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# THE EFFECT OF TURNING FREQUENCY ON SOME COMPOST QUALITY

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## ABSTRACT

Composting of organic materials (chicken manure mixed with sawdust) was performed using turned windrow method. The aim was to investigate the effect of turning frequency on some physicochemical properties of the final product of organic materials. Three turning frequency treatments were: no turning (TF0 or static compost), turning every 3 days (TF3) and every 7 days (TF7). The initial physicochemical properties of organic materials were determined. The moisture content of the treatments was adjusted to about 55% at the beginning of composting and no moisture adjustment was done thereafter. The results showed that turning frequency significantly affected moisture content ($P<0.05$), total organic carbon, total nitrogen and carbon to nitrogen ratio of composting piles. Losses were observed in moisture content (54.42-70.24% of the initial moisture content), total organic carbon (18.37-36.60% of the initial total carbon) and total nitrogen (1.01 and 14.61% of the initial total nitrogen for TF0 and TF3, respectively, but it increased 8.40% at the TF7 treatment). The loss of total organic carbon was attributed to organic matter degradation, while those of total nitrogen were largely attributed to ammonia ($NH_3$) volatilization. Moisture loss with turning frequency increased. All the treatments reached maturation at about 70 days when the pile temperatures decreased to near ambient temperature. Losses in total organic carbon and total nitrogen were significantly higher in the turned windrows (treatments TF7 and TF3) than in the static pile (treatment TF0).

**Keywords:** Compost quality, turning frequency, chicken manure, sawdust, moisture content, C:N ratio.

## INTRODUCTION

Sustainable agriculture is of strategic importance for growth and poverty reduction in many developing countries. The adoption of coherent national and international policies to encourage the use of more sustainable production methods, including organic agriculture, could help save costs, develop new markets, improve revenues and enhance food security, while it also could provide considerable scope for climate change mitigation and adaptation (Brown *et al.*, 2009). Wastes generated from poultry farms are highly polluted and, if discharged directly onto soil or into water bodies, can cause undesirable effects such as unproductive crops, dissolved oxygen depletion and eutrophication. Composting is one of the fewest natural processes that is capable of stabilizing organic wastes: the stabilization process destroys most parasites, pathogens, and viruses contained in the waste, considerably reduce odor emissions by reducing levels of biodegradable hydro-carbons, and dries up the waste, making it unattractive to insects (Barrington *et al.,* 2002). Composting also converts organic wastes into a product to be used as a soil conditioner and organic fertilizer (Brake, 1992). The slow release of nutrients from composted poultry manure may lessen adverse environmental effects from leaching of nitrogen (N) in runoff from farmlands (Chang and Janzen, 1996). The disadvantages of composting organic wastes include losses of N (through $NH_3$ volatilization) and of other valuable nutrients, time for processing, cost of handling equipment, available land for composting, odors amongst others (Eghball, 1997). A major advantage of the turned windrow method is the homogenization of the pile. Turning frequency is commonly believed to be a factor which affects the rate of composting as well as compost quality. Turning is often cited as the primary mechanism of aeration and temperature control during windrow composting (Tiquia, 1996). The parameter most widely used for composting is the C:N ratio of the initial composting material; high initial C:N ratio will cause a slower beginning of the process and the required composting time to be longer than usual (Tuomela *et al.,* 2000), while low initial C:N ratio results in high emission of $NH_3$ (Tiquia and Tam, 2000). Moore *et al*. (1997) found that $NH_3$ volatilization from poultry litter increases once the temperature increased and pH rises above 7.0. Temperature is a simple and excellent indicator of how well the composting process is positively progressing and how much $O_2$ is being used (Walker, 2004). Misra *et al.* (2003) reported that high temperatures during composting contribute to the killing of weed seeds and pathogenic organisms. The effects of turning frequency (TF) on composting have been examined (Wong *et al.,* 2001). However, studies about the effect of turning frequency on composting of chicken litter (CL) using turned windrow method with no moisture replenishment are rather scarce. Therefore, the present study aims to examine the effect of turning frequency on some physicochemical properties of chicken manure and sawdust mixture during composting with no moisture replenishment.

