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**Innovative Use of Saga Seeds as a Primary Material in Jewellery Crafting:
A creative research exploration**

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Abstract

This creative research explores the innovative use of *Adenantha pavonina* (saga seeds) as a sustainable material in contemporary jewellery design. Traditionally overlooked, saga seeds are investigated for their aesthetic, structural, and ecological properties. Through artistic experimentation and traditional craftsmanship, the study demonstrates its adaptability across various fabrication techniques. The research highlights their potential to inspire environmentally conscious and culturally meaningful adornments. By integrating nature-derived materials with modern design principles, this study redefines conventional jewellery practices, offering a new direction in botanical jewellery. Saga seeds emerge as a symbol of sustainable creativity, bridging material innovation with heritage and ecological awareness.

Keywords: Innovation; Saga seeds; Jewellery design; Exploration

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1.0 Introduction

Natural materials have long been central to human adornment. Archaeological evidence reveals that early societies employed Natural materials that have long played a central role in human adornment. Archaeological evidence reveals that early societies used bones, shells, coral, and animal teeth not only for decoration but also for symbolic expressions of status, identity, and spirituality (Dubin, 2009; Francis, 2022). As craftsmanship evolved, jewellery incorporated metals, pearls, and gemstones (Zhao et al., 2023). Today, amid growing environmental concerns, designers are revisiting plant-based materials as sustainable alternatives to extractive or synthetic resources. This movement aligns with ethical fashion and slow design principles, advocating for ecological responsibility and cultural authenticity (Brismar, 2016; Fletcher & Tham, 2019). Seeds, including *Adenantha pavonina* (saga seeds), are increasingly recognised for their narrative and aesthetic potential (Armstrong, 2000; Miller, 2021). This study investigates saga seeds as a viable jewellery material using the Biomimicry Design Spiral (Benyus, 2016). It explores how material experimentation, informed by cultural significance, can redefine contemporary jewellery through sustainable and heritage-driven design innovation.

2.0 Literature Review

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2.1 The Significance of Saga Seeds

The *Adenanthera pavonina* tree flourishes in tropical regions, producing glossy red seeds that are visually striking, durable, and uniform in structure (Lim, 2014; Yap & Lee, 2021). In Malay culture, saga seeds symbolise love, memory, and longing, often exchanged as sentimental tokens (Ismail, 2006; Rahman et al., 2022). Their heart-like form and vibrant hue lend emotional and visual appeal. This symbolism extends across Southeast Asia and beyond, with seed adornments also present in African and South American traditions (Francis, 2022; Gamarra & Abudayyeh, 2023). As sustainable, biodegradable, and locally abundant materials, saga seeds support ethical fashion and circular design, while early tests indicate strong durability and adaptability for contemporary jewellery-making (Davis & Mehrabi, 2023).



Fig. 1: Saga seed, a round, flat seed with a red colour
(Source: Nazirah M. Ba'ai, 2023)

2.2 Innovation in Botanical Materials

Sustainable material demand has elevated biomaterials such as leaves, fibres, and seeds in design practices (Fletcher & Tham, 2019). Saga seeds, once used in simple beaded adornments, are now reimagined through contemporary methods like resin coating, wire construction, and 3D-printed settings (Gamarra & Abudayyeh, 2023). Their hardness and resistance to environmental stress render them stronger than many other botanical materials (Lim, 2014). Moreover, saga seeds embody narrative potential: their symbolism connects with heritage while offering market appeal to consumers seeking meaningful, sustainable products. This aligns with global calls for regenerative, culturally rooted design (Benyus, 2016). Yet challenges remain in ensuring long-term durability, colour stability, and broader acceptance in commercial markets.

2.3. Contemporary Jewellery Concepts

Contemporary jewellery transcends ornamentation, blending art, narrative, sustainability, and technology (Dormer, 2020; Walker, 2021). Designers increasingly adopt unconventional materials, recycled metals, plastics, or natural fibres, emphasising ethical and symbolic value over rarity (Fletcher & Tham, 2019; Zhao et al., 2023). Jewellery now communicates themes such as identity, ecology, and heritage (Le Van, 2022; Sunderland, 2021). In Southeast Asia, designers reinterpret traditional motifs and materials within modern contexts, reviving elements like batik or flora while incorporating indigenous resources, including saga seeds (Rahman et al., 2022). This synthesis of heritage and innovation strengthens cultural identity while responding to global sustainability discourse.

