



Biodegradable Glitter: A Sustainable Alternative to Microplastic-Based Sparkle

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Abstract—This study presents a simple, low-cost method to make biodegradable glitter from corn husk, an agricultural waste. Conventional glitter is a primary microplastic made from polyethylene terephthalate (PET) and polyvinyl chloride (PVC), and it pollutes soil and water for decades. To offer a greener option, cellulose was extracted from corn husk using a mild alkaline (NaOH) treatment, dried, ground, coloured with natural pigments (turmeric, beetroot, and spinach), and bound with corn flour to form glitter-sized particles. The product was tested for cellulose content (Congo red staining), thermal stability, turbidity, colour fastness across different pH conditions, and biodegradability in soil, with each measurement carried out in triplicate. The glitter stayed stable in boiling water (absorbance 0.02 at 580 nm), added almost no turbidity to water (absorbance 0.02 at 600 nm), and held its colour well in acidic and neutral conditions, fading only in strong alkali. In soil, the glitter broke down within 2–3 weeks, indicating strong biodegradability. At around ₹50 per 4 g, the product is far cheaper than commercial bio-glitters. These results show that corn husk glitter is an eco-friendly and affordable alternative for arts and crafts and decorative applications, and a promising candidate for cosmetics after further skin-safety testing.

Index Terms—Biodegradable Glitter, Corn Husk, Cellulose, Microplastic Pollution, Circular Economy, Natural Pigments

I. INTRODUCTION

A. The Rise of Glitter and Its Environmental Cost

Glitter has become a common feature in cosmetics, fashion, arts and crafts, and festival decorations. It is used by performers, brands, and the public to add sparkle and visual appeal, and its popularity has grown with social media and advertising. Although each glitter particle is tiny, the amounts used every year are very large. Big public events and everyday products together consume huge quantities of glitter. Because most glitter is made from plastic, this widespread use adds directly to the growing problem of microplastic pollution [1], [2].

B. Composition of Traditional Glitter

Traditional glitter is made mainly from polyethylene terephthalate (PET), a plastic film that is stretched to make it strong and then coated with aluminium to give it a shiny, reflective look. The particles are usually cut into small hexagons or other shapes such as stars and hearts. This material is dense, melts only at a high temperature, and does not dissolve in water. Besides PET, other plastics such as acrylic, poly(methyl methacrylate) (PMMA), and polyvinyl chloride (PVC) are also used. Because glitter is so small and light, it spreads easily by contact and movement, sticking to skin, clothes, and surfaces, and is often released into the environment without anyone noticing [2], [4], [23].

C. Problems Associated with Traditional Glitter

Glitter is a microplastic from the moment it is made, because the particles are already smaller than 5 mm. This creates several linked problems. First, the particles are too small to be filtered out by wastewater treatment plants, so they pass into rivers, lakes, oceans, and soil, where PET and PVC can persist for decades. Microplastics have now been found even in remote places such as the Arctic and the deep sea [1], [3], [25].

Second, glitter harms marine life. Small creatures such as plankton and shellfish swallow the particles, which can block their digestive systems. Many plastics also carry harmful additives such as phthalates, bisphenol A (BPA), and heavy metals, which can leach into animals and build up as they move up the food chain [3], [5], [18], [19]. Third, glitter affects soil and biodiversity: when plastic particles collect in soil, they can change the community of soil microbes and affect earthworms and plant growth, disturbing whole ecosystems.

Fourth, there are human health concerns. Microplastics have been detected in drinking water, table salt, seafood, and even human lungs and blood. Possible effects include inflammation, oxidative stress, and hormone disruption from endocrine-disrupting chemicals in some plastics. Because of all these issues, there is a strong and growing push for biodegradable alternatives, and some regions have started to restrict intentionally added microplastics such as plastic glitter [6], [7], [8].

