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Effectiveness of cold plasma as a new route for producing biofertilizers from food side streams

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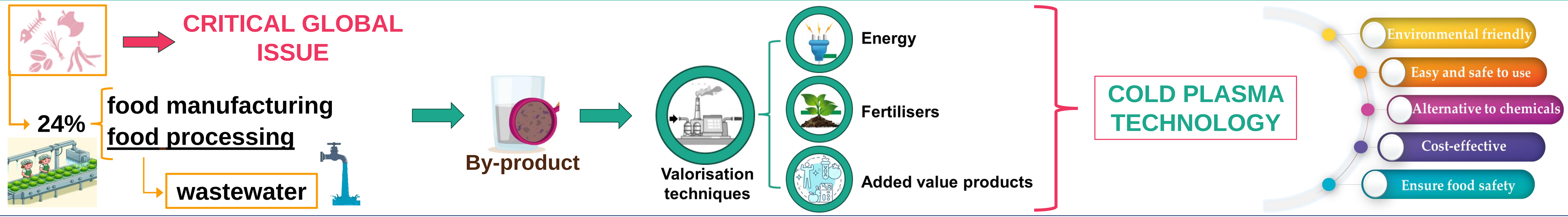
INTRODUCTION



MATERIALS AND METHODS

➢BY-PRODUCTS

Potato waste streams  **Beetroot waste streams** 

➢COLD PLASMA TECHNOLOGY TREATMENT

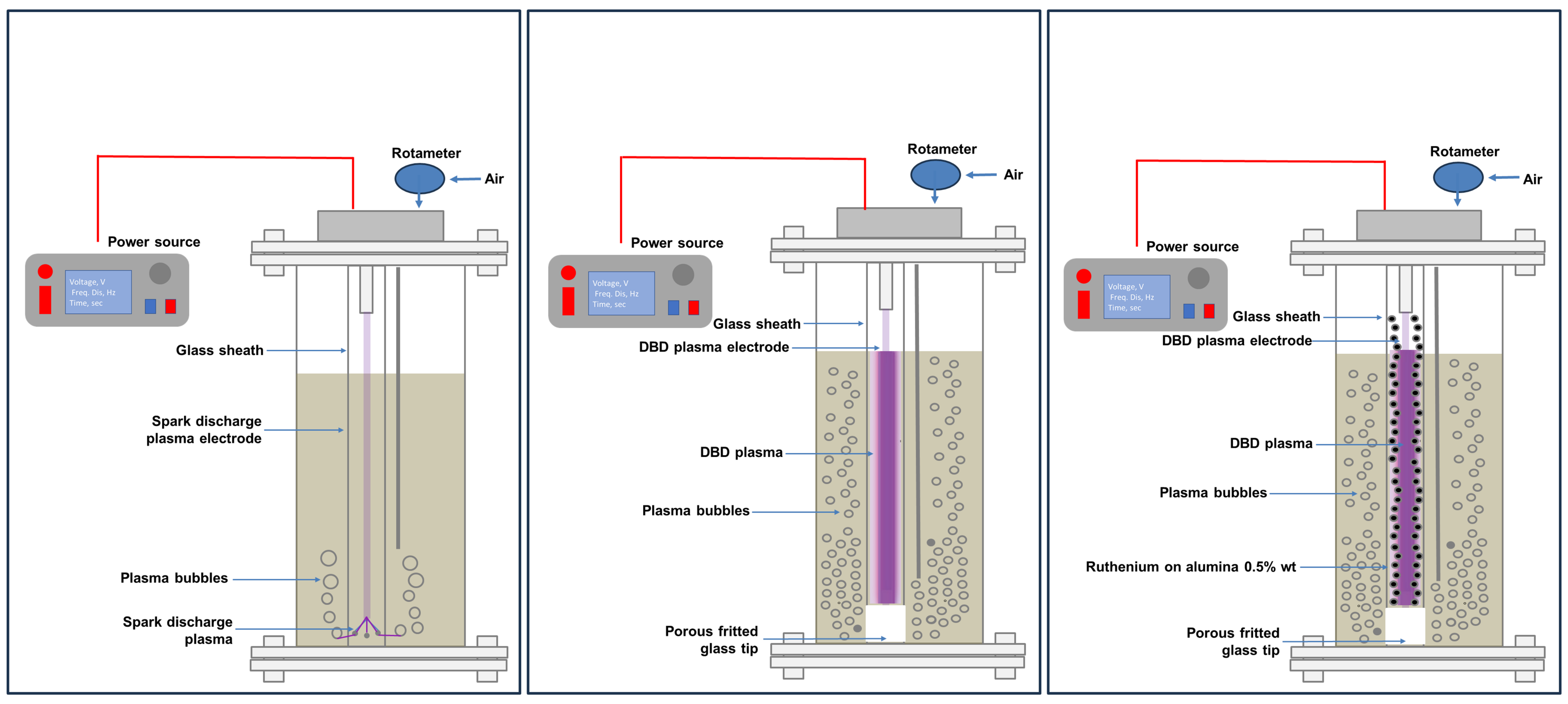


Figure 1. Scheme of cold plasma technology treatment using three different configurations, A (bubble), B (frit) and C (catalyst), to convert vegetables waste streams into biofertilizers.

