GREENHOUSE GASES EMISSIONS ON THE TREATMENT OF LAYING HENS FARM RESIDUES BY IN VESSEL COMPOSTING WITH FORCED AERATION

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ABSTRACT

A biological reactor was developed for the treatment of laying hens farm residues through in vessel composting with forced aeration. The objective of this study was to evaluate the greenhouse gases (GHG: CO_2, CH_4, N_2O) and ammonia (NH_3) emissions during the composting of a mixture of chicken manure (64.4%), discarded eggs (1.4%), dead chickens (0.9%), slaughterhouse centrifuged sludge (3.1%) and sawdust (30.2%). The reactor was loaded with 5,788 and 5,842 kg of the mixture for two 7-days trials with and without the use of a biological inoculant (Humidibiol). Afterwards, compost was removed for maturation outside bioreactor during a 21-days period. Gaseous emissions of CO_2, CH_4, N_2O, and NH_3 were measured by infrared fotoacoustic spectroscopy using an INNOVA 1412 trace gas analyzer (Lumasense Technologies, Denmark). Dry matter (DM), total carbon (TC), total organic carbon (TOC), total nitrogen (TN), phosphorous (P), potassium (K), cupper (Cu), and zinc (Zn) content in the mixture was determined at the beginning and the end of the trials (thermophilic composting phase) and after compost maturation. Biomass temperature inside reactor was maintained above 55°C in both trials. C losses measured as CO_2 and CH_4 during in vessel composting represented 12.3 and 11.1% of the original C content of the mixture, with and without inoculation, respectively. Measured N-NH_3 + N-N_2O losses represented 28.5 and 25.2% of the original N content of the mixture, with and without inoculation, respectively. No significant differences were observed on the patterns of GHG and ammonia emissions due to the use of the biological inoculant. C-CH_4 represented just 0.58% (of the measured gaseous C losses on both trials, while C-CO_2 losses accounted for 99.42%. The high CH_4:CO_2 emission ratio (1:170) showed that O_2 saturation inside bioreactor was high during all thermophilic composting phase inhibiting anaerobic methanogenic microorganisms. N-N_2O represented just 0.44% of the measured gaseous N losses on both trials, while N-NH_3 losses accounted for 99.56%. Considering the global warming potential (GWP) of each GHG, 422.3 kg of CO_2eq were emitted during composting on the average of both trials. CO_2 emissions accounted for 81.7% of total CO_2eq emission, while CH_4 and N_2O represented 3.6 and 14.6%, respectively. Mitigation of CH_4 and especially N_2O emissions during composting is critical due to the high GPW of these gases.

Keywords: Accelerated Composting, Poultry, GHG, CO_2, CH_4, N_2O.