2.4. Nature-Based Design Approaches

Nature-based design encompasses biomimicry, biophilia, and ecological approaches, drawing inspiration from nature's systems to generate regenerative, sustainable design solutions (Benyus, 2016). The Biomimicry Design Spiral, for example, encourages iterative exploration by emulating nature's strategies for adaptability, efficiency, and resilience. In the context of jewellery, nature-based design integrates organic materials and natural forms to reflect ecological values (Rahman et al., 2022; Ba'ai, 2015). *Adenanthera Pavonina* (saga seeds), with their rich symbolic meaning and tactile qualities, exemplify this approach. Biophilic design posits that incorporating nature's aesthetics into everyday objects, such as jewellery, fosters psychological well-being (Kellert, 2020). Eco-conscious adornments often use biodegradable, recycled, or ethically sourced materials like post-consumer gold to reduce environmental impact (Ba'ai et al., 2015). Saga seeds, once viewed as simple ornaments, are now reconsidered as sustainable, culturally embedded design elements. Their use in contemporary jewellery demonstrates how ecological responsibility, narrative symbolism, and material innovation can converge to redefine design values in both form and function.

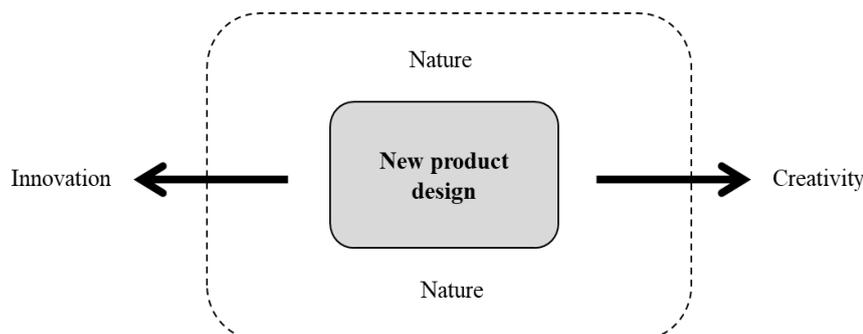


Fig. 2: The Concept of Product Design Approach
(Source: Nazirah M. Ba'ai, 2023)

3.0 Methodology

3.1 Exploratory Design Research

This study adopts exploratory research (Salkind, 2006) to investigate the potential of *Adenanthera pavonina* (saga seeds) in contemporary jewellery design, particularly focusing on their adaptability to fabrication processes such as drilling, riveting, joining, wire construction, and non-soldered settings. To critically guide this inquiry, the Biomimicry Design Spiral by Carl Hastrich (2005) was integrated into the *Product Design Framework* (refer to Fig. 3), offering a six-phase methodology that bridges biological inspiration with material innovation. The process begins with the *Identify phase*, where research objectives were set: to test saga seeds as a viable, sustainable jewellery material. The *Translate phase* involved reviewing literature, keywords, and traditional knowledge to define functional design requirements. During the *Discover phase*, seeds were harvested and analysed through physical handling and preliminary tests, including engraving and slicing, to observe their response to common jewellery-making stresses. The *Abstract phase* interpreted insights from natural forms and processes, guiding the aesthetic approach, particularly the use of cross-sectional patterns on the seed's red outer skin. In the *Emulate phase*, prototypes were developed using jewellery techniques such as the Cage Setting, a non-invasive method that structurally holds the seeds without soldering. Finally, in the *Evaluate phase*, outcomes were assessed for design viability, sustainability, and potential market appeal. By applying the spiral iteratively, the study ensured that both ecological principles and design integrity were maintained. This approach revealed that saga seeds possess not only visual appeal and symbolic value but also structural resilience, affirming their potential in nature-inspired, low-impact jewellery. The integration of the Biomimicry Design Spiral enabled a balance between cultural heritage, material experimentation, and sustainable innovation, reinforcing the seeds' relevance as a contemporary design material.

