Effect of chemical additives (coagulants) on the nutritional quality of compost prepared from poultry litter

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Abstract

This study was conducted to know about the nutritional quality of poultry litter amended with chemical coagulants after composting. For this purpose, chemical coagulants (i.e. Aluminum Sulphate and Aluminum Chloride, a dosage of 45g /chick) were applied in the selected poultry farms. Three types of poultry litter (i.e. treated with Aluminum Sulfate, Aluminum Chloride and untreated waste/control) were collected for compost and characterized for different macro and micro nutrients. It was observed that pH, EC, organic carbons were decreased while the nitrogen content was increased in chemically treated composts. The percentage difference in pH was -6.5%, -10.5% and -11.3%; -EC 6.1%, -19.3% and -15.6%; organic carbon -12.9%, -20% and -20%, while nitrogen was +24.6%, +28% and +25.2% for control compost, Al_2SO_4 treated litter compost and Al_2Cl_3 treated litter compost. Furthermore, the comparative analysis showed the sequence of high nutrition as control> control compost> Aluminum Chloride treated compost>Aluminum Sulfate treated compost. The recorded metal contents of control and composts were within the permissible limits set by USEPA and considered safe for agriculture. One-way anova among control and compost group showed significant (p =.000) effects while the interaction showed a non-significant difference (p =.744). However, the extensive and regular application of poultry litter may cause metal contamination. Hence, to ensure its benefits as a soil conditioner, it was recommended to implement management strategies such as chemical amendments of poultry litter, proper composting and regular monitoring of the poultry litter application into the soil.

Keywords: *Aluminum Sulfate (Al_2SO_4); Aluminum Chloride (Al_2Cl_3); Amendment; Poultry Farms.*

1. Introduction

In Pakistan, the poultry industry is one of the most dynamic, well-organized, growing and profitable agro-based sectors[1]. Due to rapid expansion in the poultry sector, poultry litter production is also increasing. Poultry litter is a combination of different materials as feathers, feaces, waste feed, and bedding material etc. Poultry litter is also considered as a soil builder because of its high nitrogen and organic matter that can boost plant growth[2].

Recently, poultry litter is receiving more popularity as organic fertilizer due to the high cost of inorganic fertilizers coupled with the limited ability of inorganic fertilizers to improve soil quality[2,3]. In spite of the fact that farmers use poultry litter as organic fertilizer, it contains potentially harmful metals that are also used as feed additives, for the growth of broilers and to treat diseases. Previous studies have demonstrated an increase in the content of various metals in poultry litter when applied frequently to agriculture fields because soil acts as a sink for metals where they are accumulated for long times. The metal bioaccumulation in the soil and their transfer to cultivated crops affect the food chain[4].Several other studies found elevated levels of metals in poultry litter amended soil that can be a great source of transfer and uptake in cultivated crops with repeated applications[5].

Numerous experimental researches have been conducted concerning the poultry litter amendment with chemicals and reported an enhancement in the physical and chemical properties of the soil. The amended poultry litter with chemical coagulants like Aluminum Chloride (Al_2Cl_3) and Aluminum Sulfate (Al_2SO_4) that showed effective results by making the poultry litter suitable for fertilizer[6,7,8]. The addition of Al_2SO_4 and Al_2Cl_3 in poultry litter could effectively increase the physico-chemical properties of soil[9,10].

Mostly farmer's stored poultry litter in the open air before application on the agriculture field[11]. The storage of poultry litter is a better option but this open storage is a source of unpleasant odor, the release of toxic gases along with the losing of essential nutrients. If poultry litter is covered with a tarp, this practice will not only conserve valuable nutrients but also limit the potential generation of environmental pollution[12]. The covered storage method of composting gave the best nutrients for poultry litter as a fertilizer favored by [13].

