Gaseous N and C losses during sun-drying of goat manure – Effects of drying conditions and feed additives

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Introduction & Objectives

- Animal manure is key resource in farming systems of arid and semi-arid regions
- Improper storage of manure leads to carbon (C) and nitrogen (N) losses
- Charcoal and tannins used as feed additives can stabilize organic matter and nitrogen (N) in manure
- **Research question:** Can feed additives reduce gaseous N and C losses during sun-drying and storage of manure

Materials & Methods

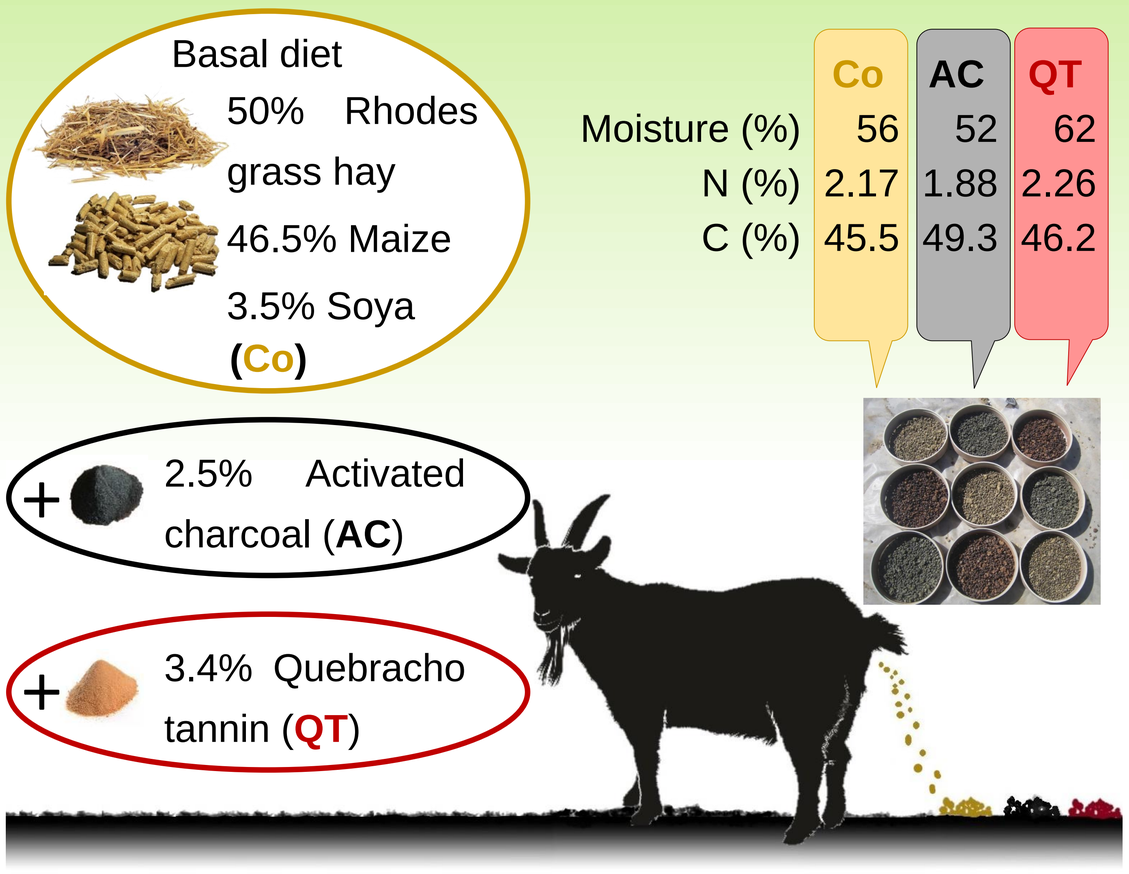

Figure 1 *Schematic illustration of experimental treatments, manure properties and set-up of manure*

- Manure from male Jebel Al Akhdar goats fed the three diets **Co**, **AC**, and **QT** in Sohar, Oman
- Pooled manure dried on plastic sheets in the sun in three experiments
- NH_3, N_2O, and CO_2 emissions from drying manure measured for five days
- Photo-acoustic multi-gas analyzer (Innova 1312) connected by Teflon tubing to a closed chamber (4 min accumulation period)
- Gas flux calculation (R^2>0.6) using linear regression (R package 'gasfluxes')

Figure 2 *Goat with fecal collection bag in individual crates*

Figure 3 *In-field gas emission measurement*

Table 1 *Conditions of the three manure drying experiments conducted in Sohar.*

Experiment	Time until DM > 90% h	Manure kg FM m^{-2}	Mean Temp. °C	Min. RH %	Max. RH %
1	4	1.4	32.2	36.4	83.8
2	79	10.8	29.6	8.5	71.7
3	84	8.8	20.5	43.8	82.2