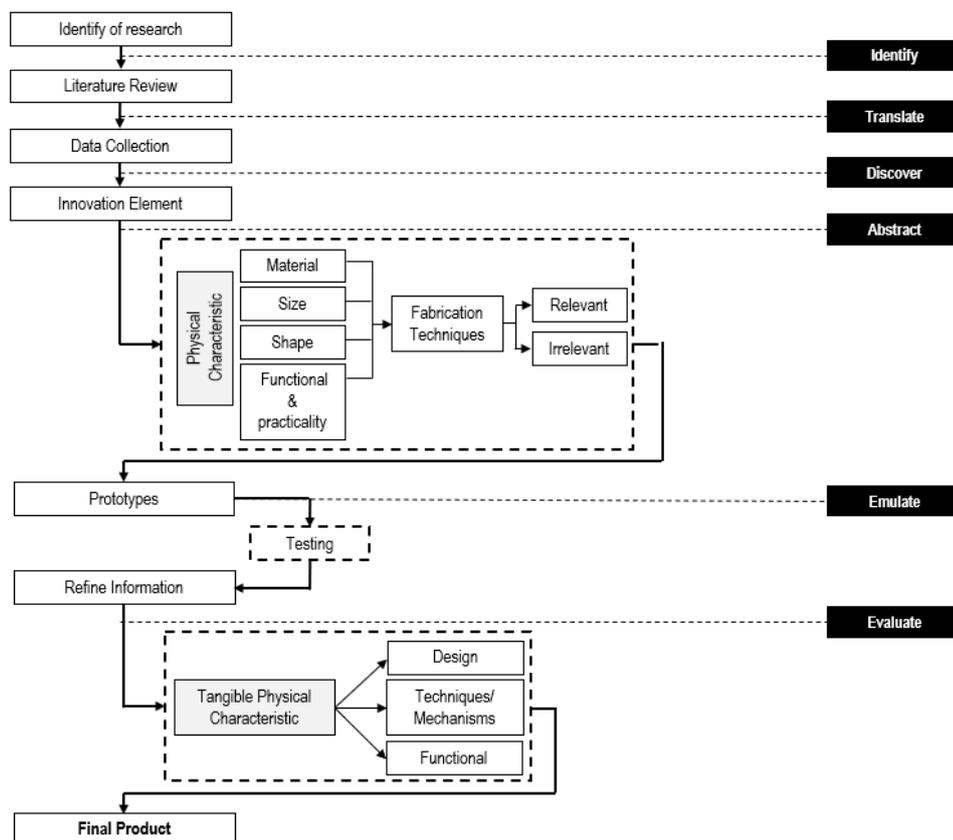


Fig. 3: The Product Design Framework
(Source: Nazirah M. Ba'ai, 2023)

3.2. Data Collection and Material Exploration

The data collection process for this creative research study on the application of *Adenanthera pavonina* (saga seeds) as a primary material in jewellery design was conducted using a structured, exploratory methodology. This approach enabled the systematic acquisition of empirical data, material characteristics, and contextual insights relevant to sustainable and culturally embedded design practices.

Saga seeds were chosen for their year-round availability and widespread natural distribution across diverse ecological regions in Malaysia, making them a reliable and sustainable botanical resource for continuous material exploration. Unlike other plant-based materials that may be seasonal or agriculturally dependent, saga seeds can be harvested from wild-grown trees, making them a practical and environmentally responsible choice for continuous experimentation and material sourcing. Following initial identification and

collection, the seeds underwent a preliminary evaluation based on visual and tactile parameters such as colour, shape, size, surface texture, and natural lustre, as well as functional criteria including durability, material density, and potential adaptability to common jewellery-making techniques. The cultural significance and sustainability of saga seeds were integral considerations in this study, particularly given their deep-rooted sentimental and symbolic value within Malay communities, where they are often associated with themes of love, memory, and emotional connection (Ismail, 2006; Rahman et al., 2022).

