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EVALUATION OF A NEW AVIAN BED CONDITIONER USED IN THE PERIOD BETWEEN THE CREATIONS OF DIFFERENT BATCHES OF CHICKEN

***[1]Pablo Machado Mendes, [2]Taiani dos Santos Toledo, [2]Juliana Forgiarini, [1]David Banner Cruz, [3]Miguel David Fuentes-Guevara, [3]Rosane Maria Morales Guidotti, [2]Victor Fernando Büttow Roll, [4]Thayli Ramires Araujo, [5]Luciara Bilhalva Corrêa and [5]Érico Kunde Corrêa**

[1]PPG CTA, Department of Food Science and Technology, Federal University of Pelotas, Pelotas/RS, Brazil
[2]PPG Z, Department of Animal Science, Federal University of Pelotas, Pelotas/RS, Brazil
[3]PPG MACSA, Department of Soil Science, Federal University of Pelotas, Pelotas/RS, Brazil,
[4]PPG ENQ, Department of chemical Engineering and Food Engineering, Federal University of Santa Catarina, Florianópolis, SC, Brazil
[5]CEng, Sanitary and Environmental Engineering, Federal University of Pelotas, Pelotas/RS, Brazil

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ABSTRACT

The present study had as objective to evaluate the effects of the use of the conditions lime virgin, agricultural gypsum and diatomaceous earth in the treatment of avian bed on the physicochemical, microbiological and toxicological aspects. The treatments consisted of: T1- Avian bed control (without treatment), T2- Avian bed + virgin lime (CaO) 600g/m², T3- Avian bed + gypsum agricultural ($CaSO4$) 600g/m² and T4- Avian bed + Earth diatomaceous 200 g/m². The germination index (%), mesophilic microorganisms, pH, carbon (%), nitrogen (%), C / N ratio, matter were evaluated for 15 days, simulating between lots of commercial aviaries. Dry matter (%), mineral matter (%) and organic matter (%), there was a similarity between the treatments, and the diatomaceous earth presented better results in the phytotoxicity tests, increasing the germination of the seeds significantly. In spite of this, more studies are necessary in order to obtain a conditioner that approaches the standard, that is, seeds germinated with distilled water, and at the same time they present improvement in the other analyzed parameters.

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INTRODUCTION

The continuous growth of Brazilian agricultural production results in activities that generate a greater amount of waste, which, due to poor management, could pollute air, water and soil Marín *et al*. (2015); Sanchuki *et al*. (2011) report that agro-industrial waste often represents a larger volume than the products themselves. And, according to the same authors, the residues of poultry farming are classified within industrial waste, consisting of feces, feathers, food debris and bedding material, which may vary according to the country and region, as shavings, shavings, peanut shells, rice hulls and other materials. The choice of material to be used as bedding for broiler chickens is of fundamental importance, precisely to support the developmental needs of the birds and to perform well (Roll and Roll, 2014). In poultry farming, constant improvements in production technology have led to the use of shade as the main bedding material, its moisture absorption capacity and the best material to receive several chicken lots (Mendes, Naas and Macari, 2004; Avila *et al.,* 2008). The aviary bed consists of the mixture of excreta together with absorbent material used as substrate to receive and absorb moisture from the excreta, feathers and scales of the skin of birds and food debris falling from the feeders, as well as aid in reducing temperature fluctuations in the aviary and, consequently, in the improvement of chicken comfort that is

****Corresponding author:*** **Pablo Machado Mendes,**
PPG CTA, Department of Food Science and Technology, Federal University of Pelotas, Pelotas/RS, Brazil

directly associated with animal welfare (Vieira, 2011). The reuse of the bed aims at reducing costs in production and contributes to environmental sustainability, as it is also a necessity for the survival of poultry as a supplier of product to the food industry. By recycling the bed avoids the cost of purchasing materials necessary to cover 5 cm to 10 cm throughout the length of the aviary (Dai Prá, 2014). The bed is commonly reused for a variable period of six consecutive batches on average. However, the major problem regarding the period or number of bed reuse lots is more related to the sanitary aspect. In this context, the evaluation of the sanitary quality of avian beds is necessary, due to the consequence of the factors of quality and the final product. In this sense, the bed has the advantage of being able to be treated for its reuse, provided that it is aimed at reducing the bacterial population present, including possible pathogenic bacteria such as Salmonella spp., Escherichia coli, Listeria monocytogenes, Campylobacter spp. and Staphylococcus spp.; pathogens that may cause chronic or acute diseases in chickens and humans, as described by Kwak, Huh and Mccaskey (2005).

