Scientific Papers. Series D. Animal Science. Vol. LVIII, 2015
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

REDUCTION OF AMMONIA LEVELS WITH ZEOLITE APPLICATION IN BROILER PRODUCTION

Hasan OZ[1], Atılgan ATILGAN[1], Ali COSKAN[2]

[1]SuleymanDemirel University, Agriculture Faculty, Agricultural Structure and Irrigation Department, 32260 Isparta, Turkey, Phone: +90 246.211.39.22, Fax: + 90 246 211 8696, Email: hasanoz@sdu.edu.tr
[2]SuleymanDemirel University, Agriculture Faculty, Soil Science and Plant Nutrition Department, 32260 Isparta, Turkey, Phone: +90 246.211.85.92, Fax: + 90 246 211 8696, Email: alicoskan@sdu.edu.tr

Corresponding author email: hasanoz@sdu.edu.tr

Abstract

The content of the air surrounding animals is important in terms of poultry production. Particularly increasing concentration of some harmful gases such as ammonia, carbon dioxide and methane cause unfavorable conditions for animals. In the insufficient ventilation conditions these gases should be taken into consideration.
In this research, the ammonia reduction effect of zeolite incorporation to litter was investigated at the poultry house which 22 m long, 10 m wide, capable to produce 3000 chicken at once. Twenty-five percent of zeolite (w/w) was applied to litter as 3 m wide band throughout the short edge of the poultry house to prevent rise of ammonia concentration. EFM/C coded electrochemical ammonia sensors were used to determine ammonia level whereas 16 bit AD/DA converter was used to log data on PC using self-developed software. The first sensor located in the middle of zeolite applied zone, second sensor located just conjunction between zeolite applied and non- applied zones and the others located on the centerline that parallel to long edge, 1.5 m far from each other.
While planning the experiment, reduction on ammonia level was predicted by means of zeolite application. Results obtained showed that the zeolite has a potential to be used in poultry house to prevent rise of ammonia concentration. However, due to the rapid diffusion capabilities of ammonia gas, the differences between measurement sites determined rather low. Therefore, measurement should repeat in tight-separated measurement sites.

Key words*: ammonia, harmful gases, poultry, zeolite.*

INTRODUCTION

Improving ambient conditions is one of the major parameters to improve productivity of broiler production. Therefore a number of researches focused on new approaches that allow reducing ammonia level of the surrounding atmosphere of poultries. Broiler production commonly performed on the litter in Turkey (Sarıca et al., 1996; Sarıca and Çam, 1998). Although many different litter materials are available, the cheapest and easily accessible regional products are preferred (Moore et al., 1996; Sarıca and Çam, 1998; Eleroğlu and Yalçın, 2004). To obtain the expected performance of broilers is closely connected to the appropriate environmental factors as well as types and management of the litter. Moreover type of the litter also effective on the performance, welfare, health and behavior of animals along with product quality (Benabdeljelil and Ayachi, 1996; Ritz et al., 2005; Torok et al., 2009; Garcia et al., 2012; Şekeroğlu et al., 2013). Sawdust accepted as the most suitable litter material for poultry; however, the price of sawdust is raised in recent years due to it has been using for different purposes, consequently production cost of enterprises is raised (Sarıca et al., 1996). Thus, researchers are encouraged to devise new materials that will not negatively affect broiler production performance with reasonable cost issues (Poyraz et al., 1991; Eleroğlu and Yalçın, 2005). A number of studies carried out to determine influence of different litter materials that may substitute sawdust litter on broiler production performance and carcass properties of poultries (Kaygisiz and Corekci, 2003). Some researchers (Eleroglu and Yalcin, 2005) are focusing divers chemical additives to