To further assess the material's suitability for jewellery fabrication, the researcher applied a series of basic material treatment processes adapted from conventional jewellery practices. These included cleaning, slicing, thermal modification using microwave heating and open flame (torch burning), and chemical immersion in a pickling solution composed of one part sulfuric acid and ten parts cold water. These procedures were designed to assess the physical response of the seeds under conditions commonly encountered in metal and mixed-material jewellery fabrication, including stress resistance, surface reaction, and structural integrity. Through this hands-on exploratory process, the study documented the behavioural characteristics of saga seeds under different fabrication treatments. Observations from this stage informed the subsequent material analysis and prototyping phases, enabling a clearer understanding of the seeds' potential as a viable and sustainable component in contemporary botanical jewellery design.

4.0 Analysis and Findings

4.1. The Durability and Characteristics of Saga Seeds

This study analysed the physical and aesthetic properties of *Adenantha pavonina* (saga seeds) through a series of experimental procedures designed to evaluate their durability, adaptability to jewellery techniques, and visual qualities. The findings contribute to understanding the feasibility of incorporating saga seeds as a sustainable, botanical material in contemporary jewellery design. Saga seeds exhibit several favourable characteristics that make them suitable for creative applications. Their hard, glossy outer shell provides a natural resistance to environmental stressors, while their uniform size and vibrant red hue offer aesthetic consistency (Lim, 2014; Yap & Lee, 2021).

To assess these properties under fabrication conditions, the seeds underwent multiple tests, including thermal exposure, physical manipulation, and chemical treatment, replicating standard jewellery-making processes such as drilling, polishing, burning, and acid immersion. Preliminary results indicate that saga seeds demonstrate moderate to high resilience in controlled conditions. They retained their structural integrity when subjected to low-intensity flame exposure (torch) for short durations, although prolonged heat led to surface darkening and occasional cracking. Drilling and wire insertion tests revealed that the outer shell, while firm, required precision tools to prevent splitting. When immersed in diluted sulfuric acid, the seeds showed no significant discolouration or deformation, suggesting chemical stability under mild acidic conditions commonly used in jewellery pickling processes (Ahmed & Choudhury, 2023).

Additionally, physical observation of the seeds confirmed a natural sheen and smooth tactile quality, which can be further enhanced by polishing. The visual and textural aspects of the seeds were also evaluated for design purposes. Their curvature, density, and colour uniformity provided favourable conditions for surface embellishment and component integration with metals or beads (Zhao et al., 2023). The following Table 1 summarises the key characteristics of saga seeds observed during the experimental analysis:

Table 1: Durability and Physical Characteristics of Saga Seeds in Jewellery Applications

| Characteristic | Observation | Design Implication |
|---------------------------|--|---|
| Colour | Bright red, glossy surface; consistent across samples | High aesthetic appeal; requires minimal enhancement |
| Surface texture | Smooth, hard shell with natural polish | Suitable for direct use or polishing |
| Structural integrity | Resists low heat and light pressure; cracks under prolonged flame or force | Can be drilled, riveted, and set with care |
| Response to drilling | Moderate resistance; risks splitting if untreated | Requires specialised tools and controlled pressure |
| Chemical resistance | Stable in diluted acid (pickling solution) | Compatible with metal-cleaning processes |
| Shape and size uniformity | Relatively uniform in natural state; size range: 5–8 mm | Ideal for bead-like or modular design components |
| Tactile quality | Lightweight, smooth feel | Enhances comfort and wearability |
| Preservation potential | Retains colour and form under natural drying and sealing | Long shelf-life with basic preservation techniques |

(Source: Nazirah M. Ba'ai (2023))

4.2. Design Process and Jewellery Fabrication Using Saga Seeds

Design plays a vital role in jewellery creation, serving as both a conceptual and technical bridge between creative vision and material innovation. In this study, integrating *Adenantha pavonina* (saga seeds) into jewellery required a rethinking of conventional design processes to suit the unique physical characteristics and cultural symbolism of this botanical material. As Galton (2012) notes, jewellery design is inherently iterative, where each phase from ideation to prototyping informs the next. The design process encompassed five stages: ideation, sketching, rendering, 3D modelling, and prototyping.

