 2021) test suggest that both madder- and indigo-dyed fabrics are suitable for use in activewear. With minimal fading and little to no transfer onto the multi-fiber fabric swatch, these natural dyes demonstrate strong resistance to perspiration, a critical factor for garments designed for physical activity. Although the indigo sample showed slight transfer to nylon fibers, its overall performance remained strong, indicating durability even under active conditions. If subjected to additional treatment processes, such as finishing, both dyes could be further stabilized, enhancing their longevity and making them strong candidates for sustainable, commercially viable activewear applications.

Colorfastness to Crocking Results: Crockmeter. The Colorfastness to Crocking (AATCC TM8, 2022) test (Crockmeter method) showed that the madder-dyed samples exhibited

very little color transfer to the white fabric swatch in the dry state, receiving a score of 4–5 on the Gray Scale for Staining. When the samples were tested in the wet state, transfer was more noticeable, with a score of 3. In contrast, the indigo-dyed samples demonstrated significantly greater transfer under both conditions, scoring 1–2 in the dry state and 2–3 in the wet state. Additionally, all dyed samples experienced tearing during the test, suggesting that this particular fabric may not be suitable for athletic applications.

Dyed, Untested Samples		
Colorfastness to Crocking (AATCC TM8, 2022)	Dry Samples	Wet Samples
Indigo		
Madder		

Colorfastness to Crocking Results Discussion: Crockmeter. The results of the Colorfastness to Crocking (AATCC TM8, 2022) test indicate that both madder- and indigo-dyed fabrics may not be ideal for activewear applications due to the potential for dye transfer during

use. While the madder samples performed better in the dry state, the increased transfer in the wet state raises concerns about color stability under the combination of perspiration and movement. Indigo samples demonstrated even greater transfer in both dry and wet states, further limiting their suitability. Although post-dye treatment processes, such as advanced finishing, could potentially improve colorfastness to crocking and reduce color transfer, further testing would be necessary to validate their effectiveness. Additionally, the fabric substrate itself (67% merino wool, 29% Tencel, 4% elastane, 170 gsm) proved unsuitable for activewear applications. Despite being within the typical weight range for activewear fabrics (120–250 gsm), the material developed holes during the colorfastness to crocking test in both wet and dry conditions, suggesting insufficient durability for athletic performance settings. This could imply that natural fibers are not strong enough to withstand these conditions. Further material development with natural fibers is needed to be comparable to the durability of industry-standard synthetic fibers.

Colorfastness to Laundering Results: Accelerated. The Colorfastness to Laundering: Accelerated (AATCC TM61, 2020) test resulted in a substantial reduction in color saturation for both dyed samples. The indigo-dyed fabric received a score of 1-2 on the Gray Scale for Color Change, while the madder-dyed fabric performed slightly better, scoring 2–3. Interestingly, the indigo sample exhibited less color transfer to the multi-fiber fabric swatch compared to the madder sample. Significant transfer of madder dye was observed on the acrylic and cotton fibers (both scoring a 2-3 on the Gray Scale for Staining), whereas the indigo dye showed only slight transfer to the nylon fibers (with a score of 4-5). This difference may be attributed to the weaker dye–fiber bonding of the madder's mordant-based anthraquinone pigments compared to indigo's insoluble vat-dye structure, which forms more stable deposits within the fiber and is therefore less prone to bleeding during laundering.

	Indigo	Madder
Dyed, Untested Samples		
Colorfastness to Laundering: Accelerated (AATCC TM61, 2020)		

Colorfastness to Laundering Results Discussion: Accelerated. The results of the accelerated laundering test (AATCC TM61, 2020) suggest that both madder- and indigo-dyed fabrics would require hand washing to preserve their color integrity and minimize transfer. While the indigo samples retained slightly more saturation and demonstrated less transfer than the madder samples, both dyes showed noticeable fading and some degree of transfer when subjected to machine washing conditions. A finishing process may help reduce this fading and color transfer, though additional testing would be necessary to confirm its effectiveness. Furthermore, because merino wool itself is typically recommended to be hand-washed, the fiber composition adds another layer of inconvenience for consumers who expect their activewear to be machine-washable. Taken together, these findings highlight that while natural dyes show promise, both the dye stability and the fiber choice present challenges for activewear applications, particularly in terms of consumer-friendly care requirements.

Overall, the results of the colorfastness to perspiration, crocking, and laundering tests demonstrate that while natural dyes such as madder and indigo produce beautiful and rich colors, their suitability for activewear applications remains limited without further refinement. Both dyes showed some degree of fading and transfer, suggesting that additional testing is needed to explore finishing processes or treatments that could better seal the dyes to improve durability. At the same time, the potential transfer of these natural dyes onto the skin raises an intriguing possibility: considering the claims that these dyes possess medicinal properties, such as reducing inflammation or alleviating pain, this transfer could indicate their ability to be absorbed by the body and deliver benefits during wear. However, investigating these health-related effects falls beyond the scope of this research and would require future interdisciplinary study.

3.2 Implement – Design

Expert Testimonials. Expert testimonials were conducted with four women possessing a combined near 30 years of experience in coaching or teaching yoga, running, and weightlifting. Insights gathered from these experts played a critical role in informing both the design of the survey assets and the development of the apparel collection. Table 4 demonstrates the activities taught/coached, certifications earned, and amount of time teaching/coaching.

Table 4

Expert Demographics

	Jen	Holly	Monica	Sarah
Teaches/Coaches	Yoga	Yoga	Weightlifting/Running	Yoga
Certifications	200 YTT, Ayurveda Health Advisor	C-IAYT & RYT-200	CPT	2 YTT 200hr certifications, 1 30-hour Yin certification
Years Teaching/Coaching	9 years	17 years	1 year	2.5 years

When asked about their preferred activewear brands and the reasons behind their choices, participants frequently emphasized comfort, quality, and fit as key decision factors. For example, Jen, a yoga teacher, stated, "-Athleta - fit, quality and price appeal the most - Vuori - so soft and great quality- Beyond Yoga - also super soft and great quality - Lululemon (mostly when it's gifted) - quality." Similarly, Holly, another yoga instructor, shared, "Lululemon. I have tried lots of the brands out there but lulu is my go to. They tend to be the most consistent with size and product. It is also sustainable, I have worn many pants and tops for years. They offer discounts for teachers that are very easy to use."

When discussing their experiences with pain during exercise, participants provided insight into the types of discomfort that can arise during physical activity. Monica, a running and weightlifting coach, noted that she often experiences a "dull ache in hamstrings and feet when I put too much pressure on my toes." Similarly, Sarah, another yoga teacher, explained, "I get shoulder pain, the intensity depends on a lot of things, but it often stops me from doing chaturanga (a common yoga pose)." These perspectives underscore the importance of supportive and targeted design features, such as dye placement, in activewear to alleviate discomfort during movement.

When asked what features they would prioritize when designing their own activewear, respondents consistently emphasized natural materials, comfort, and flexibility. Holly remarked, "I would avoid anything too tight or too bulky. Something fitted and made with organic dyes/fabrics." Jen added, "My dream activewear would be mostly natural fibers with some support (for weightlifting and HIIT more than yoga) and softness. On leggings I appreciate pockets. And I need everything to have some level of breathability while also not being see-through." Monica was more succinct, stating, "no seams, no crotch falling." Finally, Sarah

offered a more detailed perspective: “My biggest complaint about activewear is when it digs into our soft parts as women, particularly the belly (I know sometimes there’s give and take there in staying up/on versus digging in!). I love having the option to show a little bit of cleavage vs full support, and a V waistline in leggings. I think that little designs or accents or those breathable hole things make the clothes so much more fun to wear. I hate bra cups but I know some people like them, so it’s nice to have the option to take them out rather than having them sewn in.”

Expert Testimonials Discussion. Collectively, the above testimonials provided valuable qualitative data that helped shape the design direction of the collection. The emphasis on natural materials, functionality, comfort, and inclusivity directly informed key aesthetic and structural decisions, aligning the final designs with the preferences and pain points of experienced users within the target demographic.

More importantly, the insights from these expert testimonials reinforced the central argument of this study, that there is a need for activewear that not only performs well but also promotes the health and well-being of the wearer. Experts consistently expressed frustration with synthetic garments that caused irritation or discomfort during prolonged wear, supporting the idea that consumers are increasingly receptive to alternatives offering physiological and environmental benefits.