reduce microorganism abundance and ammonia level. The litter material where the production activities carried out should be clean and odorless to prevent bothering the animals. To this end, researchers are trying to optimize litter quality by a number of different approaches to improve animal welfare. Zeolite that used as a binding agent for animal feed; also be used as an additive to litter due to it has high water-holding capacity, a positive effect on litter aeration, an effect of reducing gas and odor formation (Eleroğlu and Yalçın, 2004). Ammonia formation in litter is closely related by urease activity that synthesized by particular microorganism that act to convert urea to ammonia and carbon dioxide in the presence of adequate moisture. Produced ammonia is volatile and commonly located just 3-8 cm above the litter whereas ammonium ions are water soluble and may stay in the litter (Şekeroğlu et al., 2013). Rising litter humidity and ammonia concentration in the atmosphere surrounding animals are negatively affecting growth rate of animals (Akşit et al., 2000). Optimum litter moisture content reported by Sainsbury (1992) as 24-25%; while, other researchers (Reece et al., 1980; Caveny et al., 1981) reported reduction of body weight, air bladder inflammation and some viral diseases in case of rising ammonia level above 25 ppm. Moreover, in case of ammonia level rise up to 50-100 ppm, eyes of the employees are also effecting from ammonia, with tears appearance and irritation.

In this research effect of 25% (w/w) zeolite incorporation to the litter was investigated to reduce ammonia formation under limited or non-aerated conditions.

MATERIALS AND METHODS

The research carried out at deep litter poultry house that 22 m long, 10 m wide and 3.3 m high with the capacity of 3000. Long axis of the poultry barn positioned East-West direction. The base was covered with lean concrete. Course sawdust was used as a litter throughout the experiment. Barn walls built from lean concrete blocks 20x20x40 cm in size and, therefore, heat insulation was quite poor. Between the supporting columns of southern and northern walls, series windows are located on both sides for ventilation. Two types of feeders are used during each production cycle as bottom placed or hanging tube feeders considering the age of animals. To provide water requirement of the animals a nipple type drinker was used. Barn heated by radiant type heaters, additionally greenhouse heaters (Bouderus) was used as auxiliary heat source in the coldest days.

Ross hybrid chicks which widely used in poultry production were used as a test organism and chicks transferred to barn when they were 1 day old. Thomason et al., (1987) reported that due to the chicks are not able to manage body temperature in beginning stage, ambient temperature should be carefully adjusted. Thus within first two weeks ambient temperature should be higher than 27-30 °C whereas should not rise over 32-35 °C. Considering that information ambient temperature of barn in the beginning stage adjusted between 30-32 C and gradually decreased at the rate of 2-3 C in week until reaching recommended temperature for adult chickens.

Twenty-five percent of zeolite (w/w) was applied to litter as 3 m wide band throughout the short edge of the poultry house to prevent rise of ammonia concentration. EFM/C coded electrochemical ammonia sensors (Electronic Devices Limited, UK) were used to determine ammonia level whereas 16 bit AD/DA converter was used to log data on PC using self-developed software. The first sensor located in the middle of zeolite applied zone, second sensor located just conjunction between zeolite applied and non- applied zones and the others located on the centerline that parallel to long edge, 1.5 m far from each other (Figure 1). Sensors were located to determine differences between zeolite applied and non-applied sites as well determine the ammonia gradient by means of distance from zeolite applied sites. Two more sensors were placed on 1.7 m high from bottom to determine ammonia concentration in the air where the employee was breathing.

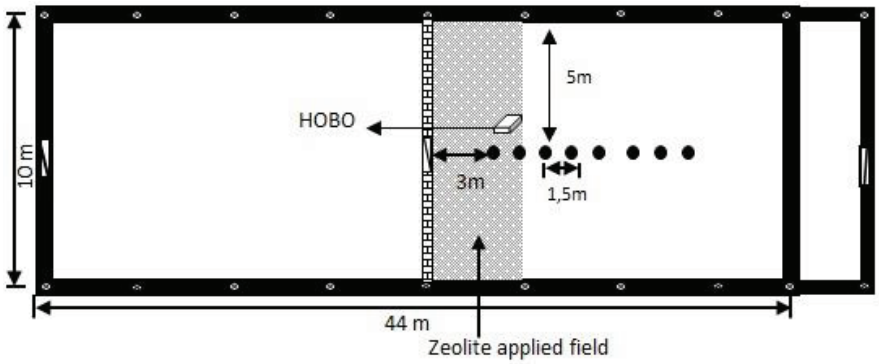

Figure 1. Placement plan of the sensors in barn (Figure is not scaled)

