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SHORT COMMUNICATION

Nitrogen Characteristics in Poultry Manure Using Sea Urchin Shell Powder as Poultry Diets : A Field Study

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Abstract

This study was conducted to evaluate the effects of sea urchin shell powder on nitrogen characteristics in poultry litter by assigning ninety 1-d-old male broiler chicks (Arbor Acres) to one of 3 treatments (control, 1% sea urchin shell powder, and 1% feed additives) in 3 replicates of 10 birds each. For all treatments, the overall dry matter contents were decreased ($P < 0.05$) as time increased, except for at 1 week. When compared with controls, the dietary sea urchin shell powder and feed additives for 0 and 3 weeks did influence their TN contents, but not for 1, 2 and 4 weeks. The treatments with sea urchin shell powder and feed additives had a significant ($P < 0.05$) influence on NH_3-N in poultry litter compared with controls. However, at 4 weeks, no marked differences were observed in NH_3-N contents among treatments. Treatments with 1% sea urchin shell powder might enhance the value of poultry litter as N fertilizer

Key words : Sea urchin shell powder, Dry matter, Total nitrogen, Ammonia nitrogen, Poultry litter

1. Introduction

Poultry manure and litter are considered as a good N fertilizer because of its high nitrogen (N) contents (Watts et al., 2012). Also, after excretion, uric acid and urea can be lost via volatilization of ammonia (NH_3). N and NH_3 loss has become a serious problem in terms of environment and agriculcutral ecosystems such as loss of plant avaliable N, the nutrient values and eutrophication (Lefcourt and Meisinger, 2001). Consequently, this has emphasized the need for new resserach to control negative environmental effects. Recently, one method of poultry litter management has been mentioned as background information in litter additives (urease inhibitor, clays, and acidifying agents) that are available to poultry producers (Wilson, 2000). Another alternative for this would be to use marine by-products (Sea urchin shell powder) as diet supplements. According to several reports, using sea urchin shells contained beneficial advantages: antioxidant and pharmaceutical effects (Kim et al., 2002; Shankarlal et al., 2011). However, the efficacy of sea urchin shells to poultry litter has not tested when compared to other feed additives. The objective of this research was to investgate nitrogen characteristics in poultry litter using sea urchin shell powder as poultry diets.

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2. Materials and methods

All animal protocols were carried out according the guidelines for an experimental poultry farms in Gunwi (South Korea). A total of 90 male broiler chicks (1-d-old, Arbor Acres) were randomly chosen to one of 3 treatments (control, 1% sea urchin shell powder, and 1% feed additives) and placed in 3 replicate pens with 10 birds each. Birds received starter diets with 23% crude protein from day 1 through 21 and finisher diets with 21% crude protein from day 22 through 28. Poultry facilites had an automatic control system with light, temperature, heating, and ventilation. All birds were free access to feed and water *ad libitum* for the experimental periods. Sea urchin shell powder (*Hemicentrotus pulcherrimus*) was obtained from Daegu Technopark (Biohealth Convergence Center, South Korea). Feed additives (Vital Gold, soluble complex nutrition supplement) were purchased from Daesung Microbiological Labs. Co. Ltd (Euiwang, South Korea). Litter samples were taken weekly from 4 random locations in each pen. The litter samples from each pen were thoroughly mixed by hand. And then, litter samples of approximately 100 g were weighed, packaged in individual plastic bags and stored in frozen storage before determination of dry matter (DM), total N (TN), and NH_3-N. Samples were analyzed for DM according to the methods of AOAC (1990). TN was determined using methods described by Nahm (1992). For measuring NH_3-N, twenty grams of sample were homogenized with 200 mL of distilled water using blender for 30 s, and then filtered immediately. NH_3-N concentrations were determined using the technique described by Chaney and Marbach (1962). Data were performed with the PROC GLM procedure in SAS (2000). Differences between means were compared using Duncan's (1955) Multiple Range Test ($P < 0.05$).

3. Results and Discussion

Effects of sea urchin shell powder on dry matter in poultry litter as a function of time are given in Table 1. During the experimental period, no difference was shown in dry matter among treatments at 1 week. For all treatments, the overall dry matter contents were decreased ($P < 0.05$) as time increased. Compared with controls, dry matter in treatment with 1% sea urchin shell powder (T1) and 1% feed (T2) was increased up to 2 weeks and 1 week and then tended to decrease after 3 weeks and 2 weeks, respectively. This indicated that dry matter was influenced by using sea urchin shell powder and feed additives, indicating dry matter contents excreted by the birds depended on the dry matter digestibility in the diet (Bolani et al., 2010). According to NRC (1994), broiler chickens have a dry matter digestibility of about 85 to 90% in the feed.