Among the treatments used in avian beds are chemical conditioners, which are substances which, when added to the bed improve their physical, chemical and microbiological quality, providing greater comfort to the birds, favoring their livestock and health performance (Oliveira, Ferreira and Cancherini, 2004). The use of chemical conditioners in the aviavy bed is touted as a quick and economical solution to reduce volatilization of ammonia and alleviate some problems, such as increased incidence of respiratory diseases in poultry and in humans, the carcass condemnations due to injury the skin and also reducing the nitrogen content in the bed, which changes its value as a fertilizer (Oliveira *et al.,* 2003). Stand out in this way, within the chemical conditioners, the use of lime and gypsum. Calcium oxide (CaO), also called simply quicklime or lime can be found in the form of ground powder. Usually CaO is used to improve litter condition by raising the pH in an attempt to stop the bacterial activity. On the other hand, according to Gloria, *et al*. (1991) the addition of calcium sulfate (CaSO4), popularly known as gypsum, possibly exerts an inhibitory action on the waste ammonia losses by volatilization. In addition, the gypsum becomes a good option due to its low cost and high availability, facilitating their acquisition front the other sulfates.

Today has been studied using Diatomaceous Earth mainly with regard to the control of catfishes (Alphitobiusdiaperinus) in avian beds. It is an inert powder from fossil diatom algae mainly consists of amorphous silicon dioxide. The diatomaceous earth is considered a natural product not presenting any risk to birds, humans and to the environment (Alves, 2008; Lorini *et al.,* 2001). Its potential as a condition of avian beds, however, is unknown in the literature to perform this work. According to the Ministry of Agriculture, Livestock and Supply (MAPA) of Brazil, the country will increase production in chicken 33.4 % between the years 2017 to 2027, reaching 34.3 million tons. Grow 2.6 % annually meat consumption and it is estimated by 2027 the increase in consumption by 29.5%, that is, in 2027 the Brazilian will be consuming 11.9 million tons of chicken meat (MAPA, 2017). These data show the importance of studying the conditioning to which the chicken will be exposed and the appropriate treatment of poultry litter to receive new batches without contamination of pathogens and disease development, ensuring the health of the chicken and Food safety the consumer. In this way, the objective of this work was to evaluate the effects of the use of virgin lime, agricultural gypsum and diatomaceous earth in the treatment of avian bed on the physicochemical, microbiological and phytotoxicological parameters

MATERIAL AND METHODS

Bed aviary: The broiler bed was granted by a breeding farm in the municipality of Santa Maria - Rio Grande do Sul, Brazil, and was composed solely of beech and ceded after the creation of a batch of broilers. After the collection, the samples were packaged, conditioned at 4 ºC and sent to the Education, Research and Extension in Waste and Sustainability Nucleus (EREWSN) of the Federal University of Pelotas, in the city of Pelotas, in the state of Rio Grande do Sul, in the state of Rio Grande do Sul. Brazil. Characterization of the aviary bed was performed as can be seen in (Table 1).

Treatments in bed aviary: Different laboratory treatments were carried out in the avian bed, where the different products were added and mixed with the bed. The treatments were submitted to 15 days of rest, at room temperature, simulating the period between batches of a commercial aviary. The treatments used were: T1- Untreated avian bed (control), T2- Avian bed + virgin lime (CaO) 600 $g \cdot m^{-2}$, T3- Avian bed + gypsum (CaSO4) 600 $g \cdot m^{-2}$, T4- Avian bed + diatomaceous earth 200 $g \cdot m^{-2}$. The quantity of each product was established on the basis of previous work and according to what is usually done in the poultry integration industry. The lime, gypsum and diatomaceous earth products came from an agricultural products store in the city of Pelotas. The treatments were performed in triplicate to obtain better experimental data, and each analysis was performed three times.