Composting is a method for waste recycling, reduction, and control of nitrogen contents. It may reduce the mobility and translocation of metals in the environment compared to raw litter. The application of poultry litter after composting is considered advantageous and beneficial to metal contaminated soil[14]. It is documented that unplanned preparation and use of composted litter may result in various related issues i.e. production/growth of crops, release toxic gases and metal contamination of the soil, which may have the potential to enter into the food chain[5]. Hence, it is necessary to identify such techniques that will improve litter quality and reduce nutrient loss. The main objective of this study was to treat the poultry litter with chemical coagulants and know the chemical characteristics for nutrients.

2. Research Methodology

This study was divided into three phases as shown in Figure 1. In the first phase, the chemical amendments of poultry litter to selected poultry farms were carried out. In the second phase, compost was prepared. In the third phase, the characterization of the control and compost group was carried out.

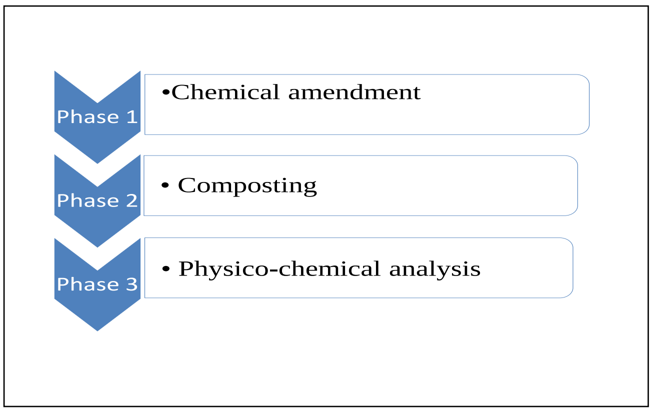

Figure 1: Phases of study

2.1. Field Visit and Chemical Treatment

A total of 6 poultry farms were randomly visited and selected for an experiment in Haripur District. These farms were easily accessible and the owners and workers were willing for the experiment. To maintain the nutrients in the poultry litter, In-situ chemical treatments were given to six selected farms and were kept under observation for a complete cycle. Out of the total, two farms were treated with Al_2SO_4 and two with Al_2Cl_3. The rest of two were considered as untreated poultry farms (control) for the comparative study. In the treatment process, chemicals such as Aluminum Sulphate and Aluminum Chloride were applied at a rate of 45 grams/bird presented in Table 1 described by[16] i.e. Aluminum Sulfate is typically applied to 45 – 90 grams/bird.

Table 1: Amendment of poultry farms with coagulants

Farm	No. of Chicks	Coagulant	
		Type	45 g/chick
Farm 1	500	Al_2SO_4	22,500
Farm 2	800	Al_2Cl_3	36,000
Farm 3	500	Control	-----
Farm 4	400	Al_2SO_4	18,000
Farm 5	500	Al_2Cl_3	22,500
Farm 6	500	Control	------

2.2. Poultry Litter Collection

A total of 6 samples, one from each poultry house were randomly collected for the compost preparation. 100 Kg of poultry litter was collected and thoroughly mixed separately from each farm. The larger aggregates from the collected litter were arranged into small pieces, air-dried and stored for compost.

2.3. Preparation of Compost

The prepared (dried and segregated) litter was categorized into control, Al_2SO_4 and Al_2Cl_3 treated litter. Further compost was prepared by a covered heap storage method. In this method, samples were placed as a pile on the ground and covered with a plastic sheet for three months, described by[17].

2.4. Laboratory Analysis of Poultry Litter and Compost

For laboratory experimentation, larger particles from samples were grinded, passed through 2.0mm screen, and stored in plastic bags. Each sample (i.e. control and compost group) was analyzed for different parameters (i.e. *p*H, EC, organic carbon, nitrogen, arsenic, cadmium, copper and zinc). The EC and *p*H of the samples were measured using Inolab *p*H and EC meter in the aqueous extract. The aqueous extract was obtained by mechanically shaking each sample with 10:1 distilled water to litter in a beaker, mixed thoroughly for 5 min as per the standard procedure of [18]. For the estimation of organic carbon, 1g of sample was taken in a silica porcelain crucible and was dried in a muffle furnace at 500 °C for 4 hours. The weight of ash was recorded. Organic carbon content in the samples was calculated by the equation 1. Where 1.8 is for the conversion of total organic matter into organic carbon as given by [17].