## MATERIALS AND METHODS

Chicken manure and sawdust are used in compost preparation. These wastes were organically produced and collected from the organic SEKEM company farm, at Bilbies, Sharkia governorate. In addition to the previously mentioned organic residues, some natural inorganic additives {soil (5% v/v), rock phosphate powder that contains 13% total phosphate (7 $kg/m^3$), feldspar ore powder which contains 10.1% total potassium (7 $kg/m^3$)} and microbial inoculation-were used according to El-Gizawy, (2005). Some of the initial properties of the raw materials were determined according to the method described by Page *et al.,* 1982 and presented in Table 1. The C: N ratio of the chicken manure was raised to reach 30:1 through the addition of sawdust (65 kg sawdust/100 kg poultry manure) according to compost recipe calculator.

**Table 1: Characteristics of organic materials used in compost**

| Characters | Chicken Manure | Sawdust | Mixture |
|---|---|---|---|
| Total Nitrogen % | 3.35 ± 0.13 | 0.17± 0.11 | 1.27±0.21 |
| OM% | 48.46 ± 1.27 | 65.00± 1.18 | 63.42±3.27 |
| C/N Ratio | 9:1 | 220:1 | 30:1 |
| Total Phosphorus % | 0.96 ± 3.21 | 0.20 ± 2.91 | ND |
| Total Potassium % | 0.78 ± 2.14 | 0.11 ± 2.11 | ND |
| Bulk Density $kg/m^3$ | 690 ± 4.56 | 240 ± 3.64 | 310 ± 2.60 |
| Moisture Content % | 60.00 ± 4.84a | 23.00 ± 2.87a | 45.00 ± 3.12 |

**ND: not determined and a: value on wet weight basis**

Sawdust and inorganic additives were mixed with the chicken manure because of its low moisture content (MC), high porosity and C:N ratio. Three piles of raw materials were built, with turning frequencies at no turning (TF0), every 3 days (TF3) and every 7 days (TF7). Each pile was pyramidal in shape with a height of about 0.9 m, 5 m a length and 1.8 m in the base wide. Each pile was three replicates and turned by compost turning machine. The moisture content of all piles was adjusted to 55% at the beginning of composting, and no moisture adjustment was done thereafter. During the composting process, the ambient temperature and the temperatures within each pile at a depth of 30 cm from the pile top were measured daily using a digital compost thermometer. Three randomized compost samples from each pile were collected from the top, middle and bottom of the compost heap twice a week. Samples were collected except for moisture content samples, air-dried for 3 days, then oven-dried at 60 °C for 24 hours and ground, to pass through 0.2 mm sieve screen, labeled, and kept for analysis of total organic carbon. The organic matter content was determined by the wet oxidation methods and total nitrogen was determined by the modified kjeldahl methods according to Cottenie *et al.,* 1982 biweekly until the end of the composting process, pH (1:10 w/v sample: water extract) using a pH meter with a glass electrode. Total potassium (TK after acid digestion) using flame photometer and total phosphorus (TP after acid digestion) using ultra-violet visible spectrophotometer (UNICAM UV1 model) of wavelength 660 nm-were analyzed twice: the first in raw materials and the second in the final product. The mean and standard error of the three replicates were reported for all the parameters measured. Losses of total organic carbon (TC) and total nitrogen (TN) during the composting process were calculated according to the equation (Sanchez-Monedero *et al*., 1996): Y loss (%) = 100 – 100 $(Y_2/Y_1)$
Where: Y represents TC and TN, $Y_1$ and $Y_2$ represent the initial and final concentrations of Y. Weed germination and germination test were done in the final compost according to El-Gizawy, 2005. To compare the effect of TF on compost parameters, one way analysis of variance (ANOVA) statistical testing was performed. Duncan test was used to compare parameter values ($P < 0.05$) using the SPSS 16.0 program for Windows.

## RESULTS AND DISCUSSION

Composting is an aerobic process during which organic wastes undergo biological and physico-chemical reaction, mainly oxidation, resulting in the formation of humus, with the final production of carbon dioxide, water and partially humified organic matter (He *et. al.,* 1992).