Additionally, the call for more breathable, elastic, and aesthetically versatile options emphasized that functionality must coexist with style and sustainability to appeal to consumers. These findings underscore the potential for Ayurvastra-inspired activewear to fill a meaningful gap in the market by merging performance, comfort, and holistic wellness.

Trend Research. Trend research involved an analysis of current colorways and design features among leading athleticwear brands, including Lululemon, Athleta, and Calia. Findings

from this research indicated that both bright and muted color palettes maintain consistent popularity across seasons, suggesting that the hues produced by madder and indigo dyes would be well-received by consumers within this market segment. Additionally, style analysis revealed key design trends such as the incorporation of wider straps for enhanced comfort and support, non-restrictive yet secure waistbands, and functional pockets integrated into leggings. These insights directly informed the design and development of the subsequent collection, ensuring that the final garments aligned with both aesthetic and functional expectations of contemporary activewear consumers. Furthermore, the evaluation of SET Active's approachable and conversational email marketing strategy significantly informed the tone and structure of the survey's promotional email assets, allowing them to better reflect current industry communication trends and resonate with the target demographic.

Trend Research Discussion. The trend research was instrumental in ensuring that the collection not only aligned with the market's aesthetic expectations but also maintained commercial viability within a competitive activewear landscape. By analyzing leading brands such as Lululemon, Athleta, and Calia, it became evident that consumers value a balance between performance-driven functionality and visually appealing design. Incorporating the observed features into the final collection ensured that the products not only reflected user needs but also stood in direct conversation with industry standards. Together, these findings demonstrate how integrating market trend analysis with DT supports the development of activewear that is both innovative and relevant, bridging the gap between sustainability, functionality, and consumer appeal.

Collection Design. Synthesizing insights from material testing, expert testimonials, and trend research, an Ayurvastra-inspired activewear collection was designed. The collection

featured three activewear silhouettes (leggings, sports bras, and long-sleeve shrugs), each incorporating natural dyes in functional placements related to the body (Table 5). The design of each garment was informed by principles of functionality, comfort, and adaptability. The leggings were developed to be form-fitting and breathable, providing a balance between support and unrestricted movement. The sports bra was intentionally designed with an extended length for increased coverage, while its straps offer sufficient support without impeding range of motion during physical activity. Complementing these pieces, the long-sleeve shrug was introduced as a versatile layering option that can be easily worn or removed throughout exercise sessions. Its design accommodates varying temperature conditions, offering warmth in cooler environments while maintaining overall flexibility and comfort.

Table 5

Silhouettes for Ayurvastra-Inspired Activewear with Strategic Use of Natural Dyes for their Medicinal Properties

	Indigo	Madder
Activewear Legging	Legging will be designed with strategic placement of indigo-dyed material on waist band to soothe low back/hip pain	Legging will be designed with strategic placement of madder-dyed material in a wide lateral stripe from hip to ankle to soothe muscle/joint pain
Sports Bra	Bra will be designed with strategic placement of indigo-dyed material on band encompassing rib cage to soothe intercostal/serratus muscle pain	Bra will be designed with strategic placement of madder-dyed material on dorsal straps to soothe upper shoulder/back pain
Long Sleeve Activewear Shrug	Shrug will be designed with strategic placement of indigo-dyed material on chest and shoulders to soothe muscle/neck pain	Shrug will be designed with strategic placement of madder-dyed material from elbows to wrists to soothe joint pain

The images in Table 6 are the outputs of the ChatGPT design process. The garments were designed to integrate natural dyes with functional performance benefits through strategic dye placement. The indigo-dyed garments concentrated color on areas associated with muscle

tension: the waistband of leggings for low back and hip relief, the rib cage band of the sports bra for intercostal and serratus muscle comfort, and the chest and shoulders of the shrug to ease neck and upper body strain. In contrast, the madder-dyed garments emphasized joint-focused applications, with dye placed in a wide lateral stripe from hip to ankle on the leggings, along the dorsal straps of the sports bra, and from elbows to wrists on the shrug to target joint and muscle pain.

Because the leggings, sports bras, and shrugs were each designed to target different areas of the body commonly affected by pain or inflammation, ideally, the garments can be mixed and matched to provide customizable support based on individual needs. This modular design approach allows wearers to select specific pieces to address localized discomfort (such as lower back tension, shoulder strain, or joint inflammation) while maintaining overall aesthetic cohesion. When worn together, the garments may offer a more comprehensive distribution of potential therapeutic benefits, whereas wearing individual pieces may allow for targeted relief. This adaptability not only enhances the functional value of the collection but also aligns with consumer preferences for versatile and personalized activewear solutions that respond to both comfort and wellness goals.

Table 6

Completed ChatGPT Design with Performance Features Using Natural Dyes for Medicinal Properties

	Indigo	**Madder**
Shrug **Indigo shrug** - designed with strategic placement of extra indigo-dyed material on chest and shoulders to soothe muscle/neck pain		

Madder shrug - designed with strategic placement of extra madder-dyed material from elbows to wrists to soothe joint pain		
Set **Indigo leggings** - designed with strategic placement of extra indigo-dyed material on waist band to soothe low back/hip pain **Indigo bra** - designed with strategic placement of extra indigo-dyed material on band encompassing rib cage to soothe intercostal/serratus muscle pain **Madder leggings** - designed with strategic placement of extra madder-dyed material in a wide lateral stripe from hip to ankle to soothe muscle/joint pain **Madder bra** - designed with strategic placement of extra madder-dyed material on dorsal straps to soothe upper shoulder/back pain		
Model		

Collection Design Discussion. Insights from expert testimonials and trend research directly informed the design features of the collection, ensuring each garment met contemporary

standards of comfort, functionality, and aesthetic appeal. Feedback emphasizing practicality and support guided key design decisions such as incorporating functional pockets, a mid- to high-rise waistband on the leggings, and medium-width straps on the sports bra, features consistent with current consumer preferences identified in leading activewear trends. To complement the design development process, ChatGPT was utilized to generate both flat-lay sketches and realistic renderings of the garments on model figures. This visualization method provided a comprehensive understanding of garment fit and proportion while allowing for cohesive aesthetic evaluation across the collection.

Beyond functional and visual design, the collection also explored the potential of medicinally dyed textiles as a value-added innovation in the activewear market. Consumers today face an overwhelming number of activewear options, yet few brands combine high performance with potential health benefits. Individuals experiencing mild pain or discomfort during low- to medium-intensity exercise often rely on analgesics such as NSAIDs, acetaminophen, or topical salves containing lidocaine and opioids like fentanyl (Gudin & Nalamachu, 2020). However, frequent use can lead to tolerance and increased dosage requirements (Dumas & Pollack, 2008). Integrating naturally medicinal dyes into activewear fabrics may therefore present a healthier, long-term alternative for supporting recovery and reducing exercise-induced inflammation.

3.3 Implement – Online Survey

Lastly, the online survey was conducted to gather information about this activewear concept. After removing incomplete surveys, the total number of respondents was 56. There were 18 responses for Condition 1: Sustainability messaging, 19 responses for Condition 2: Health Benefit messaging, and 19 responses for Condition 3: Innovation messaging.

Demographics. The sample consisted primarily of White or Caucasian respondents (*n* = 45, 80%), followed by Asian or Pacific Islander (*n* = 3, 5%), Hispanic (*n* = 3, 5%), Black or African American (*n* = 2, 4%), and participants identifying with multiple ethnicities (*n* = 2, 4%). One respondent (2%) declined to report their ethnicity.

Participants represented a wide range of income levels (Table 7), with the largest group reporting annual household incomes between $75,001 and $100,000 (*n* = 12, 21%). Ten respondents reported earning $25,000 or less (*n* = 10, 18%), while smaller proportions reported incomes exceeding $150,000 (*n* = 12, 21%), indicating moderate to upper-middle income representation within the sample.

Table 7

Income Range of Survey Respondents

Income Range	Count
$25,000	10
$25,001 – 50,000	3
$50,001 – 75,000	7
$75,001 – 100,000	12
$100,000 – 125,000	7
$125,001 – 150,000	3
$150,001 – 200,000	5
$200,001 – 300,000	3
$300,001 – 500,000	3
$500,001	2
n/a	1
Total N	**56**

Geographically, participants were distributed across 12 U.S. states (Table 8), with the majority residing in Texas (*n* = 22, 39%) and Colorado (*n* = 11, 20%), followed by smaller clusters in California (*n* = 6, 11%) and Illinois (*n* = 4, 7%).

