AMMONIA FROM DAIRY BARNS AS AIR CONTAMINANT

Kristina Matkovic[1], Bara Vinkovic[2], Marija Vucemilo[1], Alenka Tofant[1], Srecko Matkovic[3], Željko Pavicic[1]

[1]Kristina Matkovic, DVM, MS – junior researcher, Marija Vucemilo, DVM, PhD – professor, Alenka Tofant, PhD – professor, Željko Pavicic, DVM, PhD – assistant professor , Department of Animal Hygiene, Environment and Ethology, School of Veterinary Medicine, University of Zagreb, Heinzelova 55, HR-10000 Zagreb, Croatia, phone +385 1 2390292, e-mail: kmatkov@vef.hr*;*
[2]Bara Vinkovic, DVM, PhD – scientific associate, Department of Zoohygiene and Livestock Technology, Croatian Veterinary Institute, Savska cesta 143, HR-10000 Zagreb, Croatia;
[3]Srecko Matkovic, DVM – Krmiva Co., Gunduliceva 45, HR-10000 Zagreb, Croatia

Key words: ammonia, dairy cows, air, environment

Introduction

Air pollutants are logic result of animal breeding and their concentracion in stable air depend on object concustruction in which animals are housing, animal population density, type of housing, microclimatic parameters (air temperature, relative humidity, air velocity), ventilation and similar. Ammonia created in barn being due on distance by air and cosequently can cause eutrophication and acidification of waters and ground, and with methan represent the biggest risk for environment (Hartung and Philips, 1994). Therefore, the aim of this research was to determine ammonia concentration in air of dairy cows barn and outside. For that purpose measurements were done in barn with 15 dairy cows, which represent small farm breeding, which is also the most often type of dairy cows breeding in Republic Croatia.

Material and methods

Researched barn is placed in private plot complex, build from customary building material. At researched time in barn was 15 dairy cows which in winter stay in barn, on berth, and in summer on the nearest pasture ground. Cows are feeding by customary food (hay, concentrat), manure is cleaning once per day, by hands, on the nearest manure silo. Ammonia concentration was determined by air sampling with Dräger – Multiwarn (Dräger, Darmstadt, Deutschland) device, through two autmn months in three time terms (morning, noon, evening) in barn and outside. Simultaneously were determined air temperature, relative humidity and air velocity in barn air and outside by TESTO 400 – GmbH & Co device. In barn measurements were done in animal stay zone, alongside food corridor, and outside on distance of 10 meters. Results were treated with Statistica computer program.

Results and discussion

Measured values of basic microclimatic parameters inside dairy cows barn and outside in all three terms were between range described in literature, that are: for air temperature 5 – 25ºC, for relative humidity 65 – 85% and for air velocity 0,2 m/s (Kadzere et al., 2002.; Vucemilo et al., 2002.; Marthi et al., 1990) (Table 1). Noted ammonia concentration inside were below values described in literature (8-10 ppm) (Anderson et al., 2002; Demmers et al., 2001, Wathes et al., 1998) (Table 1). That point at good ventilation and apropriate barn construction. Common impresion is that in researched barn are used good technological procedures (housing, feeding, cleaning) that have none influence on ammonia concentration increase. Only at one measurement, at evening term in barn, is noted ammonia concentration of 8 ppm and that was also the biggest noted concentration. At that measurement relative humidity value was also the biggest noted (87,96%), air temperature was 14ºC, air velocity was 0,09 m/s. The most common ammonia concentration outside was under device detection limit. This finding of no ammonia existence in outside air is against literature quotation (Frank et al., 2002; Hartung 1998, 1999) that cattle represent the biggest source of ammonia in air. Of course, it must be taken into consideration that researched barn is in type of small farming, placed in private plot complex.

Conclusion

Air velocity in barn during research was under optimal limits, however it have no influence on ammonia concentracion increase. Reason for that was apropriate animal population density in barn and daily manure removing from barn. Thus ammonia concentration in this housing type do not represent significant air pollution for barn inside and environment.