**Temperature changes during the composting process.**

Temperature cycle could be used as an indicator of compost maturation. The changes in temperature values of composted heaps (TF0, TF3 and TF7) at different periods are shown in Fig (1). For no turning composting piles (TF0), it was found that initial temperature was 22 $^{o}$C then suddenly increased to reach 69 $^{o}$C on the 10$^{th}$ day. After 10 days, the temperature was gradually decreased but still in the thermophilic stage (more than 45 $^{o}$C) on the 30$^{th}$ day then, it gradually decreased again to reach 38 $^{o}$C at the 45$^{th}$ day and remained almost constant nearly ambient temperature for the later 25 days. Concerning, turning frequency every three days composting piles (TF3), it was found that initial temperature was 22 $^{o}$C on the first day, then suddenly reached to 73 $^{o}$C despite of the existence of first turn on the third day. After the second turning on the sixth day, it dropped to 62 $^{o}$C and the heat to affect the turning during the first 15 days (around 61 $^{o}$C). Temperature suddenly dropped to 45 $^{o}$C on the 16$^{th}$ to the 21$^{st}$ day and then a gradual descent until it reached 38 $^{o}$C on the 24$^{th}$ day (the end of thermophilic stage) and continued around ambient temperature till the composting period indicated maturation.

According to turning frequency every seven days composting piles (TF7), it was found that initial temperature was 22 $^{0}$C on the first day then, suddenly reached 68 $^{0}$C on the 13$^{th}$ day. After 14 days, the temperature was gradually decreased but still in the thermophilic stage (more than 45 $^{o}$C) on the 21$^{st}$ day then, it gradually decreased again to reach 35 $^{o}$C on the 30$^{th}$ day and remained almost constant nearly ambient temperature for the later 40 days, which indicated maturation. It has been noted that temperature curve for TF7 was suitable and agreed with the ideal thermal compost curve.

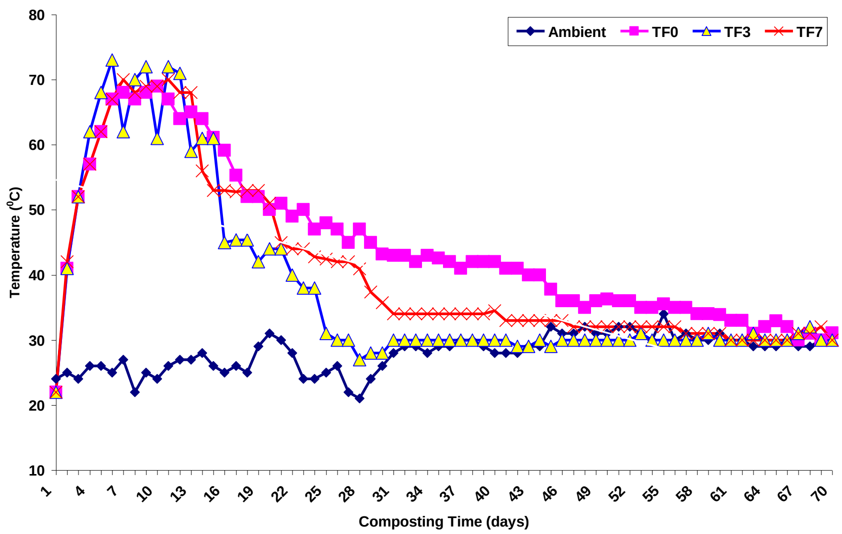


**Fig. 1: Temperature changes during composting process.**

From Fig 1, it could be noticed that the pile temperature changes during the first 2 weeks of composting showed 3-4 fluctuation cycles for turned piles. Hence it was noticed that the temperature of the piles decreased and then it increased every turning until the 14$^{th}$ day. Then temperature did not increase any more and gradually decreased to reach ambient temperature during 24 days of composting for TF3 treatment, 30 days composting for TF7 treatment and 45 days composting for TF0 treatments. This temperature increase could be explained on the basis of the metabolic biochemical reactions of the decomposing microflora. Vournin and Saharinen (1997) reported that the huge temperature rose to nearly 60°C and decreased to temperature close to ambient temperature within two to three months. Temperatures of composting materials follow a pattern of rapid increase to reach 55 to 60 °C and remain near this thermophilic level for several weeks (Rynk, 2000). Temperatures gradually dropped to 38°C (100°F) and finally dropped to ambient air temperature. This characteristic pattern of temperature change over time reflects the types of decomposition and stabilization as composting proceeds (Rynk, 2000). Previous studies on composting have also shown that temperature can be used as a parameter to indicate the rate and extent of composting and maturity of composts (Tiquia *et al*., 1997 and Brown *et al.*, 2009). At the beginning of the composting process, the pile temperatures were notably higher than the ambient temperature more than 55 $^{o}$C (Fig. 1). Within the first seven days, the temperatures reached peak values more than 65 $^{o}$C, an indication that pathogens and weed seeds would have been destroyed (Eghball, 1997). The short thermophilic phase, ranging between 11$^{th}$ and 27$^{th}$ days, is associated with the turned windrow method (Diaz *et al*., 2002). The slight increases in the pile temperatures immediately after each turning operation in the early days of composting were responsible for the rise and fall pattern of the temperature profile and have been reported as the re-activation of the composting process, which is explained by the incorporation of external material into the pile, providing degradable substrate for the microbial biomass (Garcia-Gomez *et al*., 2003).