Table 8

Geographic Location of Survey Respondents

State	Count
Texas	22
Colorado	11
California	6
Illinois	4
Minnesota	2
Arizona	2
Ohio	2
Florida	2
Nevada	1
Utah	1
North Carolina	1
Tennessee	1
Total N	**56**

The mean participant age was 29 years (*SD* = 7.03), consistent with the targeted demographic of women aged 18–40. Across advertising conditions, the average age remained relatively consistent - Sustainability (*M* = 29, *SD* = 6.39), Health Benefits (*M* = 27, *SD* = 7.16), and Innovation (*M* = 31, *SD* = 7.38) - suggesting comparable age distributions between experimental groups.

Lastly, the survey respondents represented a range of occupations (Table 9). The largest groups were graduate students (*n* = 9, 16%) and individuals in sales and business development (*n* = 9, 16%), followed by undergraduate students (*n* = 6, 11%), educators (*n* = 6, 11%), and those working in service or retail (*n* = 6, 11%). Smaller proportions worked in administration or management (*n* = 5, 9%), creative or design professions (*n* = 4, 7%), marketing or communications (*n* = 3, 5%), and stay-at-home or care work (*n* = 3, 5%). A few participants

reported technical or engineering roles (n = 2, 4%), healthcare or mental health (n = 1, 2%), or tech development (n = 1, 2%). One respondent (2%) did not specify an occupation.

Table 9

Occupation of Survey Respondents

Occupation Category	Count
Graduate Student	9
Undergraduate Student	6
Sales & Business Development	9
Education / Teaching	6
Service & Retail	6
Administration & Management	5
Creative / Design Professions	4
Stay-at-Home & Care Work	3
Technical / Engineering Roles	2
Marketing / Communications	3
Healthcare / Mental Health	1
Tech Developer	1
n/a	1
Total N	56

Demographics Discussion. Overall, the demographic profile of respondents aligned with the intended target market for sustainable activewear, which was primarily young, educated women aged 18–40. The sample was predominantly White or Caucasian (80%), with limited racial and ethnic diversity, which may constrain generalizability. Income levels were moderately high, with most participants reporting annual household incomes between $75,001 and $100,000, indicating purchasing power consistent with activewear consumers. Participants represented diverse occupations, notably students, educators, and professionals in sales and creative fields, providing varied perspectives on sustainability and innovation. Geographic concentration in Texas and Colorado reflects regions with established outdoor and performance apparel markets.

Overall, while the sample's demographic composition limits broad population inference, it effectively represents a key consumer segment for sustainable and health-oriented activewear.

Descriptive Statistic Results.

- Frequency of Activity/Exercise - Participants were asked to indicate the types of physical activities they regularly engage in and the frequency of participation each week. The most commonly reported activities included yoga, weightlifting, running, cycling, barre, and Pilates, reflecting a diverse range of both strength-based and mind–body exercises. Additional write-in responses, such as hiking, high-intensity interval training (HIIT), volleyball, and aerial circus arts, further demonstrated the variety of movement practices represented among participants. In terms of frequency, the majority of respondents reported engaging in physical activity between 3 – 5 times per week (n = 32, 59%), followed by 1 – 2 times per week (n = 12, 22%), 6 – 7 times per week (n = 7, 13%), more than seven times per week (n = 2, 4%), and 0 times a week (n = 1, 2%).
- Pain - Participants were asked to indicate how frequently they experience pain during exercise using a 5-point Likert scale ranging from 1 (Never) to 5 (Always). The resulting mean score of M = 2.54 (SD = 0.81) suggests that, on average, participants experience pain infrequently during physical activity. However, when discomfort does occur, the most commonly reported areas included the lower back, hips, knees, feet, and shoulders, along with reports of general muscle soreness and chafing.
- Brands - Participants were asked to identify the activewear brands they currently wear, as well as those they aspire to own or wear in the future. Responses indicated that Lululemon, Alo, Athleta, Nike, Old Navy, Sweaty Betty, Target, and Under

Armour were among the most frequently worn brands, reflecting a mix of premium lifestyle labels and accessible mainstream options. When asked about aspirational brands, participants most commonly cited Alo, Lululemon, Girlfriend Collective, Vuori, Sweaty Betty, and Fabletics, while a notable portion of respondents indicated no aspirational brand preference.

Descriptive Statistics Discussion. The collective findings from participant responses offer valuable insight into the behavioral, physical, and psychological factors shaping consumer engagement with activewear. The reported frequency of exercise suggests that the sample primarily consisted of moderately to highly active individuals, aligning well with the target demographic for activewear testing and product evaluation. Although most participants indicated they do not frequently experience pain during exercise, localized musculoskeletal discomfort, particularly in the lower back, hips, knees, feet, and shoulders, was commonly mentioned. This underscores the potential value of developing activewear that supports comfort, reduces irritation, and aids in the prevention or relief of mild pain during physical activity. Additionally, participants' reported brand preferences revealed a balance between functionality-driven loyalty and aspirational consumption. While many favored established performance brands such as Lululemon, Alo, and Athleta, a significant portion expressed no strong aspirational preference, suggesting that satisfaction with performance and comfort may outweigh status-driven motivations for some consumers. These findings highlight that activewear occupies a dual role in consumers' lives, serving both as a functional tool for performance and a form of lifestyle expression, emphasizing the importance of design approaches that integrate comfort, functionality, and aesthetic identity.

ANOVA – Purchase Intention by Advertising Condition. To address the research question, "Does purchase intention differ significantly across the three advertising conditions?" a one-way ANOVA was conducted to determine if the purchase intention was different for conditions with different messaging. Participants were classified into three groups: sustainability (n = 18), health benefits (n = 19), and innovation (n = 19). The purchase intention increased from innovation (n = 19, M = 2.63, SD = 1.34), to sustainability (n = 18, M = 3.06, SD = 1.16), to health benefits (n = 19, M = 3.16, SD = 1.39), in that order, but the differences between these conditions were not statistically significant, $F(2, 53) = 0.87$, $p = 0.43$. The group means were not statistically significantly different ($p > .05$). Therefore, we cannot reject the null hypothesis, and we cannot accept the alternative hypothesis. To further examine the potential influence of demographic variables, a one-way analysis of covariance (ANCOVA) was also conducted. The overall model was not statistically significant, $F(7, 46) = 1.21$, $p = .32$, $\eta^2_p = .16$, suggesting that demographic factors did not account for a significant portion of variance in purchase intention. Neither the covariates nor the main effect of condition reached statistical significance (all ps > .05). The largest, though nonsignificant, effects were observed for occupation, $F(1, 46) = 2.84$, $p = .10$, $\eta^2_p = .06$, and race/ethnicity, $F(1, 46) = 2.86$, $p = .10$, $\eta^2_p = .06$. Post hoc analyses were conducted using Bonferroni adjustments.

Table 10

Adjusted and Unadjusted Means and Variability for Purchase Intention by Condition with Demographic Covariates Included

Condition	**N**	**Unadjusted**		**Adjusted**	
		M	*SD*	*M*	*SE*
Sustainability	17	3.06	1.20	3.12	0.34
Health Benefits	19	3.16	1.39	3.07	0.33
Innovation	18	2.67	1.37	2.70	0.32

Note. N = number of participants; *M* = Mean; *SD* = Standard Deviation; *SE* = Standard Error. Adjusted means represent estimated marginal means controlling for Age, Occupation, Income, State, and Race/Ethnicity.

ANOVA – Purchase Intention by Advertising Condition Discussion. Although differences among the message conditions were not statistically significant, a small directional trend emerged, with health benefits messaging eliciting the highest purchase intention, followed by sustainability and innovation. This pattern may suggest that appeals emphasizing personal well-being resonate slightly more with consumers than those highlighting environmental or technological benefits. However, the absence of significant effects indicates that message framing alone did not meaningfully influence purchase intention in this sample. These findings imply that consumers may perceive all message types as similarly persuasive or that other variables, such as prior attitudes, credibility, or product familiarity, play a more substantial role in shaping purchase behavior. The ANCOVA results indicated that advertising condition did not significantly affect purchase intention after controlling for demographic variables, suggesting that message framing alone did not account for differences in consumer responses. Although the overall model was nonsignificant, small effect sizes for occupation and race/ethnicity suggest that these factors may exert emerging influence on consumer preferences for sustainable activewear. Specifically, occupational background and cultural identity could shape how consumers interpret marketing appeals related to sustainability, health benefits, or innovation. These findings align with prior research demonstrating that demographic characteristics often moderate sustainable consumption behaviors but rarely serve as strong predictors of purchase intent on their own (White et al., 2019). Overall, the results suggest that effective marketing of Ayurvastra-inspired activewear may require brands to develop advertisement strategies that

account for occupational lifestyles and cultural values rather than relying solely on broad message framing.

