EFFECTS OF LITTER MATERIALS, LITTER CHEMICALS AND IN-FEED HERBS ON LITTER PH AND MOISTURE LEVEL IN NANDANAM BROILER 3 IN HUMID TROPICAL CLIMATE

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ABSTRACT

A study was conducted for 9 week periods to assess the effect of herbs in feed (*Yucca schigidera* extract and Herbal saponins) and chemicals (Alum and Lime) in different poultry litter materials (Coir pith and Paddy husk) on pH and moisture level in Nandanam Broiler 3 (NB3) in a humid tropical climate at Poultry Research Station, Madhavaram Milk Colony, Chennai-51. Three weeks old NB3 chickens were used for this study, they were randomly divided into ten treatment groups. The experimental design were T_1- Coir pith alone litter (CPL),T_2- Paddy husk alone litter (PHL), T_3- Alum 500g/10.76 sq.ft in CPL,T_4- Alum 500g/10.76 sq.ft in PHL,T_5-Lime 300g/10.76sq.ft in CPL,T_6-Lime 300g/10.76sq.ft in PHL, T_7- *Yucca schigidera* extract 125mg/kg of feed (reared in CPL),T_8- *Yucca schigidera* extract 125mg/kg of feed (reared in PHL),T_9-Herbal saponin 125g/MT of feed (reared in CPL) and T_{10}- Herbal saponins 125g/MT of feed (reared in PHL). All the birds were fed *ad-libitum* and grown under standard manage mental condition from 4th to 12th week of age. The litter pH and moisture level were estimated on 4th, 6th, 8th, 10th and 12th weeks of age. Significant difference ($P<0.05$) in litter pH and moisture levels were observed in fortnight recording. The NB 3 fed with herbal saponins (125mg/kg of feed) reared in CPL (T_7) and PHL (T_8) had shown lowest litter pH and moisture level of7.91±0.01;7.95±0.01 and 49.76±0.02; 49.80±0.02% respectively. Among litter treatments, the Coir pith and Paddy husk treated with alum at the rate of 500g/10.76sq.ft (T_3, T_4) had shown lowest litter pH and moisture level 8.00±0.05; 7.98±0.07 and 50.2±0.02%; 52.23±0.02% respectively. It is concluded that the combination of *Yucca schigidera* extract in feed and alum in litter, reduces the litter pH and moisture level and prevent ammonia emission from the litter and improve the health of birds.

Key words: *Yucca schidigera*, Herbal saponins, Alum, Lime, Litter materials, Litter pH, Litter moisture, Nandanam Broiler 3

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INTRODUCTION

In India, broilers are mainly reared in deep litter system and paddy husk is the most commonly used litter material. High humid tropical climate, poor ventilation and improper litter management results into accumulation of ammonia in the poultry house, which adversely affects productivity. Ammonia emission from the litter not only cause environmental problems, but also detrimental to the health, welfare and performance of the birds. The climate of Chennai is hot and humid for more than 8 months of the year, the average atmosphere temperature was around 30^0C and relative humidity of 60-65%.Beker *et al.*, (2004) found that ammonia in poultry houses lowers the performance and may increase disease susceptibility and suggested that poultry litter ammonia level should not exceed 25ppm in poultry houses and controlling pH, moisture of litter will reduces the ammonia level (Maliselo and Mwaanga, 2016). Previously many authors supplemented *Yucca schigidera* extract (herb) in feed and few authors treated alum and lime in litter to reduce the litter pH, moisture level so as to reduce the ammonia level. In order to reduce the litter pH and moisture level by combination of treating feed and litter, this study was carried out by supplementing two herbs (*Yucca* extract and Herbal saponin) in feed, two chemicals (Alum and Lime) in two different poultry litter (Coir pith and Paddy husk) were chosen. Based on the property, the *Yucca* and herbal saponins are inhibiting the ammonia producing bacteria (*i.e.* E.coli, Camplyo bacter, Proteus spp.) in the gut and reducing the ammonia concentration in litter. Aluminum sulfate (Alum) added to the poultry litter, will reduce the litter pH, moisture and ammonia emission from the poultry litter (Madrid *et al.*, 2012). Lime incorporated with poultry litter to reduce the bacterial pathogens that leads to decreasing the ammonia producing bacteria thus reduces pH.

