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Effect of forced aeration onmanurial value of compostedpoultry manure#

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Abstract

The demand of poultry products like egg, meat and value added products are increasingandto meet the demand their production has seenincreasing trend. The biowaste generated from the sector is a concernbecause highly nutrient rich manure has a great impact on the environmental pollution. Properly managed poultry manureacts as a very good source of nutrients for plants. Composting is one of the methods used and among these, forced aeration helps to improve the manurial value of compost. Carbon, nitrogen, pH and the C:N ratio are the important parametersof concern before applying manure into agricultural land.The present study on poultry manure co-composted with left over fodder has a great impact in reducing the pH and C/N ratio into ideal range.

Keywords: *Poultry manure, forced aeration, manurial value*

The poultry population is increasing due to demand in meat and egg.In 2019 thetotal population of poultry in India was 851.81 million, 16.81 per cent increase from 2012 (BAHS, 2019). Around 38.33 million tonne of poultry manure was produced per year (Prabakaran and Valan, 2021). Aerobic composting is regarded as an efficient and environmentally friendly method to dispose of organic solid waste. Composting helps in degrading and converting solid organic matters into stable humus-like matter by the action of microorganisms during the process, and

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the composting product could serve as organic bio-fertilizer and conditioner for farmland (Zhao *et al*., 2016). According to He*et al*. (2011) the most effective way of recovering poultry manure was aerobic composting, which turned the organic matter in the waste into humus. Forced aeration accelerated the composting process, and compost matured after 36 days in forced aeration. Compared with continuous aeration, intermittent aeration increased O_2 supply efficiency and reduced the total GHG and NH_3emission (Jiang*et al*., 2015).The most valuable manure from livestock species was poultry manure as it contained high nitrogen, phosphorus and potassium value when compared to other manure(Devi *et al*., 2012).

Materials and methods

Location of study and sample collection

The present study was conducted at College of Veterinary and Animal Sciences, Mannuthy campus of Kerala Veterinary and Animal Sciences University, Pookode, Kerala. The experimental study was conducted for a period of 45 days in the months of FebruarytoMarch, 2023. Left over fodder collected from college farm was used as co-composting material, it was chopped into 1-2 cm size and fresh poultry manure collected from the Eco-farm, College of Veterinary and Animal Sciences, Mannuthy was added to the same. The poultry manure and co-composting material were mixed in 1:1 ratio. Treatment group comprised of six replicates of forced aeration and static bin composting (control). Perforated plastic bins of height and diameter of 53 and 39.8 cm respectively used for composting, were placed under a well aerated roofed area to protect them from adverse environmental conditions. The control group wasset undisturbed during composting. In forced aeration treatment, air was passed through manure every dayat an interval of four hours for five minutes from 8.00 am to 4.00 pm using a combination of pipeswith a blower. The blower had an air volume of 1.2- 3.0m^3/min and flow rate of 0.17L min^{-1} kg^{-1}(Chowdhury*et al.,* 2014).

Analysis

The pH value of the treatments in compost was measured after diluting the sample with distilled water (1:10 W/V) (Lie *et al*.,2012) using eco Tester pH2 at weekly intervals(Oviedo-Ocana*et al.,* 2015).Carbon was estimated from organic matter and nitrogen by Kjeldahl method (Bremner, 1965) at the beginning and end of study.

Variables were analysed by One-way ANOVA followed by Duncan Multiple Range Test (DMRT) in each week. Between weeks of each treatment group repeated measures of ANOVA followed by least significant difference (LSD) test was done. Paired t-test was used for the comparison of initial and final value. Statistical analysis was done by SPSS 24.0 version as per Snedecor and Cochran (1994).

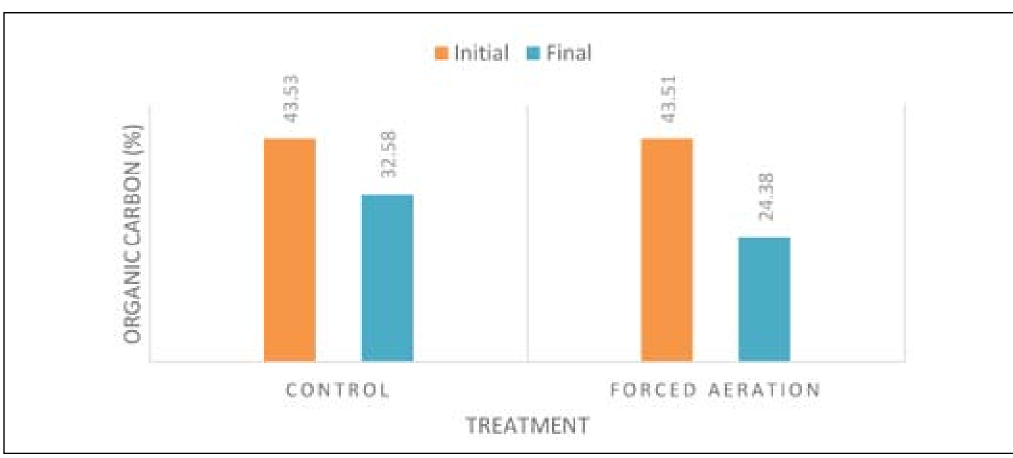

Fig 1. Change in organic carbon (per cent) at beginning and end of poultry manure composting

