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Preferred presentation type (oral/poster):

Oral

Session:

Session 1 “Fate & modelling of micro- and nanoplastics in terrestrial environments”

Title:

Preliminary results on the degradation of three microplastic polymers by rumen microbiota

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Abstract:

The livestock sector is affected by plastics and microplastics (MPs) pollution. MPs have been found in various ruminants' matrices including blood, faeces, follicular fluid, meat, and milk. Ruminants could be able to bring a solution to this problem. In fact, microorganisms in the rumen have hydrolytic enzymes capable of degrading natural polyesters such as cutin. These enzymes could potentially also degrade synthetic polyesters, like polyethylene terephthalate (PET) and other plastics commonly used in livestock farms, such as low-density polyethylene (LDPE) and polyamide (PA). In this work, we investigated the ability of rumen fluid (RF) to degrade three MP powdered polymers: PET, LDPE, and PA. The RF was collected from a slaughterhouse. MPs were weighed (0.5g) in F57 bags (6 replicates for each polymer) plus 2 empty bags, for a batch of 20 bags. Three batches were prepared and incubated in the Ankom Daisy^{II} for 24h (jar1), 48h (jar2) and 72h (jar3) with 400mL of rumen fluid, 1600mL of buffer solutions and 20g of nutrients (ground Total Mixed Ration). Degradability percentage was calculated as the difference between pre-incubation and post-incubation MPs weight (corrected for rumen solids captured within empty bags) divided pre-incubation MPs weight. Upper-tailed T Test was applied to check for non-zero degradability. PA was not degraded throughout all the incubation periods. LDPE was significantly degraded at very low level (0.20±0.132%) after 72h. PET was significantly degraded: 24h=0.54±0.230%, 48h=0.61±0.142% and 72h=0.82±0.129%. Future studies are needed to confirm these promising results.