$$C = \frac{100 - (\text{Ash } \%)}{1.8} \quad \ldots\ldots\ldots\ldots (1)$$

The content of nitrogen was measured by Kjeldahl analysis. In this method, 1 g of dried sample was taken into a Kjeldahl flask with 20 ml of concentrated H_2SO_4 and 3 grams of digestion mixture. The flask was heated until the clear digestate appeared. Nitrogen was determined by distillation followed by titration against 0.01 N H_2SO_4[17]. As, Cd, Cu, and Zn were analyzed using an atomic absorption spectrophotometer. The samples were digested separately with aqua-regia as[19]. In this method, 1gram of each sample was digested in 15 ml of aqua regia at 80 – 180 °C. This solution was filtered and diluted with distilled water to 50 ml to obtain a transparent solution and subjected to an atomic absorption spectrophotometer for metals detection.

2.5. Statistical Analysis

The average, percentage difference and standard deviation were determined by MS Excel 2010. Further, the data was subjected to statistical analysis using SPSS Version 16.0. ANOVA was employed to find the statistically significant differences between groups The significant difference was considered as $p = 0.05$ with 95% confidence intervals for the independent variable (litter) for each separate group (control, control compost, Aluminum Sulfate treated litter compost and Aluminum Chloride treated litter compost), as well as when all groups are combined (Total).

3. Results and Discussion

3.1. Compost

The compost of control, Al_2SO_4 and Al_2Cl_3 treated litter was prepared. The poultry litter took 90 days (3 months) for complete biodegradation of the material. After composting, poultry litter changed from light brown to dark brown and became fine and soft as compared to raw litter, shown in Figure 2. These results are in line with those of [20] that a favorable time for composting was between 60 – 90 days. In this period, the maximum decomposition of organic waste occurred. Composting is an important and effective pre-treatment for effective utilization of poultry litter as fertilizer.[21] The compost will have a more stable organic content and long-lasting residual effect on soil as compared to the application of inorganic fertilizers[22]. Thus, the application of compost litter is economically viable and promotes sustainable productivity.

Figure 2: Comparison of litter and composts group

3.2. Physico-chemical Characterization of Control and Compost Group

3.2.1 pH

The *p*H value was decreased in the compost group as compared to the control. Although a slight difference in the value of *p*H was found among composts (Table 2). The *p*H of poultry litter is a driver of gaseous emissions, directly increased with an increase in *p*H of poultry litter[10]. Poultry litter with *p*H lower than 7 released 10 times less ammonia than litter with a *p*H above 8. The addition of $Al_2(SO_4)_3{\cdot}14H_2O$ and $AlCl_3{\cdot}6H_2O$ as chemical coagulants to the litter can control the release of nutrients[23,24]. It is quite clear from the recent data that after the chemical amendment at poultry litter, a progressive decline in the *p*H was observed. The reason may be the acidic nature of coagulants that are used for the poultry litter amendment and the hydrolysis of aluminum that also dropped the litter *p*H. A similar finding was proved by [7] that Al_2SO_4 and Al_2Cl_3 dropped the litter *p*H. The *p*H of poultry litter has special concerns and effects on the quality of composts. The *p*H value of poultry litter 6.7 – 9 is considered favorable for composting[25]. This stated that poultry litter is suitable for composting. Therefore, composting along with the amendment of poultry litter with both coagulants was found to be helpful in reducing *p*H of litter and made it safe for fertilizer.

