



**RECYCLING OF POULTRY LITTER THROUGH NOVCOM COMPOSTING METHOD:
A CASE STUDY FROM HOWRAH KRISHI VIGYAN KENDRA, WEST BENGAL, INDIA**

Antara Seal¹, Ranjan Bera¹, Koushik Mukhopadhyay² and Sudipta Mukherjee²

¹Inhana Organic Research Foundation (IORF), 168 Jodhpur Park, Kolkata, West Bengal, India.

²Howrah Krishi Vigyan Kendra, Bidhan Chandra Krishi Viswavidyalaya, Jagatballavpur, Howrah, West Bengal, India

*Corresponding Author Email: mukherjee@rediffmail.com

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ABSTRACT

Poultry litter waste is considered as hazardous raw material and source of environmental pollution, despite its high nutrient content. Poultry litter could be potential organic manure, if it can be treated through a proper biodegradation process to eliminate the pathogens and related phytotoxicity. In the present study Novcom composting method developed by Dr. P. Das Biswas was tried out to develop quality compost from poultry litter for organic soil management, at Howrah Krishi Vigyan Kendra (West Bengal) in 2014. Novcom poultry compost was produced within 21 days and the final compost was brownish in colour with earthy smell which indicated compost maturity. Quality analysis of Novcom poultry compost showed considerably high NPK (4.31 %), but the most significant finding was, very high self-generated microbial population (in the order of 10^{16} c.f.u.), which also pointed towards good post soil application effectivity. Most importantly, high temperature generated during composting ($> 62.8^{\circ}\text{C}$) as well as phytotoxicity bioassay test confirmed that Novcom poultry litter compost was completely free from pathogens and non-phytotoxic in nature and therefore could be safely used in agriculture. The findings indicated that Novcom composting method had the potential for large scale dissemination due to its short biodegradation period, easy adoptability (no infrastructural requirement) and generation of high quality end product (compost) from even a hazardous organic source.

Keywords: Novcom compost, poultry litter, phyto-toxicity, compost quality

INTRODUCTION

Increasing soil health and environmental problems compels the agriculturists towards renewed interest in the organic manures all over the world which forms the basis of sustainable agriculture. One of such potential residues likely to get importance in Indian agriculture is poultry manure which is as such a valuable resource of plant nutrition but a potential source of pathogenic microorganisms too¹. According to United state Environmental Protection Agency Report² poultry manure can contain a variety of pathogens. Risks from manure-associated pathogens can arise when runoff, spills, or infiltration enable microorganisms to reach surface water or groundwater, or comes into contact with food crops. However at the same time, poultry litter is a excellent source of plant nutrient especially for nitrogen (N), phosphorus (P), and potassium (K) and be utilized as an organic manure, if it can be biodegrade properly to eliminates it's risk factors. However, under the existing composting processes, more than fifty percent of the nitrogen in poultry litter is lost during composting, as also reported by Martins and Dewes³, who found average nitrogen losses 59.6 to 69.2 percent from poultry manure. Hence, unless environmentally and economically sustainable management technologies are evolved⁴, practical applicability of poultry litter as a potential resource for sustainable organic soil management remains a big question mark. Hence the present study, biodegradation of poultry litter using Novcom composting method was taken up to evaluate whether the composting process can ensure a safe and quality end product, which can be replicate in farmer's level as a viable option towards organic soil management.

MATERIALS AND METHODS

The study was done at Krishi Vigyan Kendra (KVK), Jagat ballavpur, Howrah in 2014. Analytical work was done partly in the Soil Laboratory, Howrah Krishi Vigyan Kendra and partly at Inhana

Biosciences laboratory, Kolkata. Composting was done through Novcom composting method⁵ utilizing poultry litter and cow dung (80 : 20 ratio) as raw material.

Novcom Composting Method

Novcom solution: Novcom solution is a research product of Inhana Biosciences, (a R&D organization based in Kolkata, India) and is developed under the element energy activation (EEA) principle by Dr. P. Das Biswas, an Indian Scientist who pioneered scientific organic tea cultivation⁶. Radiant solar energy is stored in plants and the bound stored energy components are extracted from energy-rich plant parts using a specific extraction procedure and subsequently potentized in the order of 10^3 to 10^4 ⁵. The solution contains biologically activated and potentized extracts of *Cynodon dactylon*, *Sida cordifolia* L. and *Ocimum basilicum*. This solution is used during erection of the Novcom compost heap and further on days 7 and 14 of composting, i.e. during heap restructuring (as described below). Henceforth, this process is known as the Novcom composting method and the end product as Novcom compost.

Total requirement of Novcom solution: Total 250 ml Novcom solution is required for 1 ton of raw materials (100 ml on day 1 followed by 75 ml each, on day 7 and day 14).

Preparation of Novcom compost

Day 1 : At a selected upland and flat area, a bamboo structure was made to initiate Novcom poultry litter compost heap measuring 6 ft. in length, 4 ft. in breadth. Poultry litter was sprayed to make a 1 ft base layer. This layer was sprinkled thoroughly with diluted Novcom solution (5 ml/ ltr. of water) and over this layer, a layer of cow dung (3 inches thickness) was made followed by a second layer of poultry litter, once again 1 ft. in thickness. The poultry litter layer was once again sprinkled with diluted Novcom solution (5 ml/ ltr. of

water) and the process was continued till the total height reached to about 6 ft.

