



Design and Development of a Semi-Automated Machine for Foaming Biodegradable Grow Cups from Banana Pseudostems

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The increasing demand for sustainable alternatives to plastic containers in agriculture has highlighted the potential of biodegradable materials. In this study, a machine capable of producing biodegradable grow cups from banana pseudo-stem pulp is designed and developed. This machine demonstrates that banana pulp is a viable eco-friendly raw material for scalable agricultural applications and offers a sustainable substitute for plastic containers and traditional grow bags used in agriculture. Due to the lack of large-scale automated machinery, this study focuses on addressing the shortcomings of current machinery. First, compression force testing was conducted. From this test, we confirmed that 500 N compression force was needed to form the cup. After the pre-made pulp is fed into the hopper, it is molded into the required shape using a compression mechanism and subjected to required temperatures in the dryer chamber. The machine consists of an extruder with hopper, mold and rotating mold carousel, compressing mechanism, and dryer chamber. The machine uses a sequential four-stage molding cycle where the rotating carousel rotates 90 degrees following each compression to achieve maximum production efficiency, producing four cups per cycle. Arduino-controlled relay systems combined with thermocouples regulate temperature-stable heating conditions in both the drying chamber and mold. Four heating elements in the dryer with exhaust ventilation, monitored by temperature and humidity sensors, provide ideal drying conditions. Timed extrusion cycles achieve precise pulp volume control, maintaining uniform cup dimensions. This project is primarily concerned with the utilization of pulp derived from banana pseudostems for the fabrication of biodegradable pots intended for nursery applications. The study aims to identify and evaluate optimal pulp composition parameters, as well as corresponding machine operating conditions, to establish an automated production process.

Keywords: Biodegradable grow cups, Bio-pot, Banana pseudostem pulp, Foaming machine, Sustainable agriculture