Table 2: Physico-Chemical Analysis of control and Composts

Element		Control	Compost		
			Control	Al_2SO_4 treated litter	Al_2Cl_3 treated litter
pH	Min	8	7.4	7.1	7.1
	Max	8.1	7.8	7.3	7.25
	Avg	8	7.5	7.2	7.15
	Std. Dev	0.06	0.21	0.10	0.08
	Percentage Difference (%)		6.45	10.5	11.2
EC (dS/m)	Min	3.1	2.9	2.5	3.0
	Max	3.8	3.3	2.9	2.8
	Avg	3.4	3.2	2.8	2.9
	Std. Dev	0.35	0.67	0.23	0.65
	Percentage Difference (%)		6.1	19.3	15.6
Organic C%	Min	32	28	25	25
	Max	34	30	29	28
	Avg	33	29	27	27
	Std. Dev	1.58	1.82	1.13	1.94
	Percentage Difference (%)		12.9	20.0	20.0
Nitrogen %	Min	1.17	1.72	1.74	1.73
	Max	1.54	1.74	1.85	1.77
	Avg	1.35	1.73	1.79	1.74
	Std. Dev	0.19	1.01	0.06	0.08
	Percentage Difference (%)		24.6	28	25.2

Analytical results revealed a variance of electrical conductivity values among poultry litter and compost group as presented in Table 2. The highest value was observed for control without composting. In composts, the percentage difference of electrical conductivity of both Al_2SO_4 treated litter *compost* (-19.3%) and Al_2Cl_3 treated litter compost (-15.6%) was on the lower side as compared to control compost (-6.1%) (Table 2). Overall results indicated that EC remained in a normal range with no salinity and was found suitable for crop production. Electrical conductivity is expressing the salinity or potentially toxic salts in the soil. High electrical conductivities indicated high salt contents that can disrupt the physical properties of soil[26]. Only a few crops could tolerate an EC having values above 6.0dS/m in poultry litter[2]. In view of these, the control litter and different composts are considered suitable and safe for crops. Another study conducted by [27] reported similar findings as showing decreasing values in EC after composting. A decrease in poultry litter EC is due to humic fractions that might have complexed the soluble salts which tend to reduce the amount of mobile free ions[28].

3.2.3 Organic Carbon

The percentage difference data indicated that a numerically lower content of organic carbon i.e. -12.9%, -20% and -20% for control compost, Al_2SO_4 treated litter compost and Al_2Cl_3 treated litter compost, respectively (Table 2). A reduction in organic carbon in compost is also found by [29] which are in accordance with the recent findings. These results are in support of literature that the reduction in carbon value was due to the addition of Al_2SO_4, causes higher nitrogen content in the poultry litter[10,30].

3.2.4 Nitrogen

The overall results demonstrated variations in nitrogen contents at the control and composts. An increasing trend of nitrogen was recorded for Al_2SO_4 treated litter compost (+28%), followed by Al_2Cl_3 treated litter compost (+25.2%) and control compost (+24.6%). The lowest concentration was observed for control given in Table 2.

Nitrogen has profound effects on the fertility of the soil and the productivity of crops as other macronutrients [31]. The type of manure, handling ~~-~~and management procedure can influence the nitrogen contents in poultry litter that is available for plant growth. Nitrogen content could improve through the amendment of the poultry litter. A high dose of Al_2SO_4 resulted in a doubling of the nitrogen contents in the poultry litter. It increases the value of litter and enhances the crop yield[10]. The results of another study justified the higher nitrogen contents from treated litter with Al_2SO_4 regardless of the litter source. Nitrogen content of agricultural compost resulted from the large quantities of nitrates in organic waste, which give stability and maturity to compost[32]. This study goes in favor of [33] statements. A similar trend that the addition of Al_2SO_4 to poultry litter results in less nitrogen being lost than normal litter was also reported by[34]. An elevated nitrogen content in covered composted litter was found by [17]. This was related to plastic sheet cover that reduces nitrogen losses through ammonia volatilization. Another reason could be that the mineralization of the nutrients from poultry litter causes an increase of different nutrients[13]. The results of this study indicated that litter can be a good source of nitrogen.