RESULTS AND DISCUSSIONS

In the experiment, cultivation in poultry house was continued for 45 days; however, measurement was not cover all cultivation period. Because, in the earlier stage of cultivation, litter was not enough dirtied by poultry dung; thus ammonia emission in the barn atmosphere was quite low, even lower than the detectable threshold value of the sensors. In the later stage of cultivation, ventilation was necessary due to higher outside temperature; therefore, ammonia concentration was rarely exceeded 60 ppm. It was not possible to suspend ventilation on the day time and thus, at the late afternoon ventilation windows are closed and then opened at the morning. Data from ammonia sensors started to log 2-3 hours before closing ventilation windows, whereas log closed 2-3 hour later then windows opened. Figure 2 presents the ammonia measurement of three days average at 1/2 hour interval that representing overall situation about ammonia level in the barn.

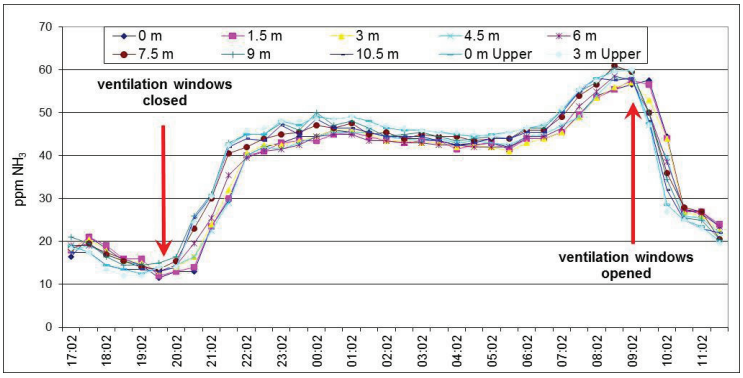

Figure 2. Ammonia values of representative measurement day (please note 0 m upper and 3 m upper are stand for employee nose level ammonia concentration)

Ammonia concentration of barn atmosphere along with ambient temperature was starting to rise dramatically just after closing the ventilation windows. It was expected situation but ammonia increment settled up couple hours later and ammonia level became constant between 40 to 50 ppm nearly all night long. Early in the morning ammonia level started to increase once more and reached slightly higher than 60 ppm. Results obtained were not clearly revealed the emission-reducer effect of zeolite application. Between the measurement sites

there was minor differences by means of ammonia values; however these differences was not significant to conclude precise suggestions. On the other hand, reasons for not determining the difference between the measurement sites seems to be closely related to diffusion of ammonia gas from one measurement sites to other. Thus based on this experimental design it is hard to make inferences revealing that zeolite incorporation is beneficial or useless.

Eleroğlu and Yalçin (2004) reported that intensive ventilation condition prevents reliable measurements on ammonia level in the barns. Supporting that evaluation Sarıca and Demir (1998) did not reported positive effect of zeolite application on ammonia level controlling in well ventilated poultry houses. Bintaş et al., (2014) moved subject to different point and revealed that zeolite incorporation is not effective on controlling ammonia emission from litter and improving animal welfare.

