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# Polymer and Biowaste Orange Peel Hybrid for Effective Energy Harvesting

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## Description

As the world's population grows, so does the amount of energy used, which has an impact on our socioeconomic conditions. Alternate renewable energy sources like fuel cells, thermoelectric systems, and solar cells must be developed for energy generation. In the current scenario, a self-powered system is essential, particularly for biomedical health monitoring in real time. Researchers are increasingly interested in self-powered nanogenerators based on piezoelectric materials due to their suitability as flexible electronics and ease of use in biomedical devices. The naogenerators have also been made using synthetic polymers like poly(vinylidene fluoride) (PVDF) and its copolymers, piezoelectric materials like ZnO, PMN-PT (BaTiO3), and ZnSnO3. In order to use these nanogenerators in self-powered biomedical devices like artificial cardiac pacemakers, the materials need to be biocompatible. Under in vivo conditions, even a very low level of toxicity is harmful. To overcome this obstacle, a biomaterial-based nanogenerator ought to be utilized. One of the other options for generating power is the bio-waste-based self-powered system in this instance.

Because of landfills and the release of greenhouse gases from household waste, bio-wastes are one of the main pollutants. Currently, efforts are being made to use household waste for a variety of purposes. Fruit waste that consists of seed, core, and peel, contains a lot of water, is in a wet and fermentable form, and is a byproduct of the fruit processing industries. If these by-products are not further processed, they can contribute to environmental pollution by producing odor, polluting the soil, and providing insect harborage. The recovery appears to be environmentally friendly, and the researchers are able to create high-value products like medicines and cosmetics. After recent findings that fruit peels are easier to process and have better biological activities than other fruit parts, the idea of using fruit waste, particularly peels, began to gain traction. Fruit wastes are full of fibers, proteins, oils, and flavonoids. The piezoelectric nature of orange peel is one example. Utilizing biowaste's improved processability, a hybrid based on biowaste can be developed, potentially eradicating pollution to some extent. Flavoniods, which are found in orange waste at various stages of industrial processing, are found to be more abundant in peels than in juice, indicating their enormous potential for use in industry. According to the Food and Agricultural Organization of the United Nations, citrus is a significant crop, accounting for 135.8 million metric tons of production annually. The chemical and antioxidant properties of citrus peel indicate that it is a good source of natural bioactive compounds, including blended diesel as an alternative fuel. Additionally, citrus fruit waste accounts for fifty percent of the total weight of the fruit. Without chemical pretreatment or the addition of additional media, orange peel waste has been used in a microbial fuel cell to produce bioelectricity in the energy sector, with output voltage and current density of 0.59 V and 847 mA/m$^2$, respectively Onion skin is another vegetable waste that is used for energy harvesting. It has a low power density of 1.7 W/cm$^2$ and a low open circuit voltage of 18 V. On the other hand, filled polymer systems made of DNA and activated carbon are used for energy harvesting. These systems have low power generations, with open circuit voltages of 20, 49.6 V, and power densities of 11.5 and 6.3 W/cm$^2$, respectively. The open circuit voltage and power density of the PVDF and egg shell membrane energy harvesting system were found to be 56 V and 55 W/cm2, respectively. Small electronic devices can be powered by these devices, which generate electric energy by applying minimal mechanical stress. Ice straw has been used to generate biogas through anaerobic digestion, which generates 3500 MJ of energy per ton of straw, among other bio-wastes. used oils that were extracted from microalgae to make biodiesel, which had a yield of 19.3%. Utilizing banana peel as a feedstock, oleaginous yeast was isolated from a traditional Korean fermented fish and used in the production of biodiesel.

Orange peel has been used as a polymer hybrid for the first time in this study as a novel material for energy harvesting. Different characterization methods were used to conduct the hybrid's structural and morphological studies, and the induction of the piezoelectric phase was extensively discussed. An adaptable device has been developed for capturing energy from a variety of body movements and lighting the LEDs during routine activities like door opening and closing [1-5].

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## Conflict of Interest

None.

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