➢PRODUCT ANALYSIS

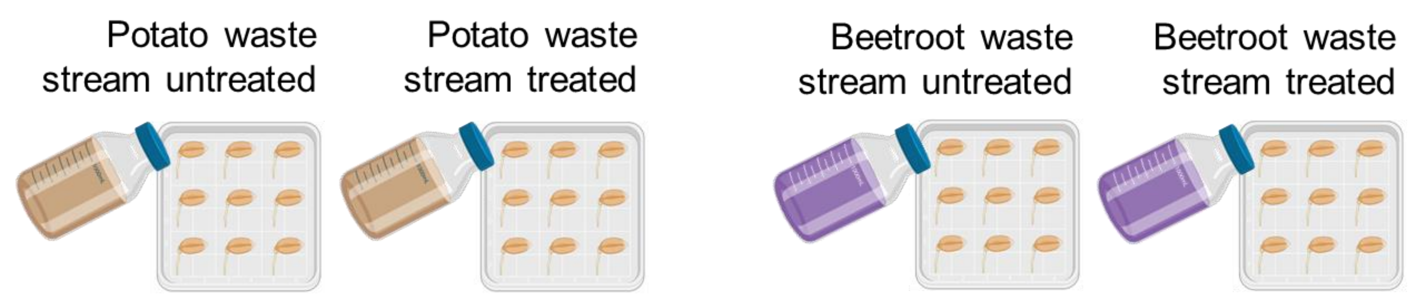
Physicochemical characterization:

- pH
- Oxidation–reduction potential (ORP)
- Electrical conductivity (EC)

Chemical characterization:

- Fluorides (F^-), Chlorides (Cl^-), Bromides (Br^-), Nitrites (NO_2^-), Nitrates (NO_3^-), Phosphates (PO_4^{3-}), Sulphates (SO_4^{2-}) } **Ion chromatography**
- Copper, Zinc, Phosphorous, Potassium ⟶ **Inductively coupled plasma mass spectrometry**
- Total Carbon (total C) and total Nitrogen (total N) ⟶ **Dumas method**
- N_{org} ⟶ **Kjeldahl method**
- $P_{assimilable}$ ⟶ **Olsen method**