Experimental Protocol: For the elaboration of the study, 90 g of avian bed were weighed for each experimental unit of each treatment and conditioned in a 500 mL becker glass, conditioned at room temperature (mean of 20 ºC ± 8 ºC). Subsequently it was weighed and added the respective amount of each product of each treatment to be homogenized along with the to aviary bed. At the end of the 15-day experimental period (batch interval simulation), samples were collected from each experimental unit for physical-chemical, microbiological and ecotoxicological analyzes. In the physicochemical analyzes the parameters moisture and dry matter were verified according to Roll and Roll (2014); Dai Prá (2014) pH according to Tedesco *et al*. (1995) carbon / nitrogen ratio according to Sharma *et al*. (1997) organic carbon by the method of Walkley-Black Tedesco *et al*. (1995) and total nitrogen by the Kjeldahl method (Silva *et al.,* 2007). For the microbiological analysis, the quantification of mesophilic microorganisms was performed through the standard plate count (SPC) (Swanson, Petran and Hanlin, 2001). In the ecotoxicological analysis, the phytotoxicity assay with lettuce seeds (Lactuca sativa - giovana variety) was performed, which is a quick, reliable, economical and easy to implement test (Charles *et al.,* 2011). The phytotoxicity of samples of organic compounds and residues were performed according to Mendes *et al*. (2016).

Statistical analysis

The results were submitted to the ANOVA variance test, and the “MEANS TRAT/TUKEY LINES” procedure was used to compare the treatments.

Table 1. Initial means of physico-chemical and microbiological analyzes of bed

Parameters	Aviary bed on day zero
Mesophiles (log.CFU/g)	7,815
pH	9.3
C (%)	41.40
N (%)	0.31
C/N (%)	133.54
P (%)	1.94
DM (%)	61.98
MM (% of DM)	11,85
OM (% of DM)	88.15

Caption: C - total organic carbon; N - total nitrogen; P - crude protein; DM - dry matter; MM - mineral matter; OM - organic matter

Table 2. Means of phytotoxicological, physicochemical and microbiological analyzes of the beds in the different treatments after the 15 days of experiment

Treatment	GI (%)	Mesophiles ($log \cdot CFU \cdot g^{-1}$)	pH	C (%)	N (%)	C/N	P (%)	DM (%)	MM (%)	OM (%)
T1-Control	9.59	6.31595	9.33	33.58	0.43	78.10	2.72	62.80	12.94	87.06
T2-Lime	9.29	6.20412	10.08	34.31	0.37	95.31	2.30	65.09	16.03	83.97
T3-Gypsium	3.96	6.389166	9.03	32.82	0.41	80.06	2.59	63.91	16.58	83.42
T4-DE	11.89	6.424882	8.90	29.18	0.35	83.38	2.20	66.62	14.41	85.59

Caption: GI - germination index; C - total organic carbon; N - total nitrogen; P - crude protein; MM - mineral matter; DM - dry matter; OM - organic matter.

The means were compared using the Tukey test at 5 % probability ($p < 0.05$). The statistical program used was the SAS-2000.

RESULTS AND DISCUSSION

The results of bed characterization, relative to carbono, nitrogen, dry matter, mineral matter and crude protein (Table 2) are in agreement with the literature for bed structured with shaving. For the phytotoxicity analysis, all the samples showed a phytotoxic character, from the untreated bed to the beds that received the treatments studied, also described in the study by Mendes *et al*. (2016) who found phytotoxicity in all the samples of avian beds that received from 1 to 5 lots of broilers, although the C/N ratio was adequate in some of them. The treatment containing gypsum (T2) showed a performance of 3.96 % in relation to the standard germination index (GI) (Table 2). The other treatments indicated a similarity in the results, but it is possible to affirm that the treatment T4 obtained the highest GI, which means that this treatment obtained the least phytotoxic potential among the treatments studied. It can be observed in the experiment that, despite the small improvement in the germination index presented by the diatomaceous earth, the bed still presents a low germination index, being the highest value 11.89 % in relation to the standard germination index (with distilled water and value of 100 %). Regarding the C/N ratio, the highest observed value was 133.54 for the treatment T1 in the initial period (day zero). An excessively high ratio, which causes difficulties for the action of microorganisms in bed stabilization. Already after the 15-day period for the same treatment, it was possible to observe a reduction in the value of the C/N ratio to 78.10. Even if this value falls in the C/N ratio, the value is not within the parameters stipulated in the literature that are around 20, which coincides with the resulting values in the compounds considered stabilized. On the other hand, the highest C/N value after 15 days was observed in the treatment T2 with the use of virgin calcium, worsening its quality presenting the value of 95.31. The other treatments had values close to the treatment T1, not obtaining significant difference.