**Effect of turning frequency on moisture content and pH values**

Figure 2 shows the variation of MC with composting time. By the end of the fourth week, 34.61-59.09% of the total moisture losses had occurred when the pile temperatures were above 45 $^{o}$C and from 54.42-70.24% at the end of tenth week (Table 2). The increase in moisture loss was associated with increase in TF The high rate of moisture loss was likely due to the increase of water vapor depending on high pile temperature (Ogunwande *et al*., 2008 and Brown *et al.*, 2009). Turning frequency had a significant ($P <$ 0.05) effect on moisture content.

Indent pH values, which were between 8.53 and 8.57 (Table 2) increased slightly during the second week to between 8.83 and 8.67 for TF0 and Tf7 respectively, but decreased in TF3 to reach 8.47 at the same time. All treatment pH values were decreased afterwards to final values between 7.43, 7.27 and 7.33 for TF0, TF3 and TF7 respectively, (Fig. 3). Turning frequency did not affect ($P >$ 0.05) the pH of composting piles (Table 2). The high values of pH observed during the second week, when temperature values were above 50 $^{o}$C, may be due to the decomposition of easily degradable organic matter in composting piles and the increase of ammonium volatilizations. The continuous slight decrease in pH values of the three treatments after week 2 may be due to production of organic acids and low moisture content in composting piles (Brown *et al.*, 2009). The changes in pH values could be explained due to the production of $CO_2$ and organic acids result in microbial activity (El-Gizawy*,* 2005). Diaz *et al.,* (2002) showed that during the cooling and maturation stages the pH dropped close to neutral value, then stabilized.

**Table 2: Effect of turning frequency on moisture content and pH values during composting process.**

| Composting Time (week) | Moisture Content % | | | PH values | | |
|---|---|---|---|---|---|---|
| | **TF0** | **TF3** | **TF7** | **TF0** | **TF3** | **TF7** |
| **0** | 55 | 55 | 55 | 8.53 | 8.53 | 8.57 |
| **2** | 38.3 | 25.9 | 35.9 | 8.83 | 8.47 | 8.67 |
| **4** | 36.0 | 22.5 | 30.5 | 8.47 | 8.07 | 8.17 |
| **6** | 28.6 | 19.5 | 27.7 | 7.90 | 7.53 | 7.83 |
| **8** | 25.6 | 17.5 | 24.6 | 7.50 | 7.27 | 7.37 |
| **10** | 25.1 | 16.4 | 22.4 | 7.43 | 7.27 | 7.33 |
| **Losses %** | 54.42 | 70.24 | 59.27 | | | |
| **LSD at 5%** | **0.423** | **0.712** | **1.234** | **NS** | **NS** | **NS** |