Day 7 : On the 7th day compost heap was demolished and churned properly. The material was next laid layer wise and after making each layer diluted Novcom solution (5 ml/ ltr.) was sprinkled thoroughly as done on 1st day. After seven days the volume of the composting material decreased due to progress in decomposition process. Hence, to once again maintain the heap height to about 6 ft.; the length and breadth of the heap was maintained at 4.5 ft. x 3.5 ft. respectively. The heap was once again made compact as described earlier.

Day 14 : The same process was repeated as on day 7 and to maintain heap height to about 6 ft., the length and breadth of the heap was further reduced to 4 ft. x 4 ft. respectively.

Day 21 : The composting process was complete and compost was ready for use.

Analysis of compost samples

Six compost samples from Novcom poultry compost heap were collected and analyzed for different quality parameters following the methodology described in Seal et al⁵. Compost Quality Index was calculated as per the methodology of Bera et al⁷.

$$\text{Compost Quality Index (CQI)} = \frac{\text{NVNPK} \times \text{MP} \times \text{GI}}{\text{C/N ratio}}$$

Where NVNPK = Total nutrient value in terms of total (N+P₂O₅+K₂O) percent.

MP = log₁₀ value of total microbial population in terms of total bacteria, total fungi and total actinomycetes. GI = Germination Index.

Classification of compost as per Compost Quality Index

Compost Quality Index (CQI)	Compost Quality Classification
< 2.00	Poor
2.00 – 4.00	Moderate
4.00 – 6.00	Good
6.00 – 8.00	Very Good
8.00 – 10.00	Extremely Good



RESULTS AND DISCUSSIONS

Compost samples were analysed for different quality parameters as per National and international standards⁸ and shown in table 1A and table 1B. Unpleasant smell and flies around the raw poultry litter disappeared 3 to 4 days after the compost heap prepared, which may be due to the rise of temperature within the compost heap due to initiation of prolific microbial activity. High temperature generated within the heap compost (> 62.8°C) for more than 3 continuous day confirm destruction of pathogens within the compost heap⁹. The final compost appeared blackish brown in colour with earthy smell which was an essential criteria for mature compost¹⁰.

Physicochemical properties and Nutrient content of Novcom poultry compost

Moisture in Novcom poultry compost varied from 47.88 to 57.35 percent, which may be placed in the slightly high value range (40 to 50) as suggested¹¹. The predominant use of compost is to mix it with soil to form a good growing medium for plants, for which pH forms an important criteria of consideration (Watson, 2003). PH value of Novcom poultry compost ranged between 6.57 and 8.01, which was around the stipulated range (7.2 to 8.5) for good quality compost¹². The soluble salt concentration is important as it indicate the nutrient status of compost. At the same time very high concentration of soluble salts in the plant growth medium is detrimental to germinating seeds and to plant growth, where as very low electrical conductivity value indicates low nutrient status / poor quality compost. Electrical conductivity value ranged between 2.41 and 3.34 dSm⁻¹, indicating its high nutrient status at the same time being safely below (< 4.0 dSm⁻¹) the stipulated range for saline toxicity as per USCC, 2002¹¹.

Table 1A : Quality parameters of Novcom compost prepared from different raw materials at KVK, Howrah

Sl. No.	Parameter	Novcom Poultry Compost		
		Range Value	Mean Value	± Standard Error
Physical Parameters				
1.	Moisture percent (%)	47.88 – 57.35	54.79	± 1.10
2.	Bulk density(g/cc)	0.39 – 0.47	0.44	± 0.02
3.	Porosity (%)	65.46 – 69.29	68.03	± 0.79
4.	Water holding capacity (%)	239 – 287	263	± 3.37
Physicochemical Parameters				
5.	pHwater (1 : 5)	6.57 – 8.01	7.78	± 0.11
6.	EC (1 :5) dSm-1	2.41 – 3.34	2.89	± 0.33
7.	Total Ash Content (%)	55.12 – 58.74	56.89	± 1.87
8.	Total Volatile Solids (%)	41.26– 44.88	43.11	± 2.02
9.	Organic Carbon (%)	22.92 – 24.93	23.95	± 1.09
10.	CEC (cmol(p+)kg ⁻¹)	197 – 261	232	± 9.14
11.	Compost Mineralization Index	2.21 – 2.56	2.38	± 0.19
Fertility Parameters				
12.	Total Nitrogen (%)	1.69 – 2.14	1.83	± 0.08
13.	Total P ₂ O ₅ (%)	1.28 – 1.36	1.31	± 0.03
14.	Total K ₂ O (%)	0.98 – 1.29	1.17	± 0.07
15.	C/N ratio	13 : 1 – 14 : 1	13 : 1	± 0.16

*Range Value (Mean value) [±S.E.]