Regarding the count of mesophilic microorganisms, the treatments presented a similarity of results after 15 days of rest, distinguishing them from the result obtained from the poultry litter newly arrived for analysis, which was 7.815 log·CFU·g-1, whereas the proposed treatments in this study they obtained values on the 6 log·CFU·g-1 scale. This distinction can be attributed to the refrigeration of the sample, since it was processed days after its arrival in the laboratory. The percentage carbon content showed a significant reduction for all treatments when compared to the treatment T1 at time zero, which obtained a value of 41.40 %. On the other hand, T2 presented a reduction of 9 %, which is in line with the values found by Silva (2016) who used gypsum with the aim of stabilizing the avian bed and as a bacterial control. It was possible to observe after the experimental period of 15 days, an increase of the percentage of total nitrogen in the treatments, higher values when compared with the T1 treatment at time zero. From the 4 treatments proposed, T4 and T3 had values closer to T1 treatment at the beginning of the experiment (Silva, 2016; Benedetti *et al.,* 2009; Zapata, 2011). In the treatment that used the Diatomaceous Earth (T4), a dry matter content of 66 % was observed after the experimental period, 4 % higher when compared to the bed without the conditioning, in the initial time. The bed when treated with lime had similar results to that found by Rech (2017). As evidenced in mineral matter, the organic matter has been reduced, demonstrating the beginning of the stabilization process (conversion of organic matter to mineral). The hydrogenation potential (pH) obtained the highest value for the treatment with lime where the pH was 10.08, similar to the values observed by Rerch (2017). In the case of gypsum treatment, the lowest value among treatments was observed, with a pH of 9.0. When comparing the values of DM, MM and OM, there was a tendency of increase of DM and MM in the treatments in comparison to the control, however, in an inverse way was verified in relation to OM. Crude protein was increased in all treatments including control, when compared to the newly arrived bed sample in the laboratory, however, the treatments did not differ from each other.

Conclusion

Among the treatments applied, the Diatomaceous Earth (T4) obtained the best performance in relation to phytotoxicity, although all presented high toxicity (low GI), but in relation to the other parameters, no treatment differed significantly. Cost-effectiveness may be a drawback in using Diatomaceous Earth, although it has shown a potential higher conditioning in terms of toxicity. More studies are needed in order to obtain a conditioner that provides a considerable increase in the GI, as well as the improvement of the other physical-chemical and microbiological parameters, all together.

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REFERENCES

Alves, LFA., Neves, PMOJ., Oliveira, RC. and Oliveira DGP. 2008. Factors to be considered in the use of *Beauveria bassiana* for the control of *Alphitobiusdiaperinus* on poultry farms. *Archive of the Institute of Biology.* 75(1):13-20.

Avila, VA., Oliveira, U., Figueiredo, EAP., Costa, CAF., Abreu, VMN. and Rosa, OS. 2008. Alteranative material to replace wood shavings as broiler litter. *Brazilian Journal of Animal Science*, 37(2):273-277.

Brazil, Ministry of Agriculture, Livestock and Supply 2017. Agribusiness projections: Brazil 2016/17 to 2026/27. Ministry of Agriculture, Livestock and Supply. Secretariat for Agricultural Policy. 98 p.

Charles, J., Sancey, B., Crini, MN., Badot, P., Degiorgi, F., Trunfio, G. and Crini, G. 2011. Evaluation of the phytotoxicity of poly contaminated industrial effluents using the lettuce plant *Lactuca sativa* as a bioindicator. *Ecotoxicology Environmental Safety*. 74:2057–2064.

Ferreira, HA., Oliveira, MC. And Traldi, AB. 2004. Effect of chemical conditioners in the poultry litter on the broiler performance. *Brazilian Journal of Veterinary and Animal Science*, 56(4):536-541.

Glória, NA., Barretto, MCV., Moraes, CJ. and Mattiazzo, ME. 1991. Evaluation of gypsum and some phosphates as inhibitors of the volatilization of ammonia from manure. *Brazilian Journal of Soil Science*, 15(3):297-301.