**NS: not significant**

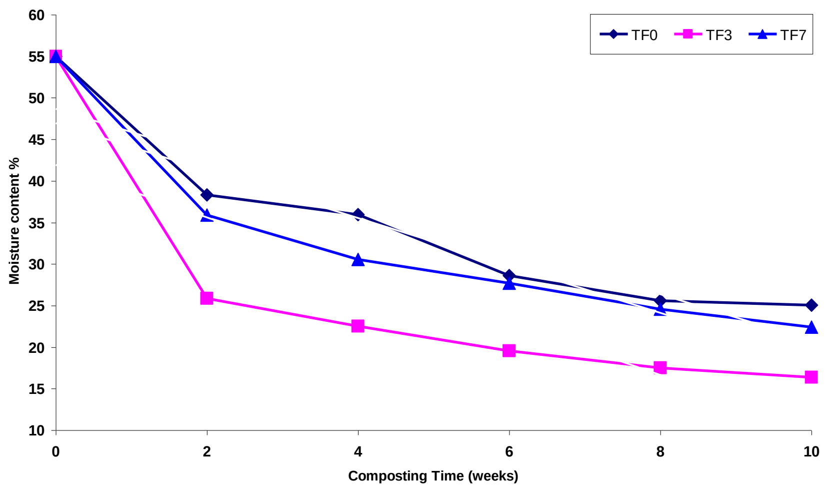


**Fig. 2: Effects of total frequency on percentages of moisture content.**

**Losses of total organic carbon and total nitrogen during composting**

Data presented in Table 3 and figures 4 and 5 show the percentage of losses of total carbon (TC) and total nitrogen (TN) after 4 weeks or after 10 weeks for each during composting process.

**Table 3: Losses of total organic carbon and total nitrogen during composting process.**

| Treatments | Losses* (%) TC | | | Losses* (%) TN | | |
|---|---|---|---|---|---|---|
| | **After 4 weeks** | **After one week** | **After 10 weeks** | **After 4 weeks** | **After one week** | **After 10 weeks** |
| TF0 | 10.76 | 2.690 | 18.37 | 8.92 | 2.230 | 1.01 |
| TF7 | 18.74 | 4.685 | 22.50 | 13.22 | 3.304 | - 8.40 |
| TF3 | 27.06 | 6.764 | 36.60 | 33.70 | 8.426 | 14.16 |

*** Mean and standard error are shown (n = 3).**

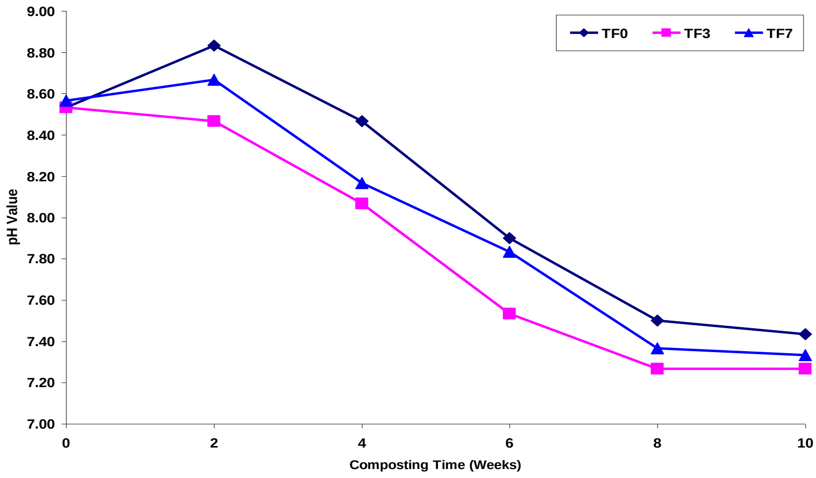


**Fig. 3: Effects of turning frequency on pH values**

It was obvious that increasing losses of either TC or TN were highly significant with increasing TF especially during the first four weeks.

Total carbon loss increased significantly ($P < 0.05$) as TF increased. By the end of composting, cumulative TC losses ranged from 18.37 at TF0 to 36.60% at TF3 of the initial TC content (Table 3). More than half of the total losses (58.57-73.93%) were recorded within the first four weeks of composting, which showed that the chicken manure had a high proportion of easily degradable organic matter.Figure 4 shows the variation of TC concentration with composting time.