3.3. Metal concentration in control, control compost, and amended compost

3.3.1. Arsenic (As)

Arsenic was recorded as 0.6 mg/kg for control~~,~~ and 0.8 mg/kg for control compost, respectively. In treated litter compost, the mean value of arsenic was found as 0.4 mg/kg for Aluminum Sulfate and 0.3 mg/kg for Aluminum Chloride. The percentage difference is given in Table 3. Table 3 indicates that As content was found below the standard value. [35] has set the As standard limit as 41mg/kg in composts (Table 3).

Arsenic exists in the earth’s crust with less concentration (i.e. average 2 mg/kg) but man-made activities cause arsenic contamination. Arsenic is a toxic compound and considered carcinogenic by the USEPA, National Research Council and International Agency for Research on Cancer, National Toxicology Program. The high content of As also inhibits Zn uptake by plants[36]. Arsenic was found below the permissible limits in the soil of Khyber Pakhtunkhwa by [37]. The concentration of arsenic as 5.84 – 17.24 mg/kg in the soil of Haripur district was reported by [38.] Arsenic observed as 18.8 mg/Kg in the litter that was higher as compared to this study[39]. Past studies showed that excessive and repeated application of litter may elevate As in agricultural fields. Arsenic in litter applied soils comes from the use of arsenical poultry feed for the growth of broilers and treating diseases[4,40]. Arsenic in poultry litter is uptaken and transported by the plant causing toxicity and food chain contamination[41]. Therefore, the safe concentration of arsenic is a need for the safe utilization of poultry litter as fertilizer.

3.3.2. Cadmium (Cd)

Cadmium was found as 0.5 mg/kg in a control and 0.4 mg/kg in control compost. In treated compost, cadmium was found as 0.4 mg/kg in Al_2SO_4 treated litter compost and 0.5mg/kg in Al_2Cl_3 treated compost, respectively. Among the litter and the compost group, the higher value of cadmium was recorded for the control. The lower value was attained in Al_2Cl_3 treated litter compost (50%) followed by Al_2SO_4 treated litter (22.2%) and control compost (22.2%) (Table 3). Poultry litter was considered safe for agriculture in comparison to the legal limit (i.e. 2,800 mg/kg) by[35].

Table 3: Metal Concentration (mg/kg) in control and Compost group and Permissible limit of metals for Composts/Organic Fertilizer

Metal		**Control**	**Compost**			**Limit[35]**
			Control	**Al_2SO_4 treated litter**	**Al_2Cl_3 treated litter**	
As	Min	0.6	0.4	0.5	0.3	41
	Max	0.7	0.5	0.4	0.4	
	Avg	0.6	0.4	0.4	0.3	
	Std. Dev	0.006	0.002	0.004	0.006	
	Percentage Difference (%)		40	40	66.6	
Cd	Min	0.5	0.3	0.4	0.3	39
	Max	0.6	0.5	0.5	0.7	
	Avg	0.5	0.4	0. 4	0.3	
	Std. Dev	0.06	0.010	0.006	0.020	
	Percentage Difference (%)		22.2	22.2	50	
Cu	Min	0.7	0.1	0.5	0.1	1500
	Max	1.11	0.9	0.7	0.4	
	Avg	0.9	0.7	0.6	0.5	
	Std. Dev	0.020	0.042	0.010	0.015	
	Percentage Difference (%)		25	40	57	
Zn	Min	1.16	1.07	1.16	1.05	2800
	Max	1.25	1.15	1.21	1.12	
	Avg	1.2	1.11	1.18	1.09	
	Std. Dev	0.046	0.040	0.026	0.038	
	Percentage Difference (%)		7.8	7.7	9.6	

Food is considered one of the major sources of cadmium exposure. 0.5 mg/kg of cadmium exists in the earth's crust. A higher content of cadmium is carcinogenic. Several literature reported organic fertilizers as the common source of cadmium in agriculture fields. Cadmium is used in the feed of poultry birds. A study conducted by [38] reported 0.06 – 1.32 mg/kg of Cd in agriculture soil in Haripur. It was found lower as compared to a report by [42] in the soil of Pakistan. In comparison to this study, [39] reported a high content of Cd as 1.7 mg/Kg in poultry litter.