D. Cellulose and Corn Husk as a Sustainable Solution

Cellulose, the main building block of plant cell walls, is one of the most abundant and renewable materials on Earth. Unlike plastic, it breaks down naturally through microbial action into harmless products. When processed correctly, cellulose can form thin, reflective, colourful particles that look like glitter but leave no toxic residue behind [9], [10], [24]. Corn husk is a cheap and widely available agricultural waste that is usually thrown away after harvest, and it is rich in cellulose, which makes it an ideal raw material for eco-friendly glitter [11]. By turning this waste into a useful product, the process supports a circular economy, where waste is converted into value instead of adding to pollution [13], [20]. This study develops biodegradable glitter from corn husk cellulose and evaluates its stability, safety, biodegradability, and cost, with the aim of offering a practical replacement for plastic glitter.

II. RELATED WORK

Several earlier studies have looked at biodegradable glitter and at cellulose from plant waste, and this work builds on their findings. Research on the ecological effects of different glitters on aquatic plants has shown that some “biodegradable” glitters can still harm plants in the short term, mainly because of metal-based coatings, while the harmful effect became weaker as the glitter aged [3]. This shows that calling a material biodegradable is not enough on its own; the ingredients and coatings must be chosen carefully so that the product is truly safe [5].

Other work has pointed out that most glitters sold today are polyester microplastics smaller than 5 mm, found in make-up, crafts, and clothing, and has called for stricter rules and greater consumer awareness [2], [6]. Studies on cellulose taken from corn husk waste have produced biodegradable and even edible

films with good strength and stability, showing that agricultural waste, including corn husk, is a suitable and reliable source of cellulose [10], [11]. Broader reviews of cellulose describe it as renewable, safe, low-impact, and easy to modify for many uses, including biodegradable packaging [11], [13]. Building on this background, the present study focuses on a simple, low-cost glitter made directly from corn husk cellulose with minimal chemical processing and natural pigments, aiming to keep the natural biodegradability of the raw material intact.

III. RESEARCH OBJECTIVES

The main aim of this study is to develop a biodegradable glitter from corn husk cellulose and to test whether it can work as a safe and eco-friendly replacement for plastic glitter. The specific objectives are:

- To extract cellulose from corn husk using a simple and low-cost method.
- To manufacture biodegradable glitter with good colour, shine, and stability using natural pigments and a natural binder.
- To assess the biodegradability of the glitter under natural soil conditions.
- To explore the potential applications of the glitter in cosmetics, arts, and decorative products, and to compare its cost with commercial bio-glitters.

IV. RESEARCH METHODOLOGY

The work was carried out in two main stages: extraction of cellulose from corn husk, followed by formulation of the glitter. A set of simple laboratory tests was then used to check the quality, safety, and biodegradability of the final product.

A. Materials and Equipment

The following materials and equipment were used:

- Raw material: dried corn husk collected from local markets.
- Chemicals: sodium hydroxide (NaOH, 1 M) for cellulose extraction; distilled water; and, for the colour-fastness test, hydrochloric acid (HCl), phosphate buffer, and NaOH.
- Natural pigments: turmeric, beetroot powder, spinach powder, and activated charcoal.
- Binder: corn flour.
- Apparatus: beakers, conical flasks, glass rods, and pipettes; a fine mesh sieve; a mortar and pestle or grinder; a hot air oven and drying trays; pH strips or a pH meter; and a spectrophotometer or colorimeter.
- Other: Congo red dye for cellulose staining, and moist garden soil for the biodegradability test.

B. Collection and Preparation of Corn Husk

Corn husks were collected from local agricultural markets, where they are normally discarded as waste. The dried husks were cleaned thoroughly and cut into pieces of about 1–2 inches to make them easier to process.

C. Extraction of Cellulose

The cut husks were first soaked in warm distilled water for 1–2 hours to soften the fibres. They were then treated with a 1 M sodium hydroxide (NaOH) solution heated to 80–90 °C and boiled for 1–2 hours. This alkaline treatment removes non-cellulosic parts such as lignin and hemicellulose [12], [14], [16]. After boiling, the fibres were rinsed several times with distilled water until the water ran clear,

showing that the NaOH had been fully removed. Any remaining impurities were filtered out using a fine sieve, leaving behind purified cellulose fibres.

D. Drying and Grinding

The purified cellulose was spread in a thin layer and dried at 25–30 °C for about 24 hours to remove all moisture. The dried cellulose was then ground into a fine powder using a mortar and pestle and sifted to keep the particle size even.