Three days average values for each measurement sites are presented in Figure 3. Ammonia concentration was increased with distance from zeolite applied zone. Considering trends on ammonia level by means of distance from zeolite zone (Polinom. 30 cm; Figure 3), it can easily said zeolite application is effective on ammonia concentration suppressing. Nose-level ammonia concentration (170 cm) was higher than all measurement points except 9th. The 9th point gives the highest ammonia level among the sites which is one of the farthest sites. The last point which 10.5 m far from zeolite applied zone shows lower value than 7.5 and 9 m points. This because that point just close to entrance of barn and while employees are entering the barn fresh air comes in. Lower values in nose-level point would be another evidence for beneficial effect of zeolite.

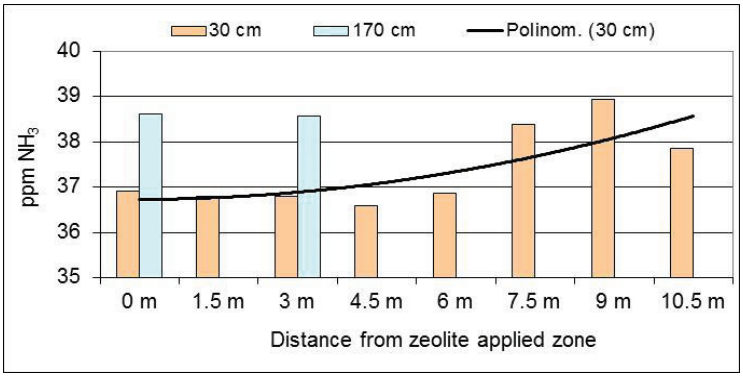

Figure 3. Mean ammonia values by means of distance from zeolite applied zone

The determined temperatures in the barn presented in Figure 4. Results revealed that the air temperature in barn were higher than recommended value of 21-22 °C. The experiment carried out in spring time and outside temperature increased rapidly when cultivation near to end. Last week of cultivation, all windows tightly closed at the night time to be able to evaluate effect of zeolite application, this would be another factor elevating air temperature in the barn. There was no difference in temperature between the measuring points as expected.

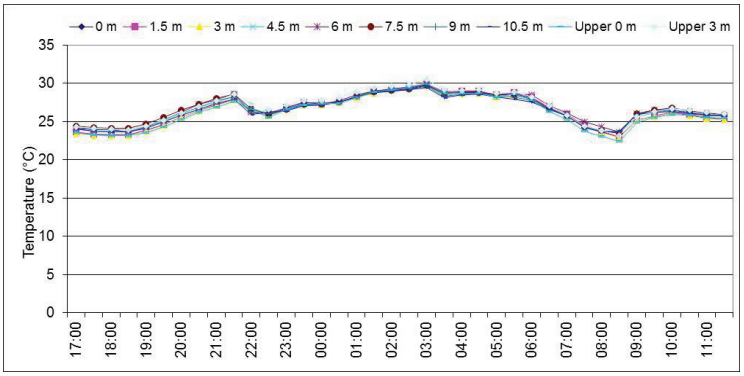

Figure 4. Air temperatures of poultry house

CONCLUSIONS

Overall results obtained from the experiments revealed that zeolite may use as an ammonia suppressing agent. However, due to the mean ammonia concentration fluctuating within only 3 ppm band, based on present data given here it is hard to conclude any reliable decision. Thus, further experiment should carry out using air tight compartments to prevent ammonia diffusion from one site to other. Although ventilation seems to be the most effective method for reducing ammonia concentration, yet it should be noted the negative effects of air quality.

ACKNOWLEDGEMENTS

This research work was carried out with the support of The Scientific and Technological Research Council of Turkey was financed from Project No 107O114.

REFERENCES

Akşit M., Bozkurt M., Alçiçek A., 2000. Farklıformdayemlerlebeslenenetlikpiliçlerdealtlığade ğişikdüzeylerdezeolitilavesininperformansvealtlıköze lliklerüzerineetkileri.HayvansalÜretim, 41: 84-90. (Turkish press)

Benabdeljelil K., Ayachi A., 1996. Evaluation of alternative litter materials for poultry. J. Appl. Poultry Res., 5 (3): 203-209.