3.3.3 Copper (Cu)

The higher value of Copper was found for control as 0.9mg/kg followed by control compost as 0.7mg/kg and Al_2SO_4 treated litter compost as 0.6 mg/kg while the low level of copper was attained in aluminum chloride treated litter compost as 0.2mg/kg. The percentage difference was observed as 25%, 40%, and 57% for control compost, Aluminum Sulfate treated litter compost and Aluminum Chloride treated litter compost compared to control as presented in Table 3. The recent results showed that values of copper were detected below the permissible limit set by [35] for copper (1500mg/kg) in compost (Table 3).

Copper is a naturally occurring micronutrient of soil. Past literature on poultry litter and their compost showed a higher concentration of Cu. Poultry litter has been observed to contain a potentially harmful content of Cu that may be related to the chemicals used to treat poultry diseases. Copper was reported as 8.10–39.33 mg/kg in the soil by [40]. In comparison, [43] found Cu content as 59 mg/kg and [44] measured between 90–139 mg/kg in poultry litter. Cu concentration ranged between 92 – 128 mg/kg during composting of poultry litter was found by [45]. Among the control and compost group, copper content was detected below among compost. Similar results were also reported by[46]. They found a decrease in copper contents of the composted organic waste. The reason for the decline of copper content might be associated with the progressive humification of organic manure applied and the formation of stabilized Cu complexes with humic substances[47]. Copper is a great source of transfer and uptake in the cultivated crops. The compost and amended poultry manure for the optimization of copper in contaminated soil was recommended by [21].

3.3.4 Zinc (Zn)

Zinc concentrations in control and composts are given in Table 3. The percentage difference for zinc was observed as 7.8%, for control compost, 7.7% for Al_2SO_4 treated litter compost and 9.6% for Al_2Cl_3 treated litter compost as compared to control (Table 3). These values of Zn were detected below the permissible limit (2,800mg/kg) by [35] (Table 3).

The past studies reported that Zn in the soil of Pakistan was below the toxic level. A study conducted by [38] reported the Zn between 12.99 – 162.00 mg/kg. In these points of view, the soil is zinc deficient but the application of control and treated litter compost reduces this deficiency to some extent. Past studies showed a variation in the contents of zinc in poultry litter applied soil in contrast to non-litter applied soil. Higher Zn contents in litter applied soil as compared to control were reported by[48]. Other studies conducted by [49,45] measured an increasing trend of zinc during the biodegradation of organic waste. Zinc is an essential trace metal and plays important role in reproduction and growth. A soil rich in organic matter with high nitrogen contents would be susceptible to a deficiency of zinc. The lower value of Zn reduces plant growth and crop yield but higher value has potentially toxic effects on plants and the food chain[50].

The sequence of metals in control was observed as Zn>As>Cu>Cd. Among compost group, in control compost the observed pattern was Zn>As>Cu>Cd, Zn>Cu>As>Cd for Aluminum Sulfate treated litter compost and Zn>Cd>Cu>As for Aluminum Chloride treated litter compost (Table 3). Recent results indicated that control, control compost, Aluminum Sulfate treated litter compost and Aluminum Chloride treated litter compost did not exceed the permissible limit for selected metals. So, it can be considered safe for the crop.

3.4 One-way Anova

Statistical analysis of one-way anova for control, control compost, Al_2SO_4 treated litter compost and Al_2Cl_3 treated litter compost showed a significant (p =.000) effects. Among litter the interaction was non-significant (p = .744) (Table 4). A significance difference for control and blended litter with Aluminum Sulfate and Ferric Chloride was also observed by [24].