Fig. 1. Cellulose extracted from corn husk.

E. Formulation of Biodegradable Glitter

The cellulose powder was mixed with natural pigments to give colour: turmeric for yellow, beetroot powder for red or pink, and spinach powder for green. The pigments were added in small amounts and mixed well to reach the desired shade. A binder made from corn flour solution was used to hold the cellulose particles together into glitter-sized flakes. The mixture was spread on a flat surface and pressed through a fine mesh sieve to form small, even particles, then left to dry for 12–24 hours. After drying, the glitter was sieved again to remove clumps and irregular pieces, giving a fine and consistent product. Finally, the glitter was packed in eco-friendly containers such as paper bags or glass jars and stored in a dry place to prevent moisture absorption.

Natural pigment source	Colour produced
Turmeric	Yellow
Beetroot powder	Red or pink
Spinach powder	Green
Activated charcoal	Black or grey

Table 1. Natural pigments used and the colours they produce.

F. Analysis Methods

The finished glitter was evaluated using the following tests, described in detail with their results in the next section: estimation of cellulose content using Congo red staining, thermal stability in boiling water, turbidity in water, colour fastness under different pH conditions, and biodegradability in soil. A cost comparison with commercial bio-glitters was also carried out. Each spectrophotometric measurement was performed in triplicate ($n = 3$), and the values reported are the means of these readings.

V. RESULTS AND DISCUSSION

A. Estimation of Cellulose Content (Congo Red Staining)

Congo red is an anionic dye that binds strongly to cellulose because of its attraction to the hydroxyl groups in cellulose fibres. When the glitter sample was stained and viewed under the microscope, the cellulose fibres appeared red, while non-cellulose material stayed pale or unstained. A brighter and more intense red colour indicates a higher cellulose content. The stained sample (Fig. 2) showed a strong red colour, confirming that the glitter is largely made of cellulose and that the extraction from corn husk was successful [16].



Fig. 2. Microscopic image of glitter fibres stained with Congo red.

B. Thermal Stability

Thermal stability tells us whether the glitter can survive heat without breaking apart or leaching colour. It was checked by adding a known amount of glitter (about 0.02 g) to distilled water at room temperature and, separately, to boiling water (100 °C), and then measuring the absorbance of the water. At room temperature there were no visible changes. In the boiled sample, the absorbance measured at 580 nm was only 0.02, which is very low. This shows that very little glitter degraded or leached out at high temperature. In other words, the glitter keeps its structure even in boiling water, which is useful for products that may be exposed to heat [15].

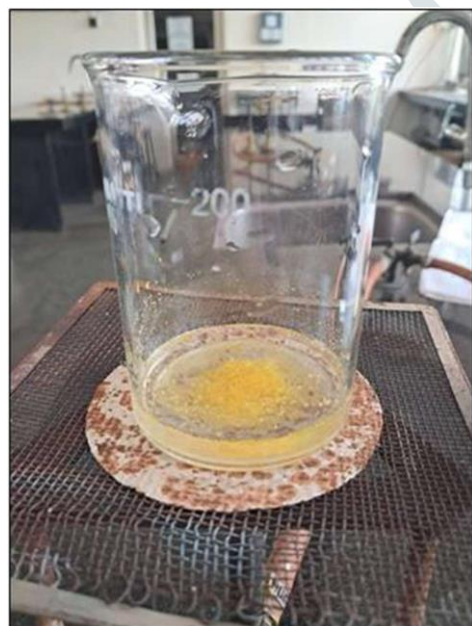


Fig. 3. Glitter sample in boiled distilled water (thermal stability test).

C. Turbidity

The turbidity test measures how cloudy water becomes when glitter is added, based on how much light the suspended particles scatter. This is important because high turbidity can harm aquatic life and interfere with water treatment. When glitter was added to distilled water and measured at 600 nm, the absorbance stayed low at 0.02. This means the glitter did not make the water noticeably cloudy; the particles either settled quickly or did not disperse much. A low turbidity value suggests that the glitter is unlikely to disturb water clarity, pointing to a lower environmental impact in water bodies compared with plastic glitter.



Fig. 4. Glitter dispersed in distilled water (turbidity test).