ANCOVA – Purchase Intention, Advertising Condition, and Views of Sustainable Activewear. To address the research question, "How do views on sustainable activewear influence consumers' purchase intention across different message framing in the advertising conditions (sustainability, health benefit, innovation)?" a one-way ANCOVA was conducted to examine whether purchase intention differed by condition after controlling for views of sustainable activewear. Part of the survey assessed participants' views on sustainable activewear (Nam et al., 2017) to measure different underlying constructs related to this concept. The views of sustainable activewear scale consisted of four items. The scale demonstrated a high level of internal consistency, as indicated by a Cronbach's alpha of 0.92. Therefore, the four items were combined to create a composite "view of sustainable activewear" score.

All assumptions for ANCOVA were met. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance, $p = 0.11$. Standardized residuals for the interventions were normally distributed, as assessed by Shapiro–Wilk's test ($p > 0.05$). Homoscedasticity was confirmed by visual inspection of standardized residuals plotted against predicted values. No outliers were identified, as no cases had standardized residuals greater than ±3 standard deviations.

Unadjusted and adjusted means are presented in Table 11. The overall model was not statistically significant, $F(2, 52) = 2.00$, $p = 0.56$, partial $\eta^2 = 0.02$. None of the covariates or main effects of condition reached statistical significance ($p > 0.05$). After adjustment for participant views of sustainable activewear, there was no statistically significant difference in

purchase intention between the advertising conditions, $F(2, 52) = 2.00$, $p = 0.56$, partial $\eta^2 = 0.02$. Post hoc comparisons using Bonferroni adjustments were also nonsignificant.

Table 11

Adjusted and Unadjusted Means and Variability for Purchase Intention by Condition with Views of Sustainable Activewear Included

Condition	N	Unadjusted		Adjusted	
		M	*SD*	*M*	*SE*
Sustainability	18	3.06	1.16	3.01	0.31
Health Benefits	19	3.16	1.39	3.14	0.30
Innovation	19	2.63	1.342	2.69	0.30

Note. Covariates appearing in the model are evaluated at the following values: Sustainability Scale Score = 3.97

ANCOVA – Purchase Intention, Advertising Condition, and Views of Sustainable Activewear Discussion. The results suggest that advertisement condition framing (sustainability, health benefit, innovation) did not significantly influence consumers' purchase intention after controlling for views of sustainable activewear. Although the health benefit condition produced slightly higher adjusted means than the sustainability and innovation of the advertising conditions, these differences were not statistically significant (Table 11). This indicates that consumers' intention to purchase the product was relatively stable across message types and was not strongly influenced by participants' view of sustainable activewear. One possible explanation is that sustainability awareness alone may not be a strong driver of purchase intention when compared with other motivational factors, such as perceived personal benefit or product innovation. These findings align with prior research suggesting that while consumers may value sustainability conceptually, it does not always translate into behavioral intentions or purchase behavior (Nam et al., 2017; White et al., 2019).

ANCOVA – Purchase Intention, Advertising Condition, and Physical Pain Level.

Finally, pain level was explored to understand whether self-reported physical pain influenced purchase intention or moderated responses to the advertising message conditions. To address the research question, "How does pain level influence consumers' purchase intention across different message framing conditions (sustainability, health benefit, innovation)," a one-way ANCOVA was conducted. Unadjusted and adjusted means are presented in Table 12. All assumptions for ANCOVA were met. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance, $p = 0.08$. Standardized residuals for the interventions were normally distributed, as assessed by Shapiro–Wilk's test ($p > 0.05$). Homoscedasticity was confirmed by visual inspection of standardized residuals plotted against predicted values. No outliers were identified, as no cases had standardized residuals greater than ±3 standard deviations.

Adjusted means are presented, unless otherwise stated. Purchase intention was greater in the health benefits advertising condition ($M = 3.20$, $SE = 0.31$) compared to the sustainability advertising condition ($M = 3.04$, $SE = 0.31$) and the innovation advertising condition ($M = 2.61$, $SE = 0.30$), respectively. After adjustment for pain, there was no statistically significant difference in purchase intention between the advertising conditions, $F(2, 52) = 0.98$, $p = 0.38$, partial $\eta^2 = .04$. None of the covariates or main effects of condition reached statistical significance ($p > 0.05$). Post hoc comparisons using Bonferroni adjustments were also nonsignificant.

Table 12

Adjusted and Unadjusted Means and Variability for Purchase Intention by Condition with Pain Included

Condition	N	Unadjusted		Adjusted	
		M	*SD*	*M*	*SE*

Sustainability	18	3.06	1.16	3.04	0.31
Health Benefits	19	3.16	1.39	3.20	0.31
Innovation	19	2.63	1.342	2.61	0.30

Note. Covariates appearing in the model are evaluated at the following values: Pain = 2.54.

ANCOVA – Purchase Intention, Advertising Condition, and Pain Level Discussion.

The results suggest that the advertisement condition framing (sustainability, health benefit, innovation) did not significantly influence consumers' purchase intention after controlling for physical pain. As with the other test results, again the health benefit condition produced slightly higher adjusted means than the sustainability and innovation of the advertising conditions, these differences were not statistically significant (Table 12), potentially indicating that consumers' purchase intention was relatively stable across the message types and was not strongly influenced by physical pain. Although none of the effects were statistically significant, the adjusted means show a small, descriptive trend: participants exposed to health benefits messages reported the highest purchase intention, followed by the sustainability condition, while the innovation condition produced the lowest. However, these differences are minimal and likely due to chance, as indicated by overlapping standard errors and small effect sizes. The inclusion of pain as a covariate did not meaningfully alter these results, suggesting that pain levels did not influence how participants responded to different message frames. Pain alone may not be a strong driver of purchase intention, however no or limited products exist in the marketplace that could have health benefits and, therefore lack of consumer knowledge or skepticism about the product effectiveness could have an impact here.

Perception of Advertisements and Price. In addition, participants were also asked to provide insights into their perceptions of advertisements and products. Specifically, respondents

were invited to comment on how visually engaging they found the advertisements, how engaging they perceived the messaging to be, and how much they liked the featured product.

In the survey, the researcher asked participants to evaluate the visual engagement, messaging effectiveness, and overall appeal of the product using a 5-point Likert scale, ranging from strongly disagree (1) to strongly agree (5). The following section provides insights into how participants (N = 56), who were randomly assigned to view only one of three advertisement conditions, sustainability (n = 19), health benefits (n = 19), or innovation (n = 19), responded to their assigned ad across three dimensions: visual engagement, messaging, and product appeal. The results reflect how each group rated the single advertisement they viewed, offering a comparative look at how different themes influenced participant perceptions. Mean scores were calculated for each condition to provide contextual insight into participant perceptions and to support subsequent statistical analysis. The qualitative responses that follow offer valuable context for interpreting the numerical data by revealing participants' underlying attitudes, preferences, and emotional reactions.

- **Visual engagement -** For visual engagement, the health benefit condition was rated most favorably (n = 19, M = 4.21, SD = 0.85), followed by the innovation condition (n = 19, M = 3.95, SD = 1.18), and then the sustainability condition (n =18, M = 3.95, SD = 1.06).
- **Messaging –** For messaging, health benefits condition was rated most favorably (n = 19, M = 3.79, SD = 1.03), followed by the innovation condition (n = 19, M = 3.68, SD = 1.34) and then the sustainability condition (n = 18, M = 3.61, SD = 1.04).

- **Product -** For product, the sustainability condition was rated most favorably (n = 18, M = 3.89, SD = 0.90), followed by the Innovation condition (n = 19, M = 3.74, SD = 1.28) and then the Health Benefits condition (n = 19, M = 3.58, SD = 1.12).