Bintaş E., Küçükyilmaz K., Bozkurt M., Çatli A.U., Çinar M., Topbaş S., Koçer B., Ege G., 2014. Altlığa ilave edilen doğal zeolitin etlik piliçlerin performansı ve refahına etkileri. Tavukçuluk Araştırma Dergisi, 11(1): 10-15. (Turkish press)

Caveny D.D., Quarles C.L., Greathouse G.A., 1981. Atmospheric ammonia and broiler cockesel performance. Poultry Sci., 60: 513-516.

Eleroğlu H., Yalçın H., 2004. Zeolitle karıştırılan altlığın etlik piliçlerde besi performansı ile bazı altlık parametreleri üzerine etkileri, Tavukçuluk Araştırma Dergisi, 5 (1): 31-40. (Turkish press)

Eleroğlu H., Yalçın H., 2005. Use of natural zeolite-supplemented litter increased broiler production. South African Journal of Animal Science, 35 (2):90-97.

Garcia R.G., Almeida I.C.L., Caldara F.R., Nääs I.A., Bueno L.G.F., Freitas L.W., Graciano J.D., Sim S., 2012. Litter materials and the incidence of carcasslesions in broilers chickens. Brazilian Journal of PoultryScience, 14 (1):27-32.

Kaygısız F.H., Çörekçi Ş., 2003. Broiler Üretiminde zeolitli altliğin tekrar kullanilabilirliğinin fayda-maliyet analizi. İstanbul Üniv. Vet. Fak. Derg., 29(1): 43-50. (Turkish press)

Moore P.A., Daniel T.C., Edwards D.R., Miller D.M., 1996.Evaluation of chemical amendments to reduce ammonia volatilization from poultry litter.Poult. Sci., 75:315-320.

Poyraz Ö., Özçelik M., Çep S., Bahadıroğlu M.E. 1991. The use proportions of diatomite as litter on broiler production. J. Vet. Med. Assoc., 45-47.

Reece F.N., Lott B.D., Deaton W.J. 1980. Ammonia in the atmosphere during brooding effects performance of broiler chickens. Poultry Sci., 59: 486-488.

Ritz C.W., Fairchild B.N., Lacy M.P., 2005. Litter quality and broiler performance. cooperative extension service. The University of Georgia College of Agricultural and Environmental Sciences, Bulletin 1267, 2005.

Sainsbury D.. 1992. Poulty health and menagement. Blackwell Science Ltd. Osney Mead, Oxford. Third Edition.

Sarıca M., Saylam S.K., Öner F., Karçay N., 1996. Altlığazeolitilavesininetlikpiliçlerdebüyümevealtlıköz elliklerineetkileri.Hayvancılık Kongresi'96, İzmir, (1):346-352. (Turkish press)

Sarıca M., Çam M.A., 1998. Broiler üretimindealtlığıntekrarkullanımınınverimvealtlıközel

liklerineetkileri.DoğaTürkVeterinerlikveHayvancılık Dergisi, 22(3):213-219. (Turkish press)
Sarıca M., Demir Y., 1998. Etlikpiliçyetiştiriciliğindealtlığazeolitilavesininkümes içiçevrekoşullarıveverimözelliklerineetkileri.Ondoku zMayısÜniversitesi, Ziraat Fakültesi Dergisi, 13: 67-78. (Turkish press)
Şekeroğlu A., Eleroğlu H., Sarıca M., Camcı Ö., 2013. Litter materials and litter material management used in production on the ground. Tavukçuluk Araştırma Dergisi, 10: 25-34.
Thomason D.D., Lepley M.K.C., Dendy M., 1987. American Soybean Association Poultry Brooding, USA, 65p.
Torok V.A., Hughes R.J., Ophel-Keller K., Ali M., MacAlpine R., 2009. Influence of different litter materials on cecal microbiota colonization in broiler chickens. Poult Sci., 88: 2474–2481.