Materials and Methods

The Nandanam Broiler 3 is a variety developed by Poultry Research Station, Madhavaram Milk Colony, Chennai -51. Unlike native chicken it will attain market weight around 12^{th} week of age. So this study was planned to conduct in NB3 from 4^{th} to 12^{th} week period. Three weeks old NB3 chickens were randomly divided into ten equal groups, with 3 replicates and each replicates contains 12 birds to a total of 360 birds. The herbs *Yucca schigidera* extract and herbal saponin were purchased from Manomay Biochemicals Ltd, Maharashtra and Kemin industries (India) Ltd Company respectively. Alum, lime, paddy husk and coir pith were purchased from market. The experimental design as follows:

Table. 1 Experimental design

Groups	Treatments	Number of birds			
		R1	R2	R3	Total
T1	Control- Coir pith alone litter material	12	12	12	36
T2	Control- Paddy husk alone litter material	12	12	12	36
T3	Coir pith+ Alum (500g/10.76sq.ft)	12	12	12	36
T4	Paddy husk+ Alum (500g/10.76sq.ft)	12	12	12	36
T5	Coir pith+ Lime (300g/10.76sq.ft)	12	12	12	36
T6	Paddy husk+ Lime (300g/10.76sq.ft)	12	12	12	36
T7	Coir pith+ *Yucca* extract (125mg/kg of feed)	12	12	12	36
T8	Paddy husk + *Yucca* extract(125mg/kg of feed)	12	12	12	36
T9	Coir pith+ Herbal saponin (125g/MT of feed)	12	12	12	36
T10	Paddy husk +Herbal saponin (125g/MT of feed)	12	12	12	36
Total		**120**	**120**	**120**	**360**

All the birds were fed *ad-libitum* with standard feed as per BIS (2007). The experimental feed formula is presented in Table.2 and 3.

Table 2.Ingredients composition of the experimental broiler starter ration (4-8 weeks)

Ingredients Percent	T1-T6 Basal diet	T7 (Basal diet with Yucca extract powder)	T8 (Basal diet with Yucca extract powder)	T9 (Basal diet with Herbal saponin)	T10 (Basal diet with Herbal saponin)
Maize	51.32	51.32	51.32	51.32	51.32
Bajra	5.15	5.15	5.15	5.15	5.15
Soya bean meal	29.08	29.08	29.08	29.08	29.08
Dry fish	8.00	8.00	8.00	8.00	8.00
Mineral mixture*	3.10	3.10	3.10	3.10	3.10
Di-calcium phosphate	0.35	0.35	0.35	0.35	0.35
Salt	-	-	-	-	-
Vegetable oil	3.00	3.00	3.00	3.00	3.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
DL –Methionine	100g	100g	100g	100g	100g

Lysine	10g	10g	10g	10g	10g
Choline	40g	40g	40g	40g	40g
Feed additives	160g	160g	160g	160g	160g
Yucca extract powder	-	125mg	125mg	-	-
Herbal saponins	-	-	-	125g	125g

Mineral mixture * (BIS Standard, 2007)

Table 3. Ingredients composition of the experimental broiler finisher ration (9-12weeks)