Visual Engagement Qualitative Feedback:

- Condition 1 – Sustainability

  Participants' responses reflected strong engagement with the advertisements' visual elements, particularly color and overall aesthetic appeal. Many noted that "the colors, font was aesthetically pleasing" and that "bright colors" and "images of the garments" drew their attention. The layout was often described as "simple" and "clean," though some found it "a little too text-heavy." Representation also influenced engagement, with one participant appreciating that "the model was average and not super thin," highlighting the value of inclusive imagery. However, a few respondents felt the ad "lacked uniqueness," suggesting room to strengthen brand differentiation. Overall, visual clarity, color harmony, and authentic representation emerged as key factors driving engagement.

- Condition 2 – Health Benefits

  Participants emphasized the importance of color, layout, and product imagery in shaping their impressions of the advertisement. Many found the color palette appealing, describing it as "bold," "very colorful," and "complimentary colorways that pop off the screen," though some felt it was less effective, noting "I was not impressed with the colors." The layout was praised for being "simple," "clean and graphic," and featuring "short, easy to understand copy," while others critiqued it as

"essay-like" and "not very eye catching." Participants also appreciated "photos of the sets on models and by themselves" and "design detail callouts," though a few expressed concerns about limited body representation. Overall, color, clarity, and authentic imagery were seen as central to maintaining visual interest and effectively communicating the product's aesthetic and functional qualities.

- Condition 3 – Innovation

  Participants consistently highlighted the role of color, layout, and imagery in capturing attention and enhancing the appeal of the advertisement. Color was frequently cited as a primary draw, with responses such as "beautiful colors and informative," "colorful," and "primary colors of red and blue… make the apparel pop" emphasizing its impact. Layout and overall design cohesion were also critical, with participants noting that the "layout and colors used were aesthetically pleasing and drew me in" and appreciating "clean font and images… neither overly done nor fancy." Product imagery further enhanced engagement, as respondents valued "seeing the pieces together on the model and separately later in the email so I know which pieces she is wearing" and found the images "eye-catching" and "stylistically appealing." Overall, these insights suggest that harmonious color schemes, clear layouts, and authentic product visuals are central to maintaining visual interest and promoting engagement in activewear advertising.

Messaging Qualitative Feedback:

- Condition 1 – Sustainability

Participants' responses to the messaging revealed key themes regarding tone, content, and appeal. Many appreciated the emphasis on sustainability and health, describing the language as "eco-friendly and good for the body" and "organic." One participant noted, "Loved the callout of the dyes being soft on my skin!… it seems this brand would be safe and a smart choice," highlighting how natural materials resonated on environmental and personal wellness levels. Others valued the informative, descriptive language, such as "breathable" and "useful materials," though some wished for more explanation of the benefits of natural fibers: "Maybe if [it] explained how soft the merino blend made it versus the synthetic [it] would have captured my attention more." Participants also appreciated concise messaging, calling it "short, to the point," while a few felt it was generic or unmemorable, describing it as "somewhat cliché" and "an email I wouldn't even bother to read."

- Condition 2 – Health Benefits

  Participants highlighted clarity, tone, and relevance as key drivers of engagement. Many appreciated the concise and understandable wording, noting the ad was "short but to the point" and "well written and clear—but also kind of fun." The tone was described as engaging and personable, with one participant calling it "jaunty" and others noting the use of rhetorical devices and bold text to emphasize key points ("Using bold to highlight key words and phrases"). Participants also valued the informative and descriptive content, such as explanations of product differentiation ("I liked that it explained how they are different from other brands") and the use of natural materials. Functional or health-related claims, like references to pain alleviation, were seen as appealing ("The advertisement mentioned alleviating pain. I

think this is very engaging"), though some participants questioned the realism of these benefits, highlighting a desire for evidence-based support. Overall, clarity, tone, relevance, and credible content were central to effective messaging engagement.

- Condition 3 – Innovation

  Participants' responses indicated that messaging engagement was driven by clarity, personalization, and informative content. Many valued the detailed product information, noting that the ad "explained type of fabric and other key features to differentiate from synthetic fabrics" and emphasized "the value of the clothing well." References to natural dyes and fibers were also positively received, with participants highlighting claims that the products were "better for body and planet." Personalization enhanced engagement, as one participant explained, "I felt like I was part of the company and its values, not just a random customer," and others noted greetings like "Hey there ___" made the messaging feel individualized. Ease of reading and word placement contributed to clarity, though some found it "a bit wordy" or that the "message wasn't clear." Engagement also tied to lifestyle relevance, with participants connecting the ad to activities like "running/yoga." Overall, messaging that combined informative content, personal relevance, and readability was most effective in engaging participants.

Product Qualitative Feedback:

- Condition 1 – Sustainability

  Participants' responses revealed that color and design were central to their impressions of the garments, with many describing the hues as "rich," "bold," and

"cute," which made the sets visually striking. Several noted that the cut and style of the pieces added to their appeal, one respondent shared that they liked the "color blocks on the pants and the multi-layer look of the orange top," while another commented that the "style and color of the clothes stood out." However, not all reactions were entirely positive; some found the two-tone color choices "less cohesive" or felt that "clothing designs are nothing new," suggesting a desire for greater innovation. The materials and fabrics were another key focus, with participants appreciating the use of "non-synthetic materials" and expressing curiosity about "the merino wool," indicating an awareness of quality and comfort. Finally, respondents highlighted the functional appeal of the garments, noting they were "cute but functional" and valuing the "potential to relieve pain" as an added benefit that distinguished the collection beyond aesthetics.

- Condition 2 – Health Benefits

  Participants' liking of the activewear was influenced by color, design, comfort, functionality, and material quality. Many highlighted color, noting "I loved the more natural looking colors that stay true to the product claims" and "It matched the current trends." Comfort and fit were emphasized with comments like "It looks comfortable" and "soft," though some preferred looser tops. Design and style were praised: "Cute," "Coverage but cool," and "Love the mega cropped shirt that can be worn over the sports bra." Functional and health-related features also mattered, such as "That it is anti-inflammatory," though some questioned efficacy: "I really like the natural aspect, but it's unclear if it really does alleviate pain." Material quality reinforced positive perceptions, highlighting the importance of softness and comfort.

- Condition 3 – Innovation

  Participants' liking of the product was influenced by color, material, fit, style, and presentation. Color was frequently cited, with comments like "Colors and style," "The hue of the colors and the options," and "I like the color blocking and layering of the top pieces," though a few noted negatives: "I don't like the color or color blocking… it shows crotch sweat, butt sweat and sweat in your midsection/belly." Material and fabric quality were valued ("The material, perceived stretchiness, and colors"; "Fabric choice… sustainable"). Fit and silhouette contributed to appeal ("Love the tighter fit"; "The lines on the top and around the waist"), and presentation was important, with participants highlighting "Model photo and pictures of clothes" and "Set looks modern and is convertible." Overall, aesthetics, material, fit, and modern styling drove product appeal.

Price Qualitative Feedback:

- Sports bra -

  Participants' responses regarding the price they would be willing to pay for the sports bra varied widely, with most indicating a range between $30 and $50. A smaller number of participants suggested higher amounts, such as $60–$75, while a few either expressed skepticism about the product claims or indicated they would not purchase it at all. Overall, the data suggest that the majority of potential buyers consider $30–$50 to be a reasonable and acceptable price point for the sports bra.

- Leggings -

Participants' willingness to pay for the leggings varied considerably, with most indicating a range between $40 and $80. Several participants suggested higher amounts, up to $100–$130, while a few expressed reluctance to purchase or provided very low values. Overall, the data indicates that the majority of potential buyers consider $40–$80 to be a reasonable and acceptable price point for the leggings, with occasional outliers willing to pay more for perceived quality or brand value.

- Shrug -

  Participants' willingness to pay for the shrug varied, with most responses falling between $20 and $60. A smaller number of participants indicated higher amounts, up to $80–$100, while some either expressed uncertainty about the product or indicated they would not purchase it. Overall, the data suggest that the majority of potential buyers consider $20–$60 to be a reasonable and acceptable price point for the shrug, with a few outliers willing to pay more for perceived quality or additional features.

Perception of Advertisements and Price Discussion. Participants' responses indicate that color, design, material quality, and functional features were key drivers of product perception; however, some desired greater balance and cohesion between text and imagery. Overall, participants responded positively to visually striking colors, modern styling, and attention to fit and comfort, consistently noting features such as soft, high-quality materials, flattering silhouettes, and functional details.