Results and Discussion

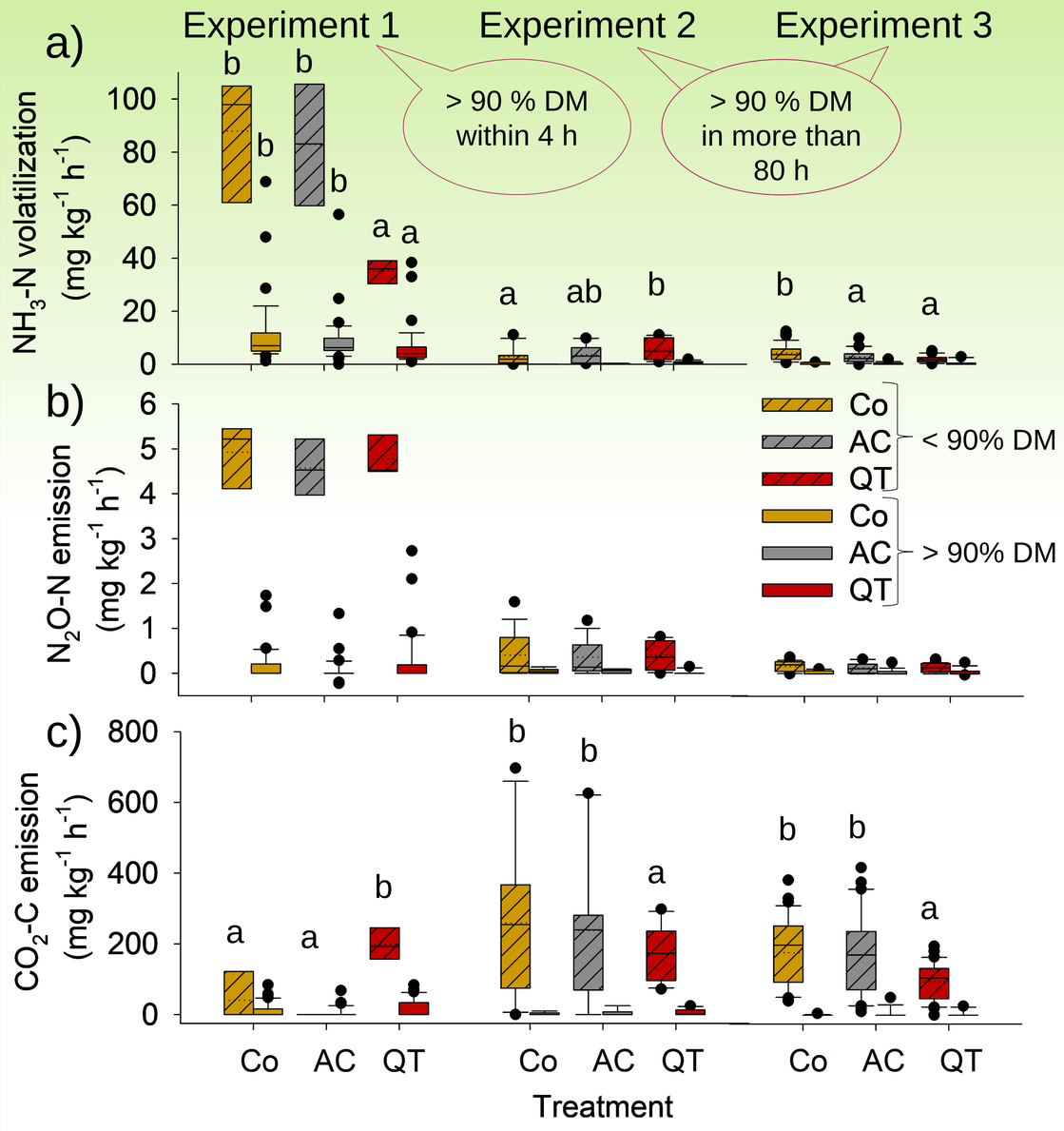

Figure 4 *Boxplots of NH_3-N (a), N_2O-N (b), and CO_2-C (c) emission rates from drying manure (< 90% DM) and after reaching constant weight (> 90% DM) measured in three experiments in Sohar, Oman.*

- Under quick drying conditions (experiment 1) low CO_2 emission and considerable NH_3 volatilization rates, even after reaching > 90% DM (→ storage losses)
- Slow drying (experiments 2 and 3) lead to high CO_2 emissions and very low NH_3 volatilization (→ microbial immobilization)
- N_2O emissions were insignificant and unaffected by treatment
- **AC** did not consistently affect gaseous C and N losses
- **QT** reduced N and C losses by up to 64% in two experiments

Table 2 *Cumulative N and C emissions during drying of manure in three experiments conducted in Sohar, Oman, and overall N and C losses related to C and N input. Letters indicate significant treatment effects.*

	Experiment 1		Experiment 2		Experiment 3		Overall
	mg N kg^{-1}	(SD)	mg N kg^{-1}	(SD)	mg N kg^{-1}	(SD)	% of initial N
Co	252 b	(51.9)	138	(27.8)	295 b	(12.5)	0.6-1.4
AC	207 ab	(38.0)	151	(27.9)	112 a	(33.1)	0.6-1.1
QT	128 a	(18.4)	208	(31.1)	107 a	(17.2)	0.5-0.9
	g C kg^{-1}	(SD)	g C kg^{-1}	(SD)	g C kg^{-1}	(SD)	% of initial C
Co	0.1	(0.09)	7.9 a	(0.07)	10.2 c	(0.49)	0.0-2.2
AC	0.0	(0.00)	10.5 b	(11.12)	7.2 b	(0.64)	0.0-2.1
QT	0.3	(0.19)	5.4 ab	(1.34)	4.3 a	(0.32)	0.1-1.2

Conclusions

- Only minor amounts of initial C and N lost from manure via gaseous emissions during sun-drying
- Slow drying favors (Exp. 2+3) microbial activity (CO_2 emissions) possibly immobilizing N and lowering NH_3 volatilization also during storage
- Feeding **QT** reduces gaseous C and N losses by up to 64% → promising feed additive for improved N cycling

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