Ingredients percent	T1-T6 Basal diet	T7 (Basal diet with Yucca extract powder)	T8 (Basal diet with Yucca extract powder)	T9 (Basal diet with Herbal saponin)	T10 (Basal diet with Herbal saponin)
Maize	56.71	56.71	56.71	56.71	56.71
Bajra	5.25	5.25	5.25	5.25	5.25
Soya bean meal	24.24	24.24	24.24	24.24	24.24
Dry fish	7.00	7.00	7.00	7.00	7.00
Mineral mixture*	1.00	1.00	1.00	1.00	1.00
Di-calcium phosphate	0.50	0.50	0.50	0.50	0.50
Salt	-	-	-	-	-
Oil	5.30	5.30	5.30	5.30	5.30
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
DL –Methionine	150g	150g	150g	150g	150g
Lysine	200g	200g	200g	200g	200g
Choline	30g	30g	30g	30g	30g
Feed additives	150g	150g	150g	150g	150g
Yucca extract powder	-	125mg	125mg	-	-
Herbal saponins	-	-	-	125g	125g

Mineral mixture * (BIS Standard, 2007)

Litter pH estimation

The pH level in litter was estimated on bi-weekly interval of 4th, 6th, 8th, 10th and 12th weeks at Department of Poultry Science, Madras Veterinary College, Chennai-07. The pH was estimated by electronic pH meter. One gram of litter samples were suspended in 10ml deionized water for 30 minutes. The pH indicating electric sensor probe was merged in sample then the pH meter was recorded until constant values were obtained (APHA, 2000).

Litter moisture estimation

The moisture level in litter was estimated on bi-weekly interval of 4th, 6th, 8th, 10th and 12th weeks at Department of Poultry Science, Madras Veterinary College, Chennai-07. A sub sample of 5-10 Grams were placed in hot air oven and kept at 105^{0}C for 24 hours then it was placed in desiccators and allowed to cool for 15 minutes. The samples were weighed and then placed in the hot air oven for an additional hour; subsequently the samples were removed from the oven and allowed to cool in the desiccator. Finally the samples were weighed again to determine if there was a change in moisture content. (APHA, 2000).The data were analyzed as per standard statistical procedure described by Snedecor and Cochran (1994).

Results and Discussion

The effect of herbs in feed and chemicals in poultry litter pH and moisture level in NB3 presented in Table 4 and 5 respectively.

Table 4. The effect of herbs in feed and chemicals in poultry litter pH level in NB 3 chicken (Mean±SE)

Treatments (n=6)	Litter pH level (Mean ± S.E)				
	4th week*	6th week*	8th week*	10thweek*	12th week*
T1-control- Coir pith without chemicals	8.12± 0.03^{i}	8.22± 0.01^{h}	8.34± 0.08^{h}	8.54± 0.06^{i}	8.87± 0.03^{i}
T2-control- Paddy husk without chemicals	8.24± 0.03^{j}	8.26± 0.00^{i}	8.41± 0.03^{i}	8.60± 0.03^{j}	8.95± 0.01^{j}
T3-coirpith+Alum (500g/10.76sq.ft)	7.69± 0.05^{g}	7.85± 0.06^{f}	7.85± 0.06^{c}	7.94± 0.04^{d}	8.00± 0.07^{d}
T4-Paddy husk + Alum (500g / 10.76 sq.ft)	7.75± 0.04^{h}	7.88± 0.07^{g}	7.85± 0.04^{c}	7.91± 0.05^{c}	7.98± 0.05^{c}
T5-Coirpith + Lime (300g/10.76sq.ft)	7.67± 0.04^{f}	7.85± 0.03^{g}	8.11± 0.03^{g}	8.31± 0.09^{h}	8.48± 0.04^{h}

