Mitigating Greenhouse Gas Emissions from Cattle Manure: The Role of Biochar

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Global warming has shown adverse impacts throughout the globe and if current greenhouse gas (GHG) emissions continue without a rapid and sustained reduction, the impacts might increase exponentially exponentially. Agriculture contributes significantly (10-12%) to the global anthropogenic emitted GHG (Malyan et al., 2021; Tellez et al., 2017). Notably, agricultural practices yield nearly seven billion tons of manure each year (Thangarajan et al., 2013), with animal husbandry in the European Union (EU-27) and the UK producing over 1.4 billion tonnes of manure from 2016 to 2019 (Orgiazzi & Briones, 2021). More specifically, livestock manure was calculated as contributing 8.9% of total methane and 9% of total nitrous oxide emissions in the EU27 + UK + ISL in 2020 (Secretariat, 2022), showcasing significant environmental impacts from manure management practices.

Biochar is a carbonaceous material created by thermal degradation of biomass (wood, manure, leaves, etc.) in an oxygen-limited environment (Stylianou et al., 2020). Biochar is a multifaceted product that has a broad range of environmental applications; adsorbing pollutants, composting, wastewater treatment, soil remediation, energy production and catalyst. Moreover, biochar has been reported to reduce GHG emissions (Castro-Herrera et al., 2023). The majority of these studies refers to biochar application to soils enhancing its fertility as well as reducing GHG emissions.

In the present study the use of manure derived biochar was investigated for the mitigation of cattle manure emitted gasses. More specifically, fresh manure was collected from various location from a cattle farm, homogenized and placed in specific in-house made glass reactors (250 mL). The reactors were filled with 100 gr manure and a thin surface layer of MB biochar was placed on top of it at 5 and 10 % respectively. Air samples were taken at intervals of 0, 20, 40 and 60 minutes across several days (0; 1; 4; 6 and 8 day). Air samples was taken with 20 ml syringes and placed in a pre-vaccumed 20 mL vial Samples were analysed for CO_2, CH_4, N_2O through Gas Chromatography GC-FID-TCD-ECD (Agilent 8890). A portable photoionization gas detector (PID, Dragger Xam 8000, Dräger Safety AG & Co. KGaA, Lübeck, Germany) was used to measure NH_3 emitted from the reactors.

Results showed that emissions for all three GHG are increasing through sampling time (0-60 min). The addition of two different concentrations of biochar decreased the emited GHG only the first day whereas the next period an increase was observed. A significant decrease in NH_3 emissions was recorder which should be further investigated with more detailed experiments.

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