ECP 2025 Conference

The 4th International Electronic Conference on Processes

20–22 October 2025 | Online

MDPI

Development of a Low-Cost Electroporator Using Recycled Electronic Components for Educational and Research Applications

Fiorotto T. A.[1], Glodowsky A. P.[1]

Facultad de Bromatología, Universidad Nacional de Entre Ríos (1)

INTRODUCTION & AIM

Electroporators are widely used devices for educational and research purposes, where they enable the introduction of foreign DNA into cells through the application of high-voltage electric pulses.

Despite their utility, their high cost limits accessibility in educational and research institutions in developing countries.

At the same time, the global increase in electronic waste has reached alarming levels.

In this context, the aim of this study was to develop a functional electroporator prototype using components recovered from discarded electronic devices.

METHOD

The device was built using a flyback-based circuit that generated logarithmic decay pulses with a duration of 5.00 ± 0.25 ms. Pulse control was achieved through a simple resistor–capacitor (RC) circuit connected to the gate of a MOSFET, powered with 200 V at the input, and subsequently stepped up by a transformer.

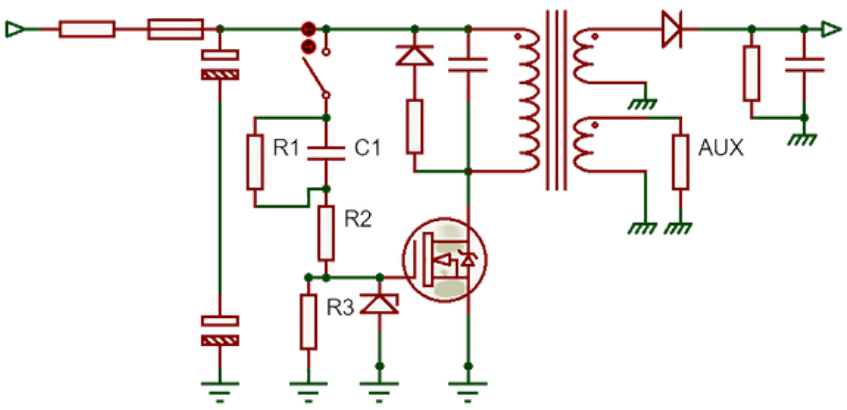

Fig 1. The time constant is determined by capacitor C1 in conjunction with the resistance formed by R2 and R3. R1 has a substantially higher value, such that it does not significantly influence the discharge constant.

Stainless steel needle electrodes were used, with a separation of 1.00 ± 0.05 mm. Performance was evaluated following the protocol described by Sambrook et al. (2001), using Escherichia coli DH5α strains, and pUC19 plasmid. Transformed cells were cultured in Luria-Bertani (LB) medium supplemented with ampicillin.

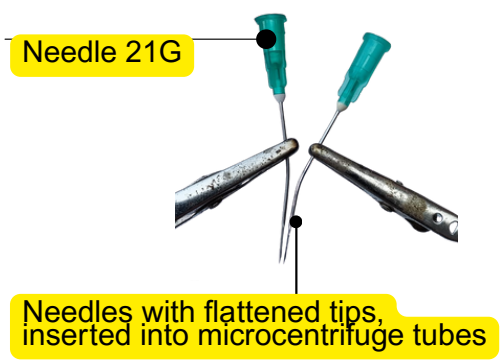

Fig 2. Electrodes

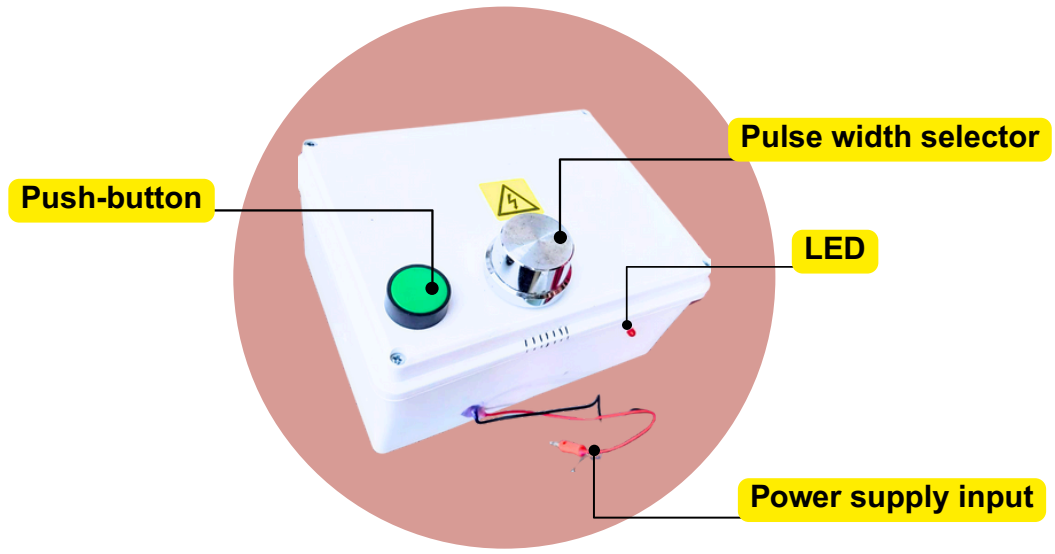

Fig. 3 Photograph of the device prototype.

Over 50% recycled materials. This proportion includes the high-voltage transformer, input capacitors and filters, heat sink, and pulse width selector.

RESULTS & DISCUSSION

Yielding an average of one colony per 200 µL of culture. It is important to note that the maximum load should consist of sample resistances greater than 4000 ohms to ensure efficient electric fields and current intensities within a safe range (with 0.750 mA being the common maximum limit for high-voltage microwave oven transformers). However, a major drawback of using this power supply configuration is that it requires precise regulation of the insertion depth of the needles used as electrodes, which in turn determines the conductivity or resistance experienced by the electroporator.

CONCLUSION

The results support the feasibility of building low-cost electroporators from recycled components, contributing to sustainable technology development

FUTURE WORK / REFERENCES

Forti, V., Baldé, C. P., & Kuehr, R. (2018). *E-waste Statistics: Guidelines on Classifications, Reporting and Indicators, second edition*.

Butkus, P., Murauskas, A., Tolvaišienė, S., &Novickij, V. (2020). Concepts and Capabilities of In-House Built Nanosecond Pulsed Electric Field (nsPEF) Generators for Electroporation: State of Art. *AppliedSciences*, *10*(12), 4244. https://doi.org/10.3390/app10124244

Sambrook, J., & David, W. R. (2001). *Molecular cloning a laboratory manual* (Tercera edición, Vol. 1). Cold Spring Harborg Laboratory Press.