T6-Paddy husk + Lime (300g / 10.76 sq.ft)	7.57± 0.06^{e}	7.80± 0.05^{e}	8.01± 0.007^{f}	8.29± 0.04^{g}	8.41± 0.02^{g}
T7- Coir pith+ Yucca extract powder(125mg/kg of feed)	7.52± 0.02^{d}	7.68± 0.03^{c}	7.69± 0.03^{a}	7.74± 0.03^{a}	7.91± 0.02^{a}
T8- Paddy husk+ Yucca extract powder(125mg/kg of feed)	7.49± 0.04^{c}	7.71± 0.04^{d}	7.78± 0.04^{b}	7.83± 0.03^{b}	7.95± 0.08^{b}
T9- Coir pith + Herbal saponin (125g/MT of feed)	7.43± 0.01^{b}	7.63± 0.05^{b}	7.98± 0.03^{e}	8.07± 0.04^{e}	8.24± 0.04^{f}
T10- Paddy husk+ Herbal saponin (125g/MT of feed)	7.38± 0.01^{a}	7.47± 0.06^{a}	7.96± 0.06^{d}	8.13± 0.07^{f}	8.20± 0.03^{e}
Overall	**7.69± 0.030**	**7.83± 0.030**	**8.00± 0.028**	**8.14± 0.036**	**8.30± 0.046**
F value	**4125.50**	**1695.14**	**1804.05**	**2872.34**	**2733.21**

Mean values within columns bearing at least one common superscript do not differ significantly. *- Significant (P<0.05) n= number of observations

A significant difference (p<0.05) was observed in litter pH level in all fortnight observations of 4 to12 weeks of age between treatments. However, the birds reared in Coir pith litter and Paddy husk litter fed with 125mg of *Yucca schigidera* extract/kg of broiler diet (T_7 and T_8) had lowest pH (below 8) in 8^{th},10^{th},12^{th} weeks than herbal saponins fed treatment groups. This finding did not agreed with Sahoo *et al*., (2015), they fed *Yucca schigidera* extract at 125mg/kg of diet and did not find any significant difference than control. No more previous research on *Yucca* extract on litter pH was traceable. The litter treated with alum (500g/10.76sq.ft) in paddy husk litter had lowest pH level of 7.98±0.05 (T_4) followed by T_3 (alum 500g/10.76sq.ft) in coir pith litter (8.00±0.07). This findings concurred with Moore *et al*., (1996), they recorded pH value of 7.45 in litter treated with alum (130g/kg of litter), Burgess *et al*.,(1998) observed similar pH when alum was given at 10:1 wet weight basis in broilers. This finding not in agreement with McWard and Taylor (2000), they observed pH level of 8.6 in alum treated (100lbs/1000sq.ft) broiler litter, Choi and Moore (2008) recorded litter pH level of 7.70; 6.98 poultry litter treated with dry alum at 4g and 8g /100 g of litter. The coir pith litter treated with 300g/10.76sq.ftlime(T_5) and paddy husk litter treated with 300g/10.76sq.ft lime (T_6) 300g/10.76sq.ft had more than 8 pH level and this findings are not concurred with Ruiz *et al*., (2008) recorded pH level of more than 10 in poultry litter treated with 15% quick lime based on the weight of the litter.

Table 5. The effect of herbs in feed and chemicals in poultry litter moisture in NB 3 chicken (Mean±SE)