Table 4: One-way ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Control	Between Groups	1337.688	3	1629.73	6.777	.000
	Within Groups	778.682	175	1038.80		
	Total	91176.177	179			
Control compost	Between Groups	636.676	3	15916.906	222.654	.000
	Within Groups	27812.511	173	78.717		
	Total	91761.771	175			
Al_2SO_4 treated litter compost	Between Groups	614.726	3	1633.282	32.852	.000
	Within Groups	176.177	195	421.006		
	Total	67811.129	197			
Al_2Cl_3 treated litter compost	Between Groups	614.726	3	1633.282	32.852	.000
	Within Groups	6.137	195	421.006		
	Total	5811.125	197			
Among litter	Between Groups	172.282	3	57.427	.413	.744
	Within Groups	29510.942	212	139.203		
	Total	29683.224	215			

4 Conclusion and Recommendations

The results of the physico-chemical analysis revealed that the chemical amendment of poultry litter compost is undoubtedly capable of producing a high nutrient organic fertilizer. Recent findings realized that composting conserves valuable nutrients from being lost. The overall results markedly indicated an increase in the nutritional value of both treated litter especially Al_2SO_4 treated-litter after composting. Thus, poultry litter amendment along with composting could be one of a way to improve litter quality for environmentally friendly sustainable agriculture management. However, less attention has been paid to the potential hazards of poultry waste constituents. Metals (As, Cd, Cu, and Zn) are used as nutritive and growth supplements in poultry. So, there is a potential for metal contamination in repeatedly litter amended soil and their bioavailability to crops. Therefore, further research is also needed on different amendment methods for sustainable utilization of poultry litter as fertilizer.

There is a need to develop a method for effective composting. Better utilization of poultry litter is one way to reduce its negative impacts on humans and the environment. So, environment friendly management techniques should be adopted to enhance the nutritional value of poultry litter. This will help in saving economic resources and sustainably reduce the burden on inorganic fertilizer. Modern strategies like chemical amendments in poultry litter are recommended to turn poultry litter into economically viable solutions for healthy agriculture.

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Vliv chemických přísad (koagulantů) na nutriční kvalitu kompostu připraveného z drůbežího steliva

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Abstrakt

Tato studie byla provedena za účelem zjištění nutriční kvality drůbežího steliva doplněného chemickými koagulanty po kompostování. Za tímto účelem byly ve vybraných drůbežích farmách aplikovány chemické koagulanty (tj. síran hlinitý a chlorid hlinitý v dávce 45 g/kuře). Tři typy drůbežího trusu (tj. ošetřené síranem hlinitým, chloridem hlinitým a neupravený odpad/kontrola) byly shromážděny pro kompost a charakterizovány pro různé makro a mikroživiny.

Bylo pozorováno, že pH, vodivost, organický uhlík byly sníženy, zatímco obsah dusíku byl zvýšen v chemicky ošetřených kompostech. Procentuální rozdíl v pH byl -6,5 %, -10,5 % a -11,3 %; -EC 6,1 %, -19,3 % a -15,6 %; organický uhlík -12,9 %, -20 % a -20 %, zatímco dusík byl +24,6 %, +28 % a +25,2 % pro kontrolní kompost, podestýlkový kompost ošetřený Al_2SO_4 a podestýlkový kompost ošetřený Al_2Cl_3. Kromě toho srovnávací analýza ukázala sekvenci vysoké výživy jako kontrola > kontrolní kompost > kompost ošetřený chloridem hlinitým > kompost ošetřený síranem hlinitým. Zaznamenaný obsah kovů v kontrolních a kompostech byl v rámci přípustných limitů stanovených USEPA a považován za bezpečný pro zemědělství. Jednosměrná analýza rozptylu mezi kontrolní a kompostovou skupinou vykazovala významné (p = 0,000) účinky, zatímco interakce vykazovala nevýznamný rozdíl (p = 0,744). Rozsáhlá a pravidelná aplikace drůbežího steliva však může způsobit kontaminaci kovů. Proto, aby byly zajištěny její výhody jako půdního kondicionéru, bylo doporučeno zavést strategie managementu, jako jsou chemické úpravy drůbežího steliva, správné kompostování a pravidelné monitorování aplikace drůbežího trusu do půdy.

Klíčová slova: *síran hlinitý (Al_2SO_4), chlorid hlinitý (Al_2Cl_3), drůbeží stelivo, kompost.*