During ideation, designers explored the symbolic associations, shape, and rich red hue of saga seeds. These ideas were expressed through initial sketches, which were refined using Adobe Illustrator to visualise surface textures, colour compositions, and structural layouts. 3D modelling in Jewe ICAD allowed simulation of dimensions, assembly, and compatibility with metal findings, especially considering the seeds' size (5–8 mm). Prototyping involved fabricating physical models using methods such as wire wrapping, drilling, joining, and fusion without soldering. Each technique was assessed for its compatibility with the seeds' hardness, surface resilience, and aesthetic quality. Iterative testing led to important design adjustments, resizing and alternative joining techniques to enhance

wearability, visual balance, and structural integrity. These adaptations ensured the feasibility of combining saga seeds with precious metals such as 925 silver, aligning both technical precision and sustainable design goals (Ahmed & Choudhury, 2023).

This integrated design process highlights the dual necessity of creative conceptualisation and technical adaptability when working with alternative natural materials in jewellery. The findings demonstrate that saga seeds can be effectively incorporated into jewellery designs when supported by strategic material assessments and tailored fabrication processes. By integration of traditional craftsmanship with modern design tools and sustainable materials, this study contributes to the growing discourse on eco-conscious innovation in craft design. The iterative nature of this process also suggests potential for broader applications of biomaterials in design education, artisanal entrepreneurship, and ethical luxury markets (Gamarra & Abudayyeh, 2023; Fletcher & Tham, 2019).

Table 2: Durability and Physical Characteristics of Saga Seeds in Jewellery Applications

| Design Stage | Key Activity | Application to Saga Seeds | Design Consideration |
|-----------------------|---|--|---|
| Ideation | Concept development, cultural and visual research | Inspired by seed symbolism, natural colour, and shape | Aesthetic alignment with sustainable, nature-based design |
| Sketching | Freehand or digital drawing of ideas | Illustrated initial arrangements with metal and organic materials | Focus on form balance and seed visibility |
| Rendering | Visualisation of detailed design features using digital tools | Applied colour, shine, and texture using Adobe Illustrator | Refinement of surface pattern and composition |
| 3D Modelling | Digital prototyping with scale and fit verification | Constructed 3D models in Jewel CAD to assess integration with metal settings | Assessed tolerance and durability under assembly stress |
| Prototyping | Production of physical samples for testing | Created test jewellery using wire, resin, and metal to assess joint strength | Iterative adjustments made for durability, flexibility, and polishability |
| Fabrication Technique | Drilling, wire work, fusion, and setting | Evaluated each method for compatibility with the seed surface and structure | Avoided excessive force and heat exposure; selected low-impact techniques |

(Source: Nazirah M. Ba'ai (2023))

4.3. Design Implications

This study presents a creative and exploratory investigation into the application of *Adenanthera pavonina* (saga seeds) in contemporary jewellery design. The research demonstrates that saga seeds possess both material versatility and cultural significance, making them suitable candidates for integration into innovative and meaningful jewellery artefacts. Through a design-led methodology grounded in material experimentation, this study demonstrates the feasibility of saga seeds as a sustainable botanical material that aligns with contemporary aesthetic sensibilities and ethical design values. The findings confirm that saga seeds can be successfully combined with conventional jewellery media, such as sterling silver (925) and other precious metals, to produce hybrid designs that bridge tradition and modernity (refer to Fig. 4). The material's compatibility with metal-based components not only enhances its structural potential but also elevates its perceived value, supporting its commercial viability in the niche market of sustainable and artisan-crafted jewellery.



Fig. 4: Neck Accessories (Choker) from Saga Seeds and Silver Wire (925).

(Source: Nazirah M. Ba'ai, 2004)

Furthermore, the natural red hue of *Adenanthera pavonina* (saga seeds) offers a striking visual identity aligned with contemporary minimalist and colour-centric design aesthetics. Empirical tests confirm their durability under moderate heat, pressure, and handling, supporting their use in long-lasting, wearable jewellery. Saga seeds are valued for their visual appeal, exclusivity, and affordability, making them accessible across markets. A key technical contribution of this study is the development of a Cage Setting technique, by using a wire construction that secures the seed without damaging its structure. This method supports sustainable fabrication and enables modular applications in pendants, earrings, and brooches.