Treatments (n=6)	PercentLitter moisture (Mean ± S.E)				
	4thweek*	6thweek*	8thweek*	10thweek*	12th week*
T1-control- Coir pith without chemicals	41.58± 0.04^{i}	47.55± 0.02^{i}	52.36± 0.04^{f}	59.61± 0.01^{h}	66.60± 0.11^{i}
T2-control- Paddy husk without chemicals	42.18± 0.06^{j}	47.13± 0.03^{h}	57.20± 0.52^{h}	60.18± 0.04^{i}	67.73± 0.04^{j}
T3-coirpith+ Alum(500g/10.76sq.ft)	30.36± 0.04^{a}	39.53± 0.08^{d}	44.83± 0.64^{d}	48.06± 0.04^{d}	52.23± 0.03^{d}
T4-Paddy husk+ Alum(500g/10.76sq.ft)	31.08± 0.04^{b}	38.28± 0.03^{b}	42.58± 0.08^{c}	46.80± 0.02^{c}	50.30± 0.02^{c}
T5-Coirpith + Lime(300g/10.76sq.ft)	35.30± 0.05^{e}	44.81± 0.03^{g}	51.55± 0.08^{e}	57.05± 0.06^{f}	59.38± 0.06^{g}
T6- Paddy husk+ Lime (300g/10.76sq.ft)	36.93± 0.04^{h}	43.55± 0.07^{f}	53.01± 0.04^{g}	57.90± 0.22^{g}	62.10± 0.03^{h}
T7- Coir pith+ Yucca extract powder(125mg/kg of feed)	35.75± 0.04^{f}	40.21± 0.04^{e}	45.10± 0.03^{d}	42.40± 0.11^{a}	49.76± 0.02^{a}
T8- Paddy husk+ Yucca extract powder(125mg/kg of feed)	35.06± 0.04^{d}	38.21± 0.03^{b}	41.21± 0.03^{b}	46.25± 0.02^{b}	49.80± 0.02^{b}
T9-Coir pith+ Herbal saponins (125g/MT of feed)	34.78± 0.03^{c}	37.43± 0.03^{a}	40.60± 0.03^{a}	49.18± 0.03^{e}	55.81± 0.06^{f}
T10- Paddy husk+ Herbal saponins (125g/MT of feed)	36.75± 0.03^{g}	38.53± 0.01^{c}	41.11± 0.03^{b}	46.28± 0.08^{b}	52.30± 0.04^{e}
Overall	**35.98± 0.46**	**41.52± 0.47**	**46.95± 0.74**	**51.37± 0.81**	**56.59± 0.85**
F value	**6933.09**	**4822.54**	**1196.84**	**5379.35**	**14229.44**

Mean values within columns bearing at least one common superscript do not differ significantly.
*- Significant (P<0.05) n= number of observations

A significant difference (P<0.05) was observed in litter moisture level in all fortnight observations of 4 to12 weeks of age between treatments. However, the birds reared in coir pith litter and paddy husk litter fed with 125mg of *Yucca schigidera* extract/kg of broiler diet (T_7 and T_8) had lowest moisture level of 49.76±0.02% and 49.80±0.02% than herbal saponins fed treatment groups. This findings did not agreed with Sahoo *et al*., (2015), they fed *Yucca schigidera* extract at 125mg/kg of diet and did not find any significant difference, Maliselo and Mwaanga (2016) recorded 27% of moisture level in feed blended with 0.7% w/w bamboo charcoal. Among litter treatment a significant difference (P<0.05) was noted in moisture level between treatments. Alum treated litter in coir pith (T_3) and paddy husk (T_4) at the rate of 500g/10.76sq.ft has lowest moisture level of 50.2±0.02% and 52.23±0.03% on12th weeks respectively. The moisture level in 8th and 10thweeks also less for the above two treatments. This findings was not in agreement with McWard and Taylor (2000) they recorded 22.9% of moisture in broiler litter treated with alum (100lbs/1000sq.ft), Ruiz *et al*.,(2008) found 31.95% of moisture in litter treated with 10%

of quick lime, Burgess et al.,(1996) also recorded lowest moisture level of 23.51% in poultry litter treated with alum(10:1 wet weight basis).

Conclusion

This study revealed that birds reared in coir pith and paddy husk litter without addition of chemicals had higher level of litter pH and moisture. The birds fed with *Yucca schigidera* extract at 125mg/kg of feed reared in both coir pith and paddy husk litter and litter materials treated with alum 500g/10.76sq.ft in paddy husk litter had lesser pH and moisture level. This study concluded that a combination of *Yucca*extract in feed and alum and lime in litter reduces the pH and moisture in litter thus reduces the litter ammonia level. Hence, this combination is beneficial to maintain litter quality, which directly enhances the productivity without any adverse effect and improve the health of the birds, in order to get more profits.

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