D. Colour Fastness

Colour fastness is the ability of the glitter to hold its colour under different conditions. It was tested by placing equal amounts of glitter in acidic (HCl, pH 4), neutral (phosphate buffer, pH 7), and alkaline (NaOH, pH 12) solutions and measuring the colour that leached out at 450 nm. The results are shown in Table 2.

Condition	Absorbance (450 nm)	Observation
HCl (pH 4)	0.04	No noticeable colour change
Phosphate buffer (pH 7)	0.04	No noticeable colour change
NaOH (pH 12)	0.08	Yellowish leaching; visible fading of glitter

Table 2. Colour fastness of biodegradable glitter under different pH conditions (mean of $n = 3$).

Almost no colour leached out in acidic and neutral solutions (absorbance 0.04 in both). In strong alkali, however, the absorbance rose to 0.08, and a yellowish colour clearly leached into the solution. This shows that the glitter holds its colour well in neutral and mildly acidic conditions, but the pigment is less stable in strong alkaline environments, likely because of weaker bonding between the pigment and the cellulose fibres [17]. For most real uses, which are close to neutral pH, the colour fastness is good.



Fig. 5. Glitter immersed in solutions of different pH (colour fastness test).

E. Biodegradability

Biodegradability was tested by burying the glitter about 1 cm below moist soil and leaving it undisturbed for 2–3 weeks at room temperature. When the samples were dug up, the glitter showed clear physical breakdown, fading, and fragmentation. The moist soil supported microbial activity, which drove the degradation. As shown in Fig. 6, the bright glitter visible at the start had largely broken down and blended into the soil by the end. This shows clear signs of biodegradation, unlike plastic glitter, which can persist in the environment for decades [3], [10].



Fig. 6. Biodegradability of glitter in soil: before (left, Day 0) and after (right, 2–3 weeks).

F. Comparison with Plastic Glitter (Control)

To make the results clearer, the corn husk glitter should be compared directly with ordinary plastic glitter tested under the same conditions. Table 3 sets out this comparison. The values for the corn husk glitter are from this study; the plastic-glitter control values are still to be measured by running the same tests on a plastic glitter sample. This side-by-side comparison is expected to show how much better the corn husk glitter performs on turbidity and biodegradation [6], [9].

Test	Corn husk glitter	Plastic glitter (control)
Thermal stability — absorbance at 580 nm	0.02	—
Turbidity — absorbance at 600 nm	0.02	—
Colour leaching at pH 12 — absorbance at 450 nm	0.08	—

Test	Corn husk glitter	Plastic glitter (control)
Breakdown in soil after 2–3 weeks	Significant breakdown	—

Table 3. Comparison of corn husk glitter with a plastic glitter control (control values still to be measured).

G. Cost Comparison

A major advantage of this glitter is its low cost. Commercial biodegradable glitters rely on complex polymer synthesis, chemical modification, or industrial composting, which raise their price. The process in this study uses only simple alkaline extraction, drying, grinding, and natural pigments, which keeps costs very low. Table 4 compares the price of common commercial bio-glitters with the product developed here.

Brand	Material composition	Cost (₹)
Moon Glitter	Regenerated cellulose with polymer coatings	3,226
Sparkle Effect	Modified biopolymers and natural resins	1,000
Mystic Bio Glitter	Stabilised cellulose acetate	700
This study	Pure cellulose from corn husk	50

Table 4. Price comparison of biodegradable glitters (per 4 g).

At about ₹50 per 4 g, the corn husk glitter is many times cheaper than commercial options such as Mystic Bio Glitter (₹700) or Moon Glitter (₹3,226). Because corn husk is widely available and the method is simple, the product can be scaled up at low cost while still using natural pigments for a range of colours.

VI. APPLICATIONS

Because the corn husk glitter can be made in different colours, sizes, and finishes, it can be used in place of plastic glitter in several areas:

- **Cosmetics:** it can be used in eyeshadows, nail products, and body glitters as an eco-friendly option, and is a promising choice once skin-safety testing has been completed [5], [9].
- **Arts and crafts:** it is well suited to greeting cards, scrapbooking, school projects, and other creative work, giving sparkle without adding microplastics.
- **Packaging and decorations:** it can add a decorative touch to gift wraps, cards, and retail packaging, supporting eco-friendly branding.