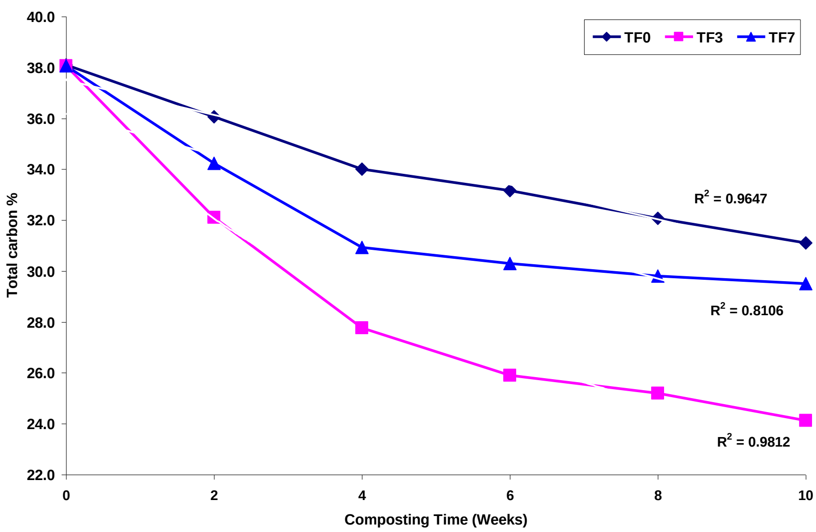


**Fig. 4: Effect of turning frequency on total organic carbon percentages.**

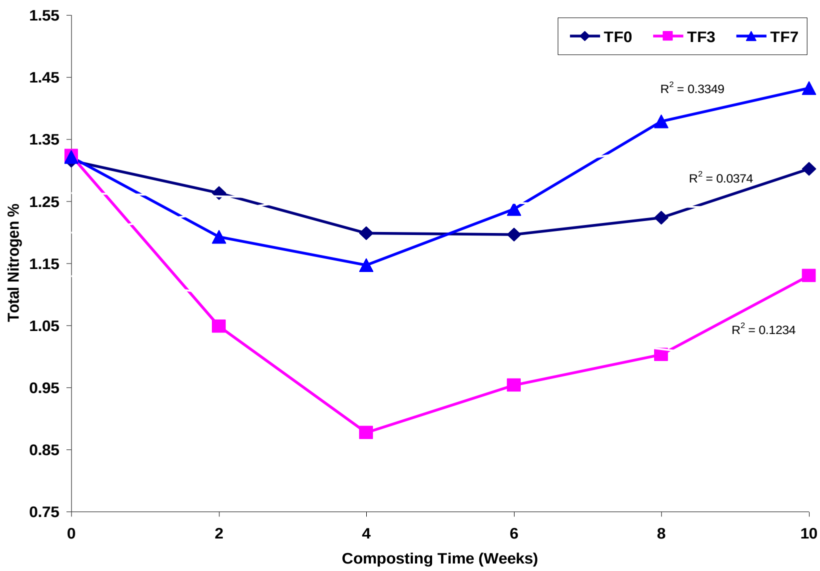


**Fig. 5: Effect of turning frequency on total nitrogen**

The results of the regression analysis showed that the rate of TC loss with composting time was the highest in treatment TF3 (0.676 g/kg TC/ week, $R^2$=0.98), followed by treatment TF7 (0.469 g/ kg TC / week, $R^2$=0.81) high proportion of easily degradable organic matter. The increasing of TC loss (meaning that effective OM degradation) occurred during the composting process and $CO_2$ and Green House Gas emissions at thermophilic compost stage (Baeta-Hall *et al*., 2005 and Brown *et al.,* 2009).

Turning frequency had a significant ($P$ < 0.05) effect on total nitrogen (TN) concentration (Table 4 and Fig. 5). Increase in TN loss was associated with the increase in TF within the first four weeks. The TN losses ranged between 8.92 and 33.70% of the initial TN concentration in the three piles, with the least loss in treatment TF0. Thereafter, total nitrogen percent was gradually increased to reach losses ranged between 1.01 and -8.40% of the initial TN concentration. The highest percentages of total nitrogen losses occurred within the first four weeks of composting when the pile temperature and pH values were above 45 °C and 8.0, respectively. Figure 3 shows the variation of TN concentration during the composting time. The results of the analysis showed that TN concentration decreased faster during the first 4 weeks in treatment TF3 (0.843 g/ kg TN/ week,) than in treatments TF7 and TF0 (0.330 and 0.223 g/ kg TN/ week, respectively). As in previous studies (Cayuela *et al*., 2006, Ogunwande *et al*., 2008 and Luostarinen and Rintala, 2007), a significant part of the TN losses was probably done by $NH_3$ volatilization which was favored by high temperature and pH values in this period. The high losses may have been due to the small size of piles involved in mineralization of organic matter by micro-organisms (Grigatti *et al*., 2004).

The enhancement of total nitrogen with time was due to the increases in the activity of compost inocula at the beginning. Indeed, it is well-known that this activity is inhibited at temperatures above 40 °C (Kaloosh, 1994).