Across all items, price expectations aligned with perceived value, with the majority of participants indicating reasonable ranges of $30–$50 for sports bras, $40–$80 for leggings, and $20–$60 for shrugs, providing insight into acceptable market positioning. Collectively, these findings underscore that an effective naturally dyed activewear collection must balance visually

engaging design, material quality, functional benefits, and competitive pricing to meet consumer expectations and support purchase intention.

DISCUSSION

Building on the preceding results, this overarching discussion synthesizes the study's insights into a comprehensive understanding of Ayurvastra-inspired activewear design. Guided by the DT framework, the research progressed through three interconnected stages. The *Understand – Define and Empathize* phase established the foundation for the research questions by identifying material and consumer challenges in sustainable activewear. The *Explore – Ideate Methods* phase addressed how the research questions would be analyzed through material testing and design development, assessing the technical feasibility and aesthetic integration of madder and indigo dyes, as well as through an online experiment imbedded in a survey. The *Materialize – Implement Results* phase synthesized the results of the material testing, design, and survey results. This chapter bridges the outcomes from these stages to demonstrate how the DT process guided the evolution of this concept from research to realization and identifies the major takeaways for future design practice and brand development.

Addressing the Research Questions.

RQ1: Material Testing — Performance Viability of Madder and Indigo Dyes

Within the *Materialize* phase, RQ1 examined whether madder and indigo dyes meet performance standards for activewear. The AATCC colorfastness tests revealed that both dyes produced visually appealing, rich colors but showed limited durability under the colorfastness to laundering, perspiration, and crocking tests. Madder performed better under dry conditions but exhibited greater transfer when wet, while indigo demonstrated slightly higher color retention yet

poor crocking performance. Both madder- and indigo-dyed fabrics were resistant to fading from perspiration, making them suitable for use in activewear. These outcomes align with prior research noting challenges in achieving consistent fastness in naturally dyed textiles (Cote et al., 2021; Thakker & Sun, 2022).

Although these limitations restrict immediate commercial feasibility, results highlight opportunities for improvement through exploration of fabric finishing techniques, hybrid fiber blends, or optimized mordanting. The observed dye transfer, while undesirable for color stability, may hold future potential for exploring limited transdermal absorption, aligning with Ayurvastra's wellness claims. Thus, RQ1 establishes a performance baseline for integrating traditional natural dye practices into modern sustainable activewear while emphasizing the need for further refinement in dye–fiber bonding and care requirements.

RQ2: Design Integration — Translating Cultural and Expert Insights into Product Strategy

Aligned with the *Define* and *Materialize* phases, RQ2 explored how expert feedback and trend analysis informed design development. Testimonials from yoga, running, and weightlifting professionals highlighted recurring needs for comfort, breathability, and supportive natural materials. These insights directly shaped the silhouettes and features, such as wide waistbands, medium-width straps, and flexible fits, reflecting design principles that prioritize mobility and comfort (Watkins & Dunne, 2015).

The strategic placement of indigo and madder dyes demonstrated how functional and symbolic considerations could merge. Indigo, positioned near the waist and ribcage, was associated with relieving muscular tension, while madder along the joints symbolized joint and muscle restoration. This integration of Ayurvedic philosophy with functional design exemplifies

both functional and symbolic (aesthetic and expressive) responsive design practices (Rosenblad-Wallin, 1985).

Trend analysis confirmed that the red and blue tones of madder and indigo aligned with current activewear palettes, ensuring aesthetic relevance. Additionally, AI-assisted visualization of the product concepts supported rapid prototyping, allowing the researcher to quickly develop prototype concepts for feedback without having to develop physical prototypes, thereby increasing efficiency of the design phase and further supporting the rapid and iterative nature of DT processes. Collectively, findings from RQ2 illustrate the potential for Ayurvedic philosophies to be able to push innovation in activewear and transform traditional wellness textiles into market-relevant, sustainable products.

RQ3: Consumer Research — Advertising Message Framing and Purchase Intention

Furthermore, RQ3 examined consumer responses to sustainability-, health benefit–, and innovation-focused marketing frames. While the ANOVA and ANCOVA analyses revealed no statistically significant differences, directional patterns provide important insights.

RQ3a: Health-benefit messaging elicited the highest mean purchase intention, followed by sustainability and innovation, suggesting that appeals emphasizing personal well-being may resonate more strongly than abstract environmental or technological claims.

RQ3b: When views on sustainable activewear were introduced as a covariate, purchase intention remained stable across conditions, reinforcing the "attitude–behavior gap" in sustainable consumption (White et al., 2019). This suggests that awareness alone does not predict behavior unless linked to self-relevant benefits.

RQ3c: Exploratory findings for pain level suggest that participants with higher discomfort reported marginally greater interest in health-benefit messaging, underscoring the

potential of wellness framing for products positioned within holistic self-care and recovery markets.

Together, these results demonstrate that while message framing did not produce significant behavioral differences, aligning sustainability with personal health and comfort may strengthen emotional resonance and purchase intent.

Synthesizing Insights Across Phases. Integrating findings from all three research questions, this study demonstrates the value of combining material science, design innovation, and consumer psychology within a DT framework. While material testing underscored technical limitations of natural dyes, design integration and consumer research revealed promising directions for product and brand strategy. The convergence of performance testing, user-centered design, and market evaluation highlights the need for iterative product development that balances environmental responsibility with functional performance and emotional appeal.

From a broader perspective, this research contributes to the emerging discourse on Ayurvastra for modern wellness apparel, suggesting that sustainable design can extend beyond environmental benefit to encompass physical and emotional well-being. Future studies should explore bio-based finishing techniques to enhance dye fastness, ethnographic research on user experience during wear, and larger-scale consumer experiments to validate the efficacy of health-oriented messaging. By bridging traditional knowledge and modern innovation, this project laid a foundation for a new category of sustainable activewear that embodies both cultural continuity and future-forward design.

CONCLUSION

In summary, this research identified a distinct gap in the activewear industry for functional, natural garments that not only support performance but may also promote physical well-being. Findings from both the expert testimonials and survey analyses suggest that consumers are interested in activewear made from natural fibers and dyes, particularly when these materials are positioned as offering potential health benefits, such as reducing inflammation or alleviating discomfort during movement. This indicates a promising market opportunity for brands that merge performance functionality with natural, health-conscious innovation.

Limitations and Future Work. While the results demonstrate positive consumer receptivity, further research is necessary to ensure the long-term durability and practicality of these materials in a commercial setting. Specifically, additional testing should be conducted on the colorfastness to perspiration, laundering, and crocking of naturally dyed fabrics to ensure they can withstand repeated use and laundering without compromising color quality or structural integrity. Moreover, future studies should investigate methods for scaling and refining the natural dyeing process to maintain its environmental integrity while improving product performance. The next step in this research is to examine the potential health impacts of these dyes through controlled testing to better understand their effects and validate their use in natural, health-conscious activewear. Additionally, emerging fiber technologies such as electrospinning could be investigated to enable the integration of dye compounds directly at the fiber level, enhancing colorfastness while allowing for controlled release of the dye's bioactive properties during wear. Another limitation of the current study was the narrow scope of survey participants and relatively small sample size, which primarily consisted of a specific age group and demographic segment. The sample size may have limited the ability to detect statistically significant differences among

the experimental conditions. A larger and more diverse participant pool in future studies would increase statistical power and enhance the generalizability of the findings. Expanding the sample would also allow for more robust analyses of potential moderating variables such as views on sustainable activewear and pain. For example, perceptions of sustainable and health-oriented activewear could differ among older or younger consumers. Future work would aim to collect data from a broader range of participants to capture these potentially diverse attitudes. Overall, this study provided foundational evidence that sustainable activewear is not only desirable to the target demographic but also represents a meaningful step toward a more sustainable and health-conscious apparel industry.