In all of these uses, the main benefit is that the sparkle is provided by a natural, biodegradable material instead of a persistent plastic.

VII. ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACT

The environmental benefit of corn husk glitter is clear. It breaks down naturally in soil and water without leaving behind harmful plastic fragments, so it does not add to the long-lasting microplastic pollution caused by conventional glitter [3], [7]. Its low turbidity and stability also suggest a gentle effect on water bodies. By replacing a plastic product with a plant-based one, the glitter helps reduce the flow of microplastics into ecosystems and the food chain.

There are social and economic benefits too. The glitter is made from corn husk, a waste material that is usually discarded after harvest. Using this waste turns it into a valuable product, which can create an extra source of income for farmers and rural communities and reduces overall agricultural waste. This

fits the idea of a circular economy, where waste becomes a resource [13], [20], [21]. The low cost of the process also makes the product easy to scale, and its success could encourage industries and policymakers to invest further in bio-based materials as replacements for single-use plastics [6], [22].

VIII. INNOVATION AND ADVANTAGES

The main strength of this work is the use of corn husk cellulose, a naturally abundant and inexpensive agricultural waste, processed with very little chemical treatment. Many commercial biodegradable glitters use chemically modified cellulose, synthetic biopolymers, or cross-linked polysaccharides. In contrast, the minimal-processing approach used here keeps the natural biodegradability of the raw material intact [10], [11].

Most commercial bio-glitters, such as those based on cellulose acetate or polylactic acid (PLA), need special industrial composting conditions to break down [9], [11]. The corn husk glitter, by comparison, decomposes naturally in ordinary soil, without industrial composting and without synthetic coatings or stabilisers. This allows faster microbial breakdown and makes full use of agricultural residues, supporting zero-waste practices. Together with its low cost, wide availability of raw material, and the option to use different natural pigments, these features give the product a clear advantage for cosmetics, fashion, packaging, and arts applications, especially as bans on microplastics grow worldwide [6].

IX. LIMITATIONS AND FUTURE SCOPE

Although the results are promising, some limitations remain. The tests were done under controlled laboratory conditions, which may not fully match real-world storage, handling, and weather. The plastic-glitter control values are still to be measured, so the comparisons in Table 3 need to be completed. The colour fastness was reduced in strong alkaline conditions, so the pigment–fibre bonding could be improved. Long-term shelf life, adhesion to skin and surfaces, and large-scale consumer acceptance were not studied here.

Future work should focus on improving colour stability and durability, testing safety for direct skin contact in cosmetics, and scaling up production. Running the full set of tests on a plastic glitter control would strengthen the comparison, and adding natural coatings or exploring nanocellulose could further improve shine and strength [9], [14], [15]. Testing the glitter on a wider range of products and under real storage conditions would also help confirm its performance. With these improvements, corn husk glitter could become a mainstream, sustainable alternative to plastic glitter.

X. CONCLUSION

This study successfully developed a biodegradable glitter from corn husk cellulose as a practical, eco-friendly replacement for plastic glitter. Using a simple alkaline extraction followed by drying, grinding, natural colouring, and a corn flour binder, an agricultural waste was turned into a useful and attractive product.

The tests showed that the glitter is stable. It kept its structure in boiling water (absorbance 0.02 at 580 nm), added almost no turbidity to water (absorbance 0.02 at 600 nm), and held its colour well in acidic and neutral conditions, fading only in strong alkali. Most importantly, it broke down in soil within 2–3 weeks, indicating strong biodegradability. At around ₹50 per 4 g, it is far cheaper than commercial bio-glitters.

Because the glitter can be made in different colours, sizes, and finishes, it is well suited to arts and crafts and decorative packaging, and is a promising candidate for cosmetics once skin-safety testing has been carried out. By using agricultural waste as the raw material, the process reduces both plastic pollution and farm waste, supporting the goals of a circular economy. Overall, corn husk glitter offers

a low-cost and sustainable alternative that could help reduce microplastic pollution in everyday consumer products.

XI. REFERENCES

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