Kwak, WS., Huh, JW. and Mccaskey, TA. 2005) Effect of processing time on enteric bacteria survival and on temperature and chemicaal composition of broiler poultry litter processed by two methods. *Bioresource Technology*, 9:1529-1536.

Lorini, I., Ferreira, FA., Barbieri, I., Demaman, NA. and Martins, RRDO 2001. Diatomaceous earth as an alter native in the control of pests stored in family property. *Agroecology and Sustainable Rural Development*, 2(4):32-36.

Marín, OLZ., Tinôco, IFF., Saraz, JAO., Souza, CF. and Vieira, MFA. 2015. Evaluation of the fertilizer and contamination potential of different broiler litter types subjected to various use cycles. *Revista Facultad Nacional Agronomía Medellin,* 68(2):7637-7646.

Mendes, AA., Naas, IA. and Macari, M. 200*).* Produção de frangos de corte. (1st ed). IA: Facta.

Mendes, PM., Becker, R., Correa, LB., Bianchi, I., Prá, MAD., Lucia, JrT. and Corrêa, EK. 2016. Phytotoxicity as an indicator of stability of broiler production residues. *Journal of Environmental Management*, 167:156-159.

Oliveira, MC., Almeida, CV., Andrade, DO. and Rodrigues SMM. 2003. Dry matter contente, pH and volatilized ammonia from poultry litter treated or not with diferente additives. *Brazilian Journal of Animal Science*, 32(4):951-954.

Prá, MAD. and Mores, E. 2014. Aspects related to the use of the bed. Chapter 2. In: Dai Prá MA, Roll VFB (eds) Avian bed: Use, reuse and destination*,* IA: Evangra.

Rech, DV., Trevisol, IM., Brentano, L., Silva, VS., Rebelatto, R., Jaenisch, FRF., Okino, CH., Mores, MAZ., Coldebella, A., Botton, SA. and Vaz, CSL 2017. Impact of treatments for recycled broiler litter on the viability and infectivity of microorganisms. *Veterinary Microbiology*, 203:308-314.

Roll, AP. and Roll, VFB. 2014. Aspects related to the use of the bed. Chapter 1. In: Prá MAD, Roll VFB (eds) Avian bed: Use, reuse and destination, IA: *Evan graf.*

Sanchuki, CE., Soccol, C., Carvalho, JC. and Soccol, VT 2011. Evaluation of poultry litter : traditional composting process. *Brazilian Archives Biology and Technology*, 54(5):1053-1058.

Santos, MP., Castro, YO., Marques, RC., Pereira, DRM., Godoy, MM. and Reges, NPR. 2016. Importance of limestone and fertilization in traditional and alternative production of forage plants. *Journal Pubvet*., 10(1):1-12.

Sharma, VK., Canditelli, M., Fortuna, F. and Cornacchia, G. 1997. Processing of urban and agroindustrial residues by aerobic composting: Review. *Energy Conversion Management,* 38:453-478.

Silva, JMP. 2016. The gypsum fertilizer improves quality of poultry litter? MscDissertation Paulista State University, Faculty of Agronomic Sciences, Botucatu– SP, Brazil.

Silva, VS., Rech, DV., Coldebella, A., Bosetti, N. and Avila VS de, 2007. Effect of treatments on bacterial litter load reused in poultry farm. *Embrapa Swine and Poultry*.

Swanson, KMJ., Petran, RL. and Hanlin, JH. 2001. Culture methods for enumeration of microorganisms. Chapter 6. In: Downes FP, Ito K (eds.), Compendium of methods for the microbiological examination of foods, 4th ed. Washington: *American Public Health Association* (AP HA). pp 53-67.

Tedesco, MJ., Gianello, C., Bissani, CA., Bohnen, H., Wolk weiss, SJ. 1995. Analysis of soil, plants and other materials. (2nd ed). Porto Alegre: Federal University of Rio Grande do Sul.

Vieira, MFA., Tinoco, IFF., Santos, BM., Inoue, KRA., Mendes, MA dos SA. 2015. Sanitary quality of broiler litter reused. *Journal of the Association of Agricultural Engineering*, 35(5):800-807.

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