Contributions. This research contributes to the academic discourse on sustainable textile innovation and consumer behavior by bridging the gap between material science, design innovation, and consumer psychology within a DT framework. While prior studies have focused on the environmental advantages of natural fibers and dyes, this study extends that conversation by exploring their potential functional and physiological benefits within the context of activewear. By combining qualitative insights from expert testimonials with quantitative survey data, this work offers a multidimensional perspective on how consumers perceive health-oriented sustainability in apparel. Furthermore, it highlights the importance of interdisciplinary collaboration (linking fashion design, textile chemistry, and marketing research) to develop apparel that not only minimizes environmental harm but also enhances user well-being. In doing so, this research lays the groundwork for future academic inquiry into bio-based performance materials and evidence-based design strategies that prioritize both human health and environmental responsibility.

In addition, brands can benefit from these insights by aligning product development with consumer demand for wellness-oriented, sustainable apparel, informing marketing strategies that emphasize functional health benefits, and differentiating themselves in an increasingly competitive activewear market that values both ethical production and user-centric innovation.

Implications. The findings of this study carry several important implications across academia, industry, and society. For academia, this research provides a holistic framework that bridges material science, design innovation, and consumer psychology within a DT framework, offering building blocks for the next generation of scholars interested in sustainable and health-oriented apparel. By integrating qualitative and quantitative methodologies, it establishes a model for interdisciplinary research that can inform future studies on bio-based performance materials, evidence-based design, and consumer behavior.

For brands, the study highlights the untapped potential of naturally dyed and natural-fiber activewear, offering insights into how these materials can be leveraged to differentiate products in a competitive market. Companies can use this evidence to refine product development, marketing strategies, and brand positioning, appealing to consumers who prioritize both sustainability and health benefits. Furthermore, the findings suggest opportunities for innovation in an underdeveloped segment of the activewear market, signaling potential pathways for brands seeking to align with emerging consumer values.

Socially, the study underscores the broader environmental and health implications of apparel innovation, demonstrating how sustainable material choices can reduce environmental impact while promoting well-being. By emphasizing natural fibers and dyes, the research advocates for an apparel industry that prioritizes environmental responsibility, functional health benefits, and wellness.

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APPENDIX

Survey

Research & Development of Ayurvastra Activewear

Q1 **Purpose, Procedure, and Duration:** We are researchers from Colorado State University (CSU), Department of Design & Merchandising, inviting you to participate in a survey. We want to learn more about your perspective on current activewear options, as well as your view of a new activewear brand's social media advertising. If you agree to participate in our study, you will be asked questions about your level of activity, knowledge and ownership of activewear brands, and your opinion on a new activewear brand's social media advertising. The survey will take about 10 minutes to complete. We expect 75 people to respond. **Eligibility:** You must meet the following requirements to participate in this research study: **• Be aged 18-40 • Have purchased activewear at least once within the last 6-9 months Risks:** Some of our questions may make you feel uncomfortable or upset, but you can stop the survey at any time. We will use Qualtrics to collect your responses. They may have Terms of Service and Privacy policies outside of the control of CSU that allow them to use your data for other purposes. We will make every effort to safeguard your data. However, we cannot guarantee the security of data obtained via the Internet. **Benefits:** You may not benefit personally from being in this study, but your answers could help us understand more about the current state of female activewear options and the perceived effectiveness of social media advertising for a new activewear brand. Alternative Opportunities: We know of no alternative except not to participate in our study. **Privacy and Future Use:** Your responses to the research survey are anonymous. That means we won't know which responses are yours. We won't collect names, internet addresses, email addresses, or any other identifiable information. We may use your responses in future research or share them with other researchers. **Complaints or Concerns:** If you have questions about the study, please contact the researcher using the contact information provided, **alixg@colostate.edu.** If you have any questions about your rights as a volunteer in this research, contact the CSU IRB at CSU_IRB@colostate.edu Thank you for taking the time to consider our study. You do not have to participate in our study, but we hope you will. To ensure your responses will be included in our study, please complete the survey by **August 16, 2025.** Please select an option below to indicate you have read this information and wish to take the survey:

O I agree to be in this study (1) O I don't want to be in this study (2)

Q1 Have you purchased activewear (i.e., any clothing designed to be worn for sports, fitness training, or casually) at least once in the last six to nine months? O No (1) O Yes (2)

Q2 Please select your gender: ○Female (1) ○Male (2) ○Non-binary / third gender (3) ○Prefer not to say (4) ○Prefer to self-describe (5) _____

Q3 Are you between the ages of 18 and 40? ○No (1) ○Yes (2)

Q4 Please select all the activities/exercises you engage in:

☐ Yoga (1)

☐ Cycling (2)

☐ Running (3)

☐ Pilates (4)

☐ Barre (5)

☐ Weightlifting (6)

☐ I do not engage in physical activities (7)

Q5 On average, how many times a week do you participate in any form of physical activity or exercise?

○0 times a week (1) ○1-2timesaweek (2) ○Between 3 - 5 times a week (3) ○6-7timesaweek (4)

○More than 7 times a week (5) ☐ Other (Please Specify) (8)

_____

Q6 I experience physical pain or discomfort while engaging in these activities/exercises.

Never (1)

Rarely (2)

Neutral/Sometimes (3)

Often (4)

Always (5)

Q7 If you experience physical pain or discomfort while engaging in these activities/exercises, please provide more information about where on the body you experience the pain, if this pain is related to an injury and any other details you would like to add.

_____
_____
_____
_____
_____

Q8. In this section, you will be asked about your expectations of sustainable activewear in terms of its appearance, performance, and durability. Please indicate the extent to which you agree or disagree with each statement.

Q8a. Sustainable activewear will have a nice appearance. (1)

Strongly disagree (1)

Somewhat disagree (2)

Neutral (3)

Somewhat agree (4)

Strongly agree (5)

Q8b. Sustainable activewear will have good functional performance. (2)

Strongly disagree (1)

Somewhat disagree (2)

Neutral (3)

Somewhat agree (4)

Strongly agree (5)

Q8c. The design and operating characteristics of sustainable activewear will meet the established standards. (3)

Strongly disagree (1)

Somewhat disagree (2)

Neutral (3)

Somewhat agree (4)

Strongly agree (5)

Q8d. Sustainable activewear will have good durability. (4)

Strongly disagree (1)

Somewhat disagree (2)

Neutral (3)

Somewhat agree (4)

Strongly agree (5)

Q9 What activewear brands do you currently own/wear? Select all that apply.

☐ Adidas (1)

☐ AloYoga(2)

- [ ] Athleta (3)
- [ ] Beyond Yoga (4)
- [ ] Fabletics (5)
- [ ] Girlfriend Collective (6)
- [ ] Lululemon (7)
- [ ] Nike (8)
- [ ] OldNavy(9)
- [ ] Sweaty Betty (10)
- [ ] Target (11)
- [ ] Under Armour (12)
- [ ] Vuori (13)
- [ ] Other (Please Specify) (14) _____

Q10 In the previous question, we asked about the activewear brands you currently wear. Are there any brands you aspire to own/wear? Please select all that apply.

- [ ] Adidas (1)
- [ ] AloYoga(2)
- [ ] Athleta (3)
- [ ] Beyond Yoga (4)
- [ ] Fabletics (5)
- [ ] Girlfriend Collective (6)
- [ ] Lululemon (7)
- [ ] Nike (8)
- [ ] OldNavy(9)
- [ ] Sweaty Betty (10)
- [ ] Target (11)
- [ ] Under Armour (12)

☐ Vuori (13)

☐ None or No (15)

☐ Other (Please Specify) (14) _____

Q11. After viewing the following marketing email, please answer all of the subsequent questions as accurately as possible.

Marketing Email – Condition 1 (See end of survey)

Marketing Email – Condition 2 (See end of survey)

Marketing Email – Condition 3 (See end of survey)

Q11a. For this first question, please reflect on how **visually** engaging you found the marketing email.

I find this advertisement visually (color, layout, etc.) engaging. (1)

Strongly disagree (1)

Somewhat disagree (2)

Neutral (3)

Somewhat agree (4)

Strongly agree (5)

Q11b. What about this marketing email did you find visually engaging? (Use a word or short phrase to explain your response. You can expand on it if you'd like.)

_____
_____
_____
_____

_____

Q12 For this question, please reflect on the **messaging** for the marketing email.

Q12a. I find the messaging for this advertisement engaging. (1)

Strongly disagree (1)

Somewhat disagree (2)

Neutral (3)

Somewhat agree (4)

Strongly agree (5)

Q12b. What about the messaging in this marketing email did you find engaging? (Use a word or short phrase to explain your response. You can expand on it if you'd like.)