Table 1. Effect of sea urchin shell powder on dry matter in poultry litter as a function of time

Time (week)	Treatment[1]			Significance	
	Control	T1	T2	SEM[2]	*P-value*
0	78.67^{c}	84.99^{b}	87.08^{a}	1.26	0.0086
1	78.85	80.77	81.32	0.70	0.1411
2	72.79^{b}	76.50^{a}	59.27^{c}	0.77	P<0.0001
3	69.98^{b}	65.36^{c}	72.85^{a}	1.18	0.0145
4	68.36^{b}	66.73^{c}	72.91^{a}	0.67	0.0018

[a-c]Mean values within rows with different superscripts are significantly different ($P < 0.05$).
[1]Control = basal diet; T1 = 1.0% sea urchin shell powder; T2 = 1.0% feed additives.
[2]Mean values are expressed as means ± SEM.

The effects of sea urchin shell powder on TN in poultry litter over time are reported in Table 2. When compared with controls, the dietary sea urchin shell powder (T1) and feed additives (T2) for 1, 2 and 4 weeks did not influence their TN contents, except for 0 and 3 weeks. Also, the addition of sea urchin shell powder and feed additives increased TN contents

from poultry litter over time. Among all treatments, the highest TN contents in poultry litter were 1% sea urchin shell powder (T1). In the present study, it was hypothesized that potential increases in TN contents of poultry litter might act as an acidifier agent. This hypothesis supported to the results of Choi and Moore (2008) who showed additional N should make poultry litter treated with liquid aluminum chloride as a better N fertilizer. In addition, two major advantages of showing that TN contents from poultry litter are increased by sea urchin shell powder are that it is possible to use best management practices (BMPs) to solve the environmental problems and improve the value of poultry litter as N fertilizer sources.

Table 2. Effect of sea urchin shell powder on total nitrogen (TN) in poultry litter as a function of time

Time (week)	Treatment[1]			Significance	
	Control	T1	T2	SEM[2]	*P-value*
0	1.64[b]	2.00[a]	0.86[c]	0.14	0.0005
1	1.96	1.84	1.77	0.25	0.1874
2	2.19	2.41	2.19	0.12	0.4304
3	2.43[c]	3.49[a]	3.22[b]	0.19	0.0260
4	2.67	3.40	2.81	0.21	0.1762

[a-c]Mean values within rows with different superscripts are significantly different ($P < 0.05$).
[1]Control = basal diet; T1 = 1.0% sea urchin shell powder; T2 = 1.0% feed additives.
[2]Mean values are expressed as means ± SEM.

Table 3 shows effect of sea urchin shell powder on NH_3-N in poultry litter over time. The treatments with sea urchin shell powder (T1) and feed additives (T2) had a significant ($P < 0.05$) influence on NH_3-N in poultry litter compared with controls. However, at 4 weeks, no marked differences were observed in NH_3-N contents among treatments. The results also suggested that unlike feed additives, adding sea urchin shell powder had been effective at reducing NH_3-N contents. In line with the current result on NH_3-N contents, previous studies (Moore et al., 1995) found using Al and Fe compounds has an acidifying effect on poultry litter which would greatly reduce NH_3 losses. In general, the main factor affecting NH_3 volatilization can be categorized in several groups: litter characteristics (dry matter and N) and environmental factors (temperature and humidity) (Meisinger and Jokela, 2000). Thus, knowing the main factor affecting NH_3 losses will help in improving litter N management.

Table 3. Effect of sea urchin shell powder on ammonia nitrogen (NH_3-N) in poultry litter as a function of time

Time (week)	Treatment[1]			Significance	
	Control	T1	T2	SEM[2]	*P-value*
0	17.73[a]	8.87[b]	7.23[c]	0.79	0.0002
1	27.30[a]	17.73[c]	20.77[b]	0.84	0.0009
2	78.02[a]	43.40[c]	58.56[b]	2.05	P<0.0001
3	110.14[a]	42.25[c]	52.97[b]	1.45	P<0.0001
4	92.86	57.93	60.21	2.92	0.1455

[a-c]Mean values within rows with different superscripts are significantly different ($P < 0.05$).
[1]Control = basal diet; T1 = 1.0% sea urchin shell powder; T2 = 1.0% feed additives.
[2]Mean values are expressed as means ± SEM.

4. Conclusion

In conclusion, using sea urchin shell powder (1%) increased TN and decreased NH_3-N contents in poultry litter for 4 weeks rather than dry matter. To use marine by-products (sea urchin shell powder) as diet supplements, therefore, it is very important to determine the values of poultry litter for supplemental fertilizer N decrease the impacts of agricultural ammonia in poultry industry.

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