The organic matter in compost is a necessary parameter for determining the compost application rate, to obtain sustainable agricultural production. Organic carbon content in Novcom poultry compost ranged between 22.92 and 24.93 percent, qualifying not only the criteria for field application (16 to 38) as per the range¹³ but also the standard suggested value of >19.4 percent for nursery application¹⁴. The CEC of Novcom poultry compost ranged between 197 and 261 cmol (p+)kg⁻¹, which is comparable with the values (36.9 to 228.6 cmol (p+)kg⁻¹) obtained for good quality compost as per Estrada *et al.*, (1987). Compost mineralization index (CMI) expressed as ash content/ oxidizable carbon indicated the ready nutrient supplying potential of compost for plant uptake and varied from 2.21 to 2.56. The values obtained complied the standard range (0.79 to 4.38)¹⁵.

Total nitrogen content in the Novcom poultry compost samples ranged between 1.69 and 2.14 percent, which was well above the reference range (1.0 to 2.0 percent)¹⁶. The highest content of nitrogen (1.83 percent) obtained in case of Novcom compost might indicate higher fixation of atmospheric-N within compost heap under Novcom composting method⁵. Total phosphate (1.28 to 1.36 percent) and total potash content (0.98 to 1.29 percent) were also higher than the minimum suggested standard (0.6 to 0.9 percent and 0.2 to 0.5 percent respectively)¹⁶. C/N ratio varied from 13:1 to 14:1

indicating that all the compost samples were mature and suitable for soil application.

Microbial properties, maturity and phytotoxicity status of compost samples

Self generated microbial population within any compost heap is one of the most important criteria for judging quality of that compost because microbes are the driving force behind soil rejuvenation as well as play a crucial role towards crop sustenance by maintaining the soil-plant-nutrient dynamics. Microbial population (in the order of 10¹⁶ c.f.u to 10¹⁴ c.f.u in case of total bacteria, total fungi and total actinomycetes count) in Novcom compost was significantly higher (at least 10³ to 10⁶ c.f.u times) than the population obtained in case of other compost samples.

Microbial respiration formed an important parameter for determination of compost stability¹⁷. Mean respiration or CO₂ evolution rate of all the Novcom poultry compost samples (2.47 to 3.88 mg/day) was more or less within the stipulated range (2.0 - 5.0) for stable compost¹⁸. The phytotoxicity bioassay test, as represented by germination index provided a means of measuring the combined toxicity of whatever contaminants may be present^{19, 20}. Test value indicated complete absence of any phytotoxic effect in all the compost samples as per the standard value of 0.8 to 1.0¹⁸.

Table 1B: Quality parameters of Novcom compost prepared from different raw materials at KVK, Howrah

Sl. No.	Parameter	Novcom compost		
		Range Value	Mean Value	± Standard Error
Stability Parameters				
16.	CO ₂ Evaluation Rate (mgCO ₂ –C/g OM/day)	2.47 – 3.88	(2.86)	± 0.11
Microbial Parameters (total count) (per gm moist compost)				
17.	Bacteria	16 x 10 ¹⁶ – 23 x 10 ¹⁶	19 x 10 ¹⁶	± 3.1 x 10 ¹⁶
18.	Fungi	12 x 10 ¹⁴ – 23 x 10 ¹⁴	17 x 10 ¹⁴	± 1.1 x 10 ¹⁴
19.	Actinomycetes	9 x 10 ¹⁴ – 11 x 10 ¹⁴	10 x 10 ¹⁴	± 1.3 x 10 ¹⁴
Maturity & Phytotoxicity Parameters				
20.	Seedling Emergence (% of control)	87 – 96	93	± 1.31
21.	Root Elongation (% of control)	85 – 103	95	± 2.25
22.	Germination Index (phytotoxicity bioassay)	0.78 – 0.98	0.88	± 0.04
Compost Quality				
23.	Compost Quality Index (CQI)	4.08 – 5.82	4.89	± 0.37
24.	Compost Quality Class	Good	Good	-

*Range Value (Mean value) [±S.E.]

Compost Quality Index

In order to classify the quality of compost, four specific quality parameters (which were combination of one or more properties that regulate the nutrient mineralization from compost as well as its post soil application affectivity) were taken up to formulate Compost Quality Index⁷. Classification of compost as per quality will enable the producer to get a fair idea about any compost choice and taking decision for soil management accordingly. Compost quality index value of the Novcom poultry compost varied within 4.08 to 5.82, which classified as good.

CONCLUSION

Study of Novcom Poultry composting method and evaluation of the quality of the end product indicated that this is an effective way out towards production of good-quality compost using poultry waste, which is still now considered as potential but one of the most hazardous raw materials. At the same time adopting speedy biodegradation method like Novcom composting method will ensure tapping of most of the Nitrogen within the poultry litter in stable organic form. Also from the practical point of view, the minimum


infrastructural requirement and simplicity in the composting process under Novcom composting method makes the process most convenient for common farmers' community. At the same time, the presence of a very large and diverse population of self-generated micro organisms in the end product, i.e. Novcom compost, indicated its effective post soil application.

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