5.0 Discussion

This study critically investigates the potential of *Adenanthera pavonina* (saga seeds) as a sustainable, culturally significant biomaterial for contemporary jewellery design. Through a creative, exploratory methodology grounded in prototyping and fabrication analysis, the research reveals that saga seeds hold both functional and symbolic potential when integrated into modern jewellery-making practices.

The study contributes to ongoing conversations in design research around sustainable materiality, ethical production, and the reintegration of traditional ecological knowledge into contemporary craft.

Saga seeds, traditionally undervalued in mainstream jewellery contexts, are repositioned here as both material and narrative agents bridging ecological values, artisanal heritage, and consumer aesthetics. Their vibrant red hue, durable shell, and uniform size allow for practical use in bead-based and wire-structured jewellery, while their rich cultural associations in Southeast Asia, linked to memory, love, and nature, imbue the pieces with emotional resonance (Ismail, 2006; Rahman et al., 2022). This research draws upon critical frameworks in eco-materiality and slow design, where the selection of materials is considered not only for their aesthetic qualities but also for their ethical and environmental implications (Fletcher & Tham, 2019; Tonkinwise, 2011). In line with these theories, the study demonstrates how locally sourced, biodegradable materials such as saga seeds can offer alternatives to extractive resources and environmentally intensive processes. The alignment with biomimicry and regenerative design models (Benyus, 2016) further supports the use of saga seeds as a renewable, nature-inspired material that embodies principles of sustainability, circularity, and resilience.

A key contribution of this study is the development of a Cage Setting technique (Fig. 5), in which saga seeds are encased using modular wire structures instead of soldering. This method preserves the seed's integrity while enabling secure and elegant integration with precious metals. It also reflects best practices in low-impact fabrication, supporting disassembly and repair, an essential component of circular design thinking (Walker, 2021). Laboratory-based durability assessments confirm that saga seeds maintain their colour and structure under common fabrication and handling conditions, supporting their long-term viability in wearable design. The combination of physical robustness and cultural richness positions saga seed jewellery within the emerging ethical luxury segment, where storytelling, origin, and environmental consciousness drive consumer value. From a socio-economic perspective, the research highlights opportunities for community-based production ecosystems, particularly in rural or indigenous contexts. By sourcing and processing saga seeds ethically, local communities can participate in sustainable value chains that combine craft, conservation, and livelihood development aligned with the United Nations Sustainable Development Goals (UNDP, 2023).



Fig. 5: Cage Setting.
(Source: Nazirah M. Ba'ai, 2004)

5.1. Limitations and Future Directions

Several limitations emerged from this study. The research was limited to artisanal-scale prototyping, with no standardised methods for grading, treating, or mass-producing saga seed jewellery. Consumer perception also remains underexplored, particularly regarding the value and market acceptance of natural materials versus conventional gemstones. Interdisciplinary applications, such as in men's accessories, religious items, and home décor, warrant further investigation. Additionally, integrating this research into design education can foster biomaterial literacy and promote sustainable design thinking. Overall, saga seeds demonstrate strong potential as a viable alternative material, offering new pathways for ecological innovation, cultural engagement, and ethical design in contemporary jewellery.

6.0 Conclusion & Recommendations

This research makes a significant contribution to contemporary jewellery and sustainable design by introducing *Adenanthera pavonina* (saga seeds) as a viable alternative material that merges ecological integrity, cultural heritage, and creative innovation. Through iterative design experimentation, fabrication testing, and critical reflection, the study demonstrates how natural materials, when approached with thoughtful methodologies, can disrupt conventional material hierarchies and open pathways for ethical and culturally grounded practices. By validating saga seeds' functionality, symbolic richness, and adaptability, the research expands the discourse on botanical jewellery and contributes to the growing field of eco-materiality and slow design. This work also offers a new model for integrating biomimicry and indigenous knowledge in material innovation, underscoring the role of design in fostering regenerative futures. The success of saga seeds in this study paves the way for further interdisciplinary explorations across design, sustainability studies, and heritage-based crafts.

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