_____
_____
_____
_____
_____

Q13 For this question, please reflect on the design of the product featured in the marketing email.

Q13a. How much do you like the product design featured in this advertisement? (1)

Not at All (1)

Slightly (2)

Neutral (3)

Quite a Bit (4)

Very Much (5)

Q13b. What specific aspects of the product do you find appealing? (Use a word or short phrase to explain your response. You can expand on it if you'd like.)

_____
_____
_____
_____
_____

Q14 In this question, please reflect on your purchase intention for the product in the marketing email.

Q14a. How likely are you to purchase the product featured in the advertisement?

Not at All (1)

Slightly (2)

Neutral (3)

Quite a Bit (4)

Very Much (5)

Q14b. After viewing the marketing email, what aspects influenced your decision to purchase or not purchase the product? (Use a word or short phrase to explain your response. You can expand on it if you'd like.)

_____
_____
_____
_____
_____

Q15 Based on the marketing email you just viewed, what is the average price you would be willing to pay for any of the garments featured?

_____

_____
_____
_____
_____

Q16 Based on the marketing email you just viewed, what is the average price you would be willing to pay for the garments featured? (In $USD)

☐ Sports Bra (1) _____

☐ Leggings (2) _____

☐ Activewear Shrug (3) _____

Q17 Which race or ethnicity best describes you? (Please choose only one.)

O American Indian (1)

O Alaskan Native (2)

O Asian / Pacific Islander (3)

O Black or African American (4)

O Hispanic (5)

O White / Caucasian (6)

O Multiple ethnicity (Please Specify) (7) _____

O Other (Please Specify) (8) _____

Q18 What year were you born?

_____
_____
_____
_____
_____

Q19 What is your total combined household income before taxes for the past year? Please check the box that applies.

O $25,000 or less (1) O $25,001 to $50,000 (2) O $50,001 to $75,000 (3) O $75,001 to $100,000 (4)

O $100,000 to $125,000 (5) O $125,001 to $150,000 (6) O $150,001 to $200,000 (7) O $200,001 to $300,000 (8) O $300,001 – $500,000 (9) O $500,001 or more (10)

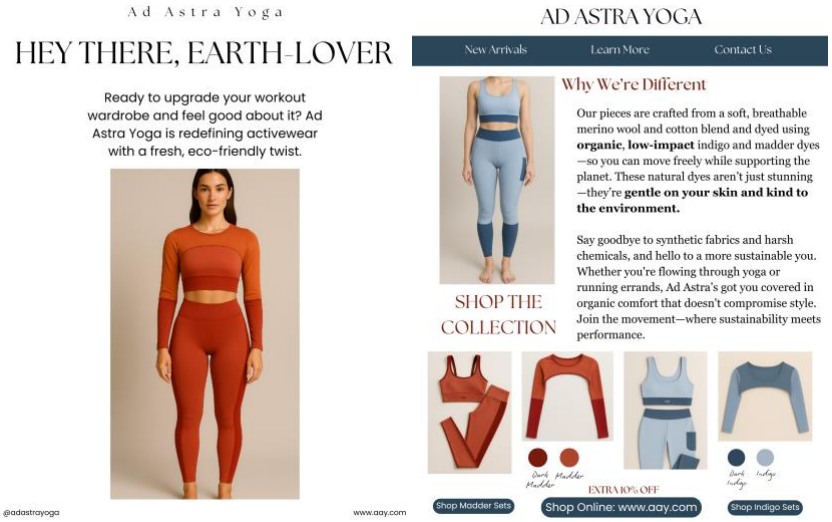
Q20 What is your occupation?

_____
_____
_____
_____
_____

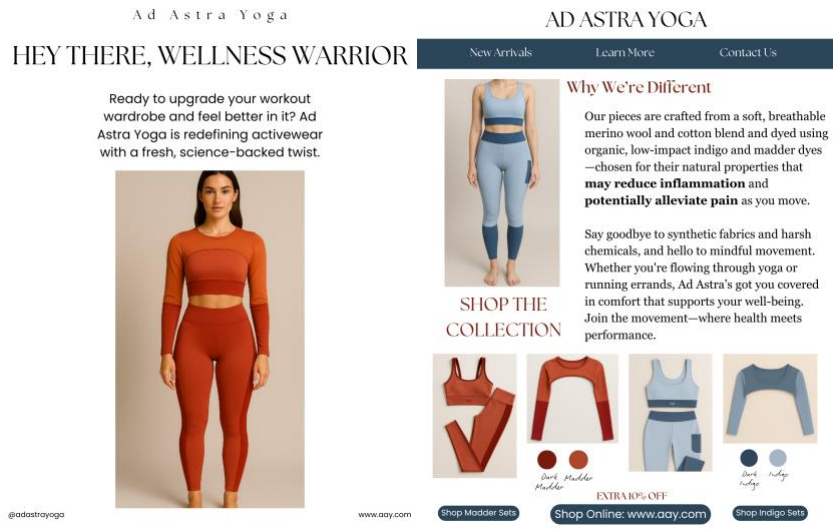
Q21 In what state do you reside?

_____
_____
_____
_____
_____

Sustainability



Health Benefits


Ad Astra Yoga
HEY THERE, WELLNESS WARRIOR
Ready to upgrade your workout wardrobe and feel better in it? Ad Astra Yoga is redefining activewear with a fresh, science-backed twist.
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AD ASTRA YOGA
New Arrivals
Learn More
Contact Us
Why We're Different
Our pieces are crafted from a soft, breathable merino wool and cotton blend and dyed using organic, low-impact indigo and madder dyes—chosen for their natural properties that may reduce inflammation and potentially alleviate pain as you move.
Say goodbye to synthetic fabrics and harsh chemicals, and hello to mindful movement. Whether you're flowing through yoga or running errands, Ad Astra's got you covered in comfort that supports your well-being. Join the movement—where health meets performance.
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Madder
Dark Indigo
Indigo
EXTRA 10% OFF
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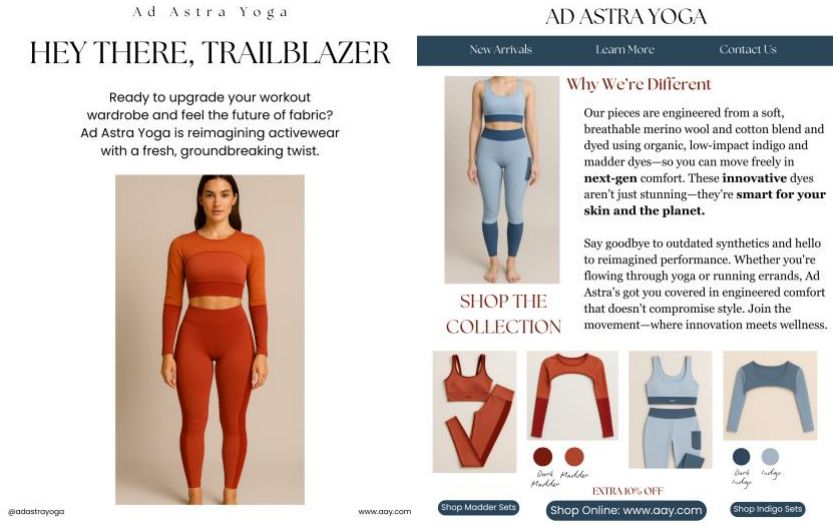
Shop Madder Sets
Shop Online: www.aay.com
Shop Indigo Sets

Innovation


Ad Astra Yoga
HEY THERE, TRAILBLAZER
Ready to upgrade your workout wardrobe and feel the future of fabric? Ad Astra Yoga is reimagining activewear with a fresh, groundbreaking twist.
@adastrayoga
AD ASTRA YOGA
New Arrivals
Learn More
Contact Us
Why We're Different
Our pieces are engineered from a soft, breathable merino wool and cotton blend and dyed using organic, low-impact indigo and madder dyes—so you can move freely in next-gen comfort. These innovative dyes aren't just stunning—they're smart for your skin and the planet.
Say goodbye to outdated synthetics and hello to reimagined performance. Whether you're flowing through yoga or running errands, Ad Astra's got you covered in engineered comfort that doesn't compromise style. Join the movement—where innovation meets wellness.
SHOP THE COLLECTION
Dark Madder
Madder
Dark Indigo
Indigo
EXTRA 10% OFF
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Shop Madder Sets
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