Results and discussion

Organic carbon and nitrogen

The organic carbon (C) value decreased from ahigh initial toa low final value. No significant difference was observed between the treatment group in the initial phase of composting. At the end of composting high significant difference ($p<0.01$) was noticed in control (32.58± 0.13 per cent), but the lowest C was observed in forced aeration treatment *ie,*24.38± 0.20 per cent. Devi *et al*. (2012) observed similar decrease in pattern in C while composting poultry manure and paddy straw. The loss in C was 51.4 to 31.7 per cent in different co-composting ratios with paddy straw. Significant difference ($p<0.05$) in C per cent was also reported by Elamahadi and Elamin (2018) between aerobic, forced air and anaerobic composting. Rizzo *et al*.(2013) observed similar reduction in C while composting the poultry manure with corn bare cobs, saw dust and shaving at different ratios.

The increase in nitrogen content was observed at the end of composting. At the beginning of composting no significant difference was noted between the treatments. The forced aeration group had the highest significant difference ($p<0.01$) in nitrogen per cent compared to control group at the end of composting.Forced aeration on spent litter composting after 60 days increased N from 1.8 to 2.7 and reached maturity in the forced aeration (Tiquia*et al*., 1996).Similar increase in total nitrogen was observed during the sludge compostby Domene*et al*.(2011). Paddy chaff litter material had nitrogen per centof 1.67 to 5.18 (Thomas *et al.,* 2005)and poultry litterhad nitrogen content of 1.47 per cent. Contrary findings were reported by Tiquia and Tam (2002)composting of poultry waste under forced aeration system with significant lossin N during composting.

pH and C/N ratio

In the present study pH of compost decreased from an initial value of 8.88 ± 0.04 to 7.23 ± 0.05 for forced aeration and from 8.85 ± 0.04 to 7.31 ± 0.06 for the control group. Significant difference ($p<0.01$) in pH was observed at the end of composting. Increase in pH was noted at the end of first week which then gradually decreased. pH of the compostvaried depending upon the raw material, co-compost material and other factors (Schwab *et al.,*1994). Maturity of the compost and microbial activity of compost depend on pH of the compost (Qiu*et al*., 2021).The increased pH up to 9 at initial stage was due to formation

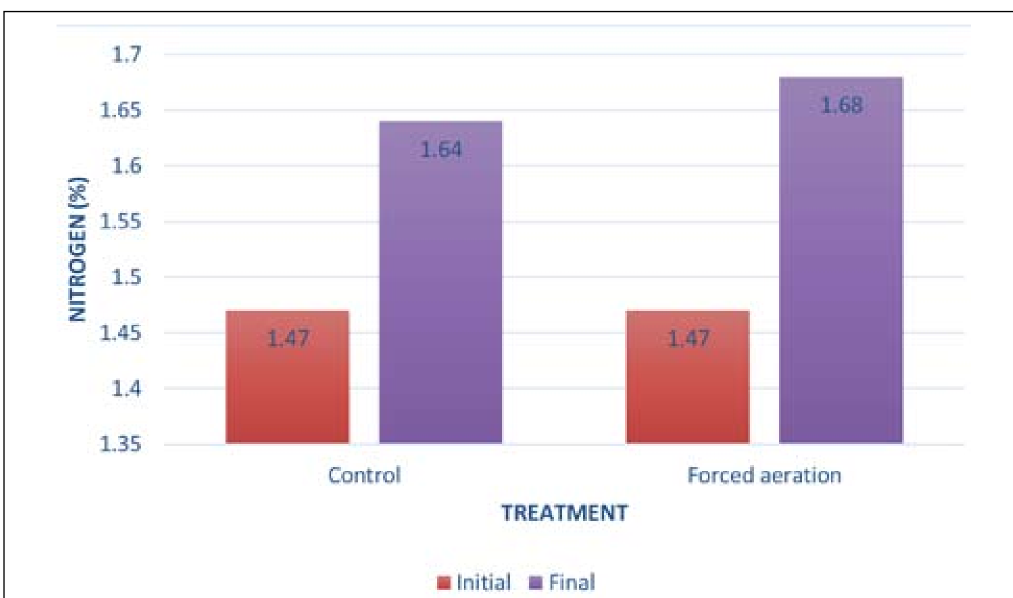

Fig 2. Change in nitrogen (per cent) at beginning and end of poultry manure composting

