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AMMONIA AND CARBON DIOXIDE CONCENTRATIONS IN DAIRY-CATTLE HOUSES OF NORTHWEST PORTUGAL

Ana Raquel F. Rodrigues*[a,d,e] Ana Gomes[b], Luís Ferreira[c], Ana R.J. Cabrita[a], Henrique Trindade[d], António J.M. Fonseca[a], José L.S. Pereira[d,e]

[a]REQUIMTE, LAQV, ICBAS, Universidade do Porto, Rua de Jorge Viterbo Ferreira, 4050-313 Porto, Portugal

[b]Cooperativa Agrícola de Vila do Conde, Rua da Lapa, 4480-757 Vila do Conde, Portugal

[c]AGROS UCRL, Lugar de Cassapos, 4490-258 Argivai, Portugal

[d]CITAB, Universidade de Trás-os-Montes e Alto Douro, Quinta de Prados, 5001-801 Vila Real, Portugal

[e]ESAV, Instituto Politécnico de Viseu, Quinta da Alagoa, 3500-606 Viseu, Portugal

Email: anaferodrigues@gmail.com

Greenhouse gas (GHG) and ammonia (NH_3) emissions from dairy-cattle production are a significant source of environment impacts (Milani et al., 2011). Environmental problems resulting from this activity are due to manure anaerobic decomposition, slurry storage and slurry spread in fields, from fertilisers and from ruminal enteric fermentation (Gerber et al., 2013). Besides, NH_3 and CO_2 exposure severely compromise animal health, namely ocular and respiratory problems. The recommended limits of prolonged exposure for animals are 7.6 mg m^{-3} (10 ppm) for NH_3 concentration and 4912 mg m^{-3} (2500 ppm) for CO_2 (CIGR, 2014). The Northwest (NW) Portugal is the largest dairy-cattle production region in mainland being responsible for more than 50% of total Portuguese milk production (Pereira and Trindade, 2015). Several strategies have been developed to minimise GHG and NH_3 emissions from cattle production and in order to achieve the Portuguese environmental limits and European directives it urges to evaluate the on-farm GHG and NH_3 emissions of dairy farms (Eckard et al., 2010, Joo et al., 2015, Mendes et al., 2017). The present study aims to evaluate the NH_3 and CO_2 concentrations in three naturally ventilated dairy buildings, located at NW Portugal and during the winter (December-2016) and spring (April-2017) seasons. Measurements were carried with photoacoustic infrared multigas monitor (INNOVA 1412) and air samples collected, in sequence (2 minutes intervals), through 6 sampling points located indoor by a multipoint sampler (INNOVA 1409). The NH_3 and CO_2 concentrations observed during winter and spring seasons are presented in Table 1. Ammonia and CO_2 concentrations in dairy-cattle farm 1 were lower during winter than during spring season, with a maximum of 39.4 mg m^{-3} and 3654 mg m^{-3} during spring and 8.7 mg m^{-3} and 1781 mg m^{-3} during winter, respectively. Ammonia concentration in dairy-cattle farm 2 had similar behaviour during winter and spring increasing in the first days of measurements, increasing in the middle and decreasing again at the final. At farm 2, the maximum concentration for NH_3 and CO_2 during winter was 12.6 mg m^{-3} and 2371 mg m^{-3} and during spring was 12.6 mg m^{-3} and 3891 mg m^{-3}, respectively. Ammonia concentration in dairy-cattle farm 3 was lower during half time of measurements during spring compared to winter, increasing in the second half of measurements. Maximum value of NH_3 concentration during winter was 52.2 mg m^{-3} and during spring 14.2 mg m^{-3}. Carbon dioxide concentrations were quite similar during the two seasons, with a maximum value <3200 mg m^{-3}. The average NH_3 concentrations of dairy-cattle farm 1 and 2 were below to limits recommended for a prolonged exposure of animals, in average dairy-cattle farm 3 had values above those recommended. Hence, for a good indoor air quality, the study suggests the use of mitigating measures for maintaining NH_3 concentrations below 7.6 mg m^{-3}. Concerning to CO_2 concentrations all dairy-cattle farms had values below the limits recommended.

Table 1 - Average, standard deviation, maximum and minimum of ammonia and carbon dioxide (mg m^{-3}) concentrations during winter and spring measurements.

		Ammonia (mg m^{-3})			Carbon dioxide (mg m^{-3})		
		Dairy-cattle farm					
		1	**2**	**3**	**1**	**2**	**3**
Winter	Average	0.4	2.3	2.1	910	1160	1601
	Standard deviation	0.4	1.5	1.3	80.1	205	212
	Maximum	8.7	12.6	52.2	1781	2371	3198
	Minimum	0.0	0.1	0.5	744	715	1004
Spring	Average	0.9	2.4	1.9	1076	1225	1317
	Standard deviation	0.9	1.4	1.2	198	302	234
	Maximum	39.4	12.6	14.2	3654	3891	3160
	Minimum	0.1	0.1	0.2	725	723	803

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