➢GERMINATION EXPERIMENT: mung bean seeds



RESULTS

➢OPTIMIZATION OF COLD PLASMA TECHNOLOGY TREATMENT

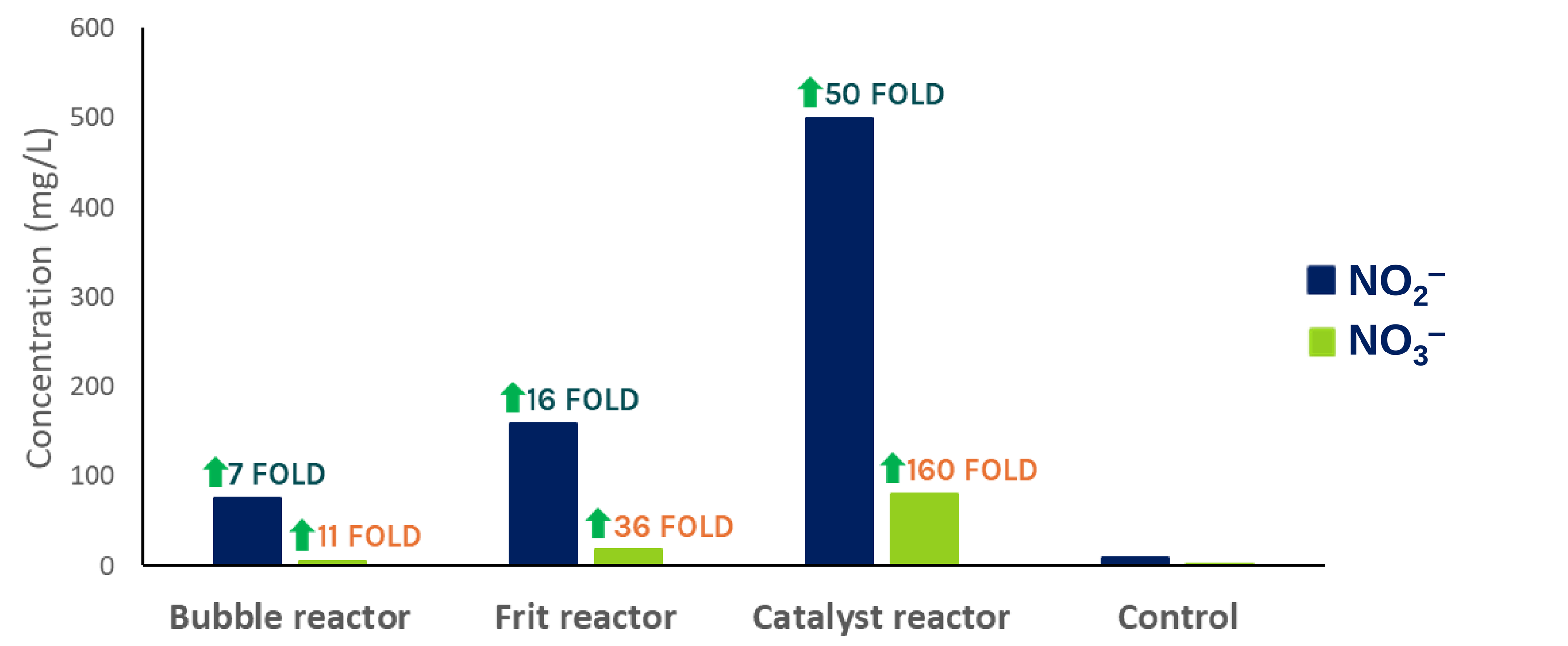


Figure 2. Concentration of NO_2^- and NO_3^- produced in potato liquid waste streams, depending on the type of reactor used.

➢PRODUCT ANALYSIS

Physicochemical characterization:

Table 1. Values of pH, ORP and EC in treated and untreated tuber processing wastes streams using catalyst reactor.

		pH	ORP (mV)	EC (µS/cm)
Potato	Untreated	6.61 ± 0.03	-396.33 ± 69.54	2.05 ± 0.05
	Treated	8.04 ± 0.05	-33.67 ± 38.27	2.11 ± 0.01
Beetroot	Untreated	4.87 ± 0.03	222 ± 0	4.77 ± 0.06
	Treated	4.92 ± 0.04	210 ± 4.50	4.63 ± 0.08

Chemical characterization:

Table 2. Concentration of N_{org}, total N, total C, Cl^-, NO_2^- and NO_3^- in treated and untreated tuber processing wastes streams using catalyst reactor.

		N_{org} (ppm)	Total N (%)	Total C (%)	Cl^- (ppm)	NO_2^- (ppm)	NO_3^- (ppm)
Potato	Untreated	232.00	0.03	0.10	124	<0.5	<0.5
	Treated	276.07	0.03	0.11	125	43.1	2.57
Beetroot	Untreated	684.53	0.12	1.08	348	<1	29.37
	Treated	665.35	0.13	1.13	356	444.6	462.7

➢GERMINATION POTENTIAL

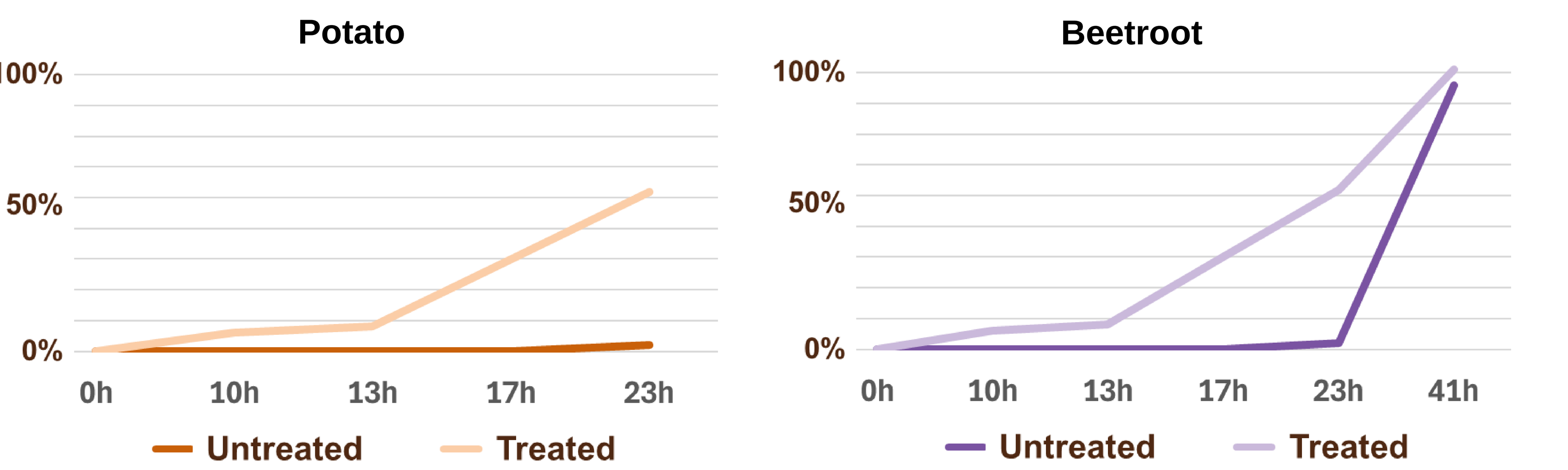


Figure 3. Germination rate (%) of mung bean seeds using potato and beetroot waste streams untreated and treated.

CONCLUSION

Cold plasma treatment significantly modified the nitrite and nitrate content in potato and beetroot waste streams and improved the germination capacity. Thereafter, cold plasma could be a sustainable and energy-efficient strategy for valorising food waste streams. This approach represents a promising option for improving nitrogen fixation and promoting sustainable practices in agro-industrial waste management.

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