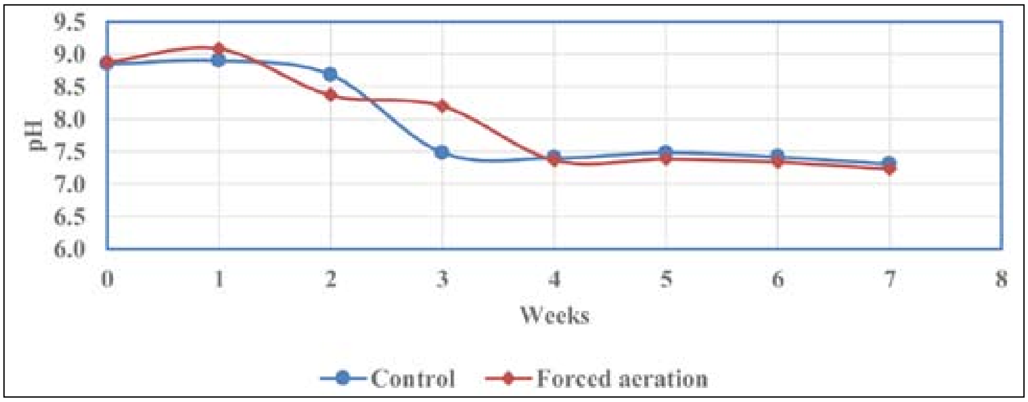

Fig 3. Change in pH during the composting period

of ammonia during ammonification and organic nitrogen mineralisation (Gao*et al*., 2010) and later volatilization of ammoniacal nitrogen and release of H^+ ions from microbial nitrification, the decomposition of organic matter and production of organic and inorganic acids and release of carbon dioxide during composting process reduced the pH gradually (Eklind and Kirchmann, 2000). Zhu *et al.*(2004) observed similar pattern of decrease in pH in swine manure compost with rice straw for 63 days.The composting of poultry manure by inoculation of nitrogen retaining microbial agent changes pH from 6.5 to 8.4 and 8.2 on 25th and 45th day of composting respectively, an increase in pH to maximum and decreased before stabilization of compost (Qiu*et al*., 2021).pH of leachate produced by poultry slaughter and food waste was in a range of 6.14 to 7.4 (Mathew *et al*., 2021)

The C/N ratio reduced from an initial value of 29.65 ± 0.12 to 19.83 ± 0.07 and 29.64 ± 0.19 to 14.64 ± 0.5 for control and forced aeration respectively. During the initial stage of composting C/N ratio was nonsignificant between treatments. Highly significant difference (p<0.01) was noticed between the treatments of composting after 45 days of composting. Lowest C/Nratio was observed in forced aeration group of poultry manure.C/N ratio played a major role for assessing compost maturity (Sun *et al.*, 2019).Flynn and Wood (1996) reported that broiler litter with peanut hulls as bedding material composted with pine bark had C/N ratio of 19 at the end of 12th week of composting. Similar findings were noticed for the control group of poultry manure compost. According to Wang *et al.* (2007) aerated compost had a C/N ratio of 18.6 and 18 on 45th and 50th day of composting respectively. Corresponding reduction in C/N ratio was observed in the turning and forced aeration treatment may be changed into composted poultry manure.Changes noticed in the control, forced aeration and turning treatment of poultry manure compost were similar to the findings of Tong *et al.* (2019).

Conclusion

The forced aeration in poultry manure compost reduced organic carbon, pH and C/N ratio compared to control while composting

Table 1.C/N ratio in control and forced aeration of poultry manure compost

Period	Control	Forced aeration	P-value
Initial	29.65 ± 0.12	29.64 ± 0.19	0.417 ^{ns}
Final	19.83 ± 0.07^{a}	14.64 ± 0.5^{b}	<0.001**
P-value	<0.001**	<0.001**	

*** Significant at 0.01 level (P<0.01); ns non-significant (P>0.05)*

Means having different small letter as superscript differ significantly within a row with left over fodder. At the end of composting there was a slight increase in nitrogen per cent compared to control. The final organic carbon, nitrogen, pH and C/N ratio was in accordance with the standards, but control group of poultry composting had similar reductionpattern and their values were slightly higher than the forced aeration group. It implied that forced aeration helped to attain early maturity on poultry manure compost.

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Conflict of interest

The authors declare that they have no conflict of interest.

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