References

1. *Anderson, N., R. Strader, C. Davidson (2002.): Airborne reduced nitrogen: ammonia emissions from agriculture and other sources. Environment international. 1011, 1-10.*
2. *Demmers, T. G. M., V. R. Phillips, L. S. Short, L. R. Burgess, R. P. Hoxey, C. M. Wathes (2001.): Validation of ventilation rate measurement methods and the ammonia emmision from naturally ventilated dairy and beef buildings in the United Kingdom. J. agric. Engng Res. 79, 107 – 116*
3. *Hartung, J., V. R. Phillips (1994.): Control of gaseous emissions from livestock buildings and manure stores. J. agric. Engng Res. 57, 173-189.*
4. *Hartung, J. (1998.): Art und umfang der von nutztierställen ausgehenden luftverunreinigungen. Dtsch. Tierärztl. Wschr. 105, 213-216.*
5. *Hartung, J. (1999.): Airborne emissions from animal production and its impact on environment and man. Regulation of animal production in Europe. International Congress in Wiesbaden, Deutschland. 9-12 May. Edited by Kuratorium für Technik ind Bauwesen in der Landwirtschaft (KTBL), Darmstadt. 183-196.*
6. *Frank, B.; M. Persson; G. Gustafsson (2002.): Feeding dairy cows for decreased ammonia emission. Livestock Production Science. 76, 171-179.*
7. *Kadzere, C. T., M. R. Murphy, N. Silanikove, E. Maltz (2002.): Heat stress in lactating dairy cows: a review. Livestock Production Science 77, 59-91.*
8. *Marthi, B., V. P. Fieland, M. Walter, R. J. Seidler (1990.): Survival of bacteria during aerosolization. Appl Environ Microbiol. 56, 3463-3467.*

9. Vucemilo, M. (2002.): Govedarstvo. U: Higijena smjestaja i držanja preživaca na obiteljskim gospodarstvima. Skripta za tecaj za doktore veterinarske medicine. (Vucemilo, M., A. Tofant, Ž. Pavicic). Veterinarski fakultet Sveucilista u Zagrebu. 10-28.

10. Wathes, C. M., V. R. Phillips, M. R. Holden, R. W. Sneath, J. L. Short, R. P. White, J. Hartung, J. Seedorf, M. Schröder, K. H. Linkert, S. Pedersen, H. Takai, J. O. Johnsen, P. W. G. Groot Koerkamp, G. H. Uenk, J. H. M. Metz, T. Hinz, V. Caspary, S. Linke (1998.): Emissions of aerial pollutants in livestock buildings in Nothern Europe; Overview of a multinational project. J. agric. Engng Res. 70, 3-9.

Table 1. Descriptive statistic analysis for ammonia concentration and basic microclimate parameters in barn air and outside during three measure therms.

	microclimate	***n***	***arithmetic mean***	***minimum***	***maximum***	***variance***	***standard deviation***
morning							
inside	***NH_3 ppm***	8	1.32	0.00	4.33	2.32	1.52
	tz^o C	8	11.20	5.26	15.80	11.50	3.39
	rv %	8	78.60	74.40	82.30	6.06	2.46
	w m/s	8	0.11	0.07	0.15	0.00	0.02
outside	***NH_3 ppm***	8	0.50	0.00	4.00	2.00	1.41
	tz^o C	8	9.44	2.50	14.10	16.70	4.08
	rv %	8	77.10	73.30	80.80	10.10	3.19
	w m/s	8	0.22	0.06	0.59	0.03	0.17
noon							
inside	***NH_3 ppm***	8	1.21	0.00	5.33	3.36	1.83
	tz^o C	8	13.10	8.23	18.20	17.40	4.17
	rv %	8	74.70	64.00	84.30	69.30	8.32
	w m/s	8	0.10	0.04	0.17	0.00	0.04
outside	***NH_3 ppm***	8	0.08	0.00	0.66	0.05	0.23
	tz^o C	8	12.00	6.95	19.20	23.90	4.89
	rv %	8	73.70	57.00	85.20	124.00	11.10
	w m/s	8	0.48	0.11	1.49	0.19	0.44
evening							
inside	***NH_3 ppm***	8	1.62	0.00	8.66	9.12	3.02
	tz^o C	8	12.90	5.50	22.50	33.40	5.78
	rv %	8	71.30	54.50	88.00	140.00	11.80
	w m/s	8	0.12	0.03	0.25	0.01	0.08
outside	***NH_3 ppm***	8	0.00	0.00	0.00	0.00	0.00
	tz^o C	8	11.40	3.29	22.20	36.90	6.08
	rv %	8	69.80	54.00	85.20	103.00	10.10
	w m/s	8	0.36	0.12	0.70	0.05	0.22