All treatments TF0, TF7 and TF3 had decreased in the final values of their C:N ratios (Fig. 6). Turning frequency affected ($P$ < 0.05) the change in the C:N ratios. The decrease in the C:N ratios of all treatments could be attributed to vigorous $NH_3$ volatilization during composting (Eghball *et al*., 1997; Tiquia and Tam, 2000). Similar findings were obtained by Kaloosh (1994) who indicated that C/N ratio tended to be narrow with time in compost heaps due to gaseous loss of carbon as $CO_2$ while the nitrogen remained more tightly bounded in organic combination.

Data in table (4) presented the effect of turning frequency on the final compost parameters. It revealed that turning frequency every seven days in this case is the best specially for total carbon, total nitrogen, C/N ratio, weed germination and germination test of cress as compared to unturned or turning frequency every three days. It is also expected that will be less in the final product cost with less air and environment pollution.

**Table 4: Effect of turning frequency on final compost parameters**

| S | Compost parameters | Turning Frequency | | |
|---|---|---|---|---|
| | | TF0 | TF3 | TF7 |
| 1 | Temperature °C (ambient 29) | 31 | 29 | 29 |
| 2 | Moisture content % | 25.1 | 16.4 | 22.4 |
| 3 | pH (1:10 $H_2O$ $_{ext.}$) | 7.43 | 7.27 | 7.33 |
| 4 | Total Carbon % | 31.1 | 24.1 | 29.5 |
| 5 | Total Nitrogen % | 1.302 | 1.130 | 1.433 |
| 6 | Carbon/Nitrogen | 23.9 :1 | 21.4 :1 | 20.6 :1 |
| 7 | Total Phosphorus % | 0.982 | 1.240 | 1.318 |
| 8 | Total Potassium % | 1.246 | 1.652 | 1.687 |
| 9 | Weed Seeds | + | - | - |
| 10 | Germination Test % | 82 | 91 | 92 |

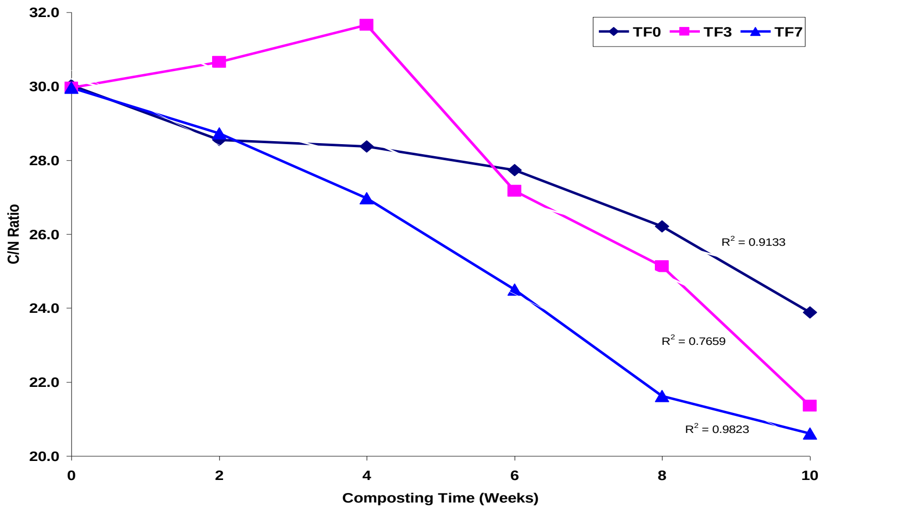


**Fig. 6: Effect of turning frequency on carbon/nitrogen ratio**

## Conclusion

Turning frequency did not affect temperature and pH of composting piles but it affected moisture content, total organic carbon, total nitrogen, and C:N ratio. Final values showed that C:N ratio decrease and losses in total organic carbon and total nitrogen were higher in the turned windrows within the fourth weeks than in the unturned windrow. Turning frequency every seven days is a better treatment during the first month of composted chicken manure.

## REFERENCES

Baeta-Hall L., Saagua M.C., Bartolomeu M.L., Anselmo A.M., and Rosa M.F., 2005. Bio-degradation of olive oil husks in composting aerated piles. Bioresource Technol., 96, 69-78.

Barrington S., Choiniere D., Trigui M., and Knight, W., 2002. Effect of carbon source on compost nitrogen and carbon losses. Bioresource Technol., 83, 189-194.

Brake J.D., 1992. A Practical Guide for Composting Poultry Litter. MAFES Bulletin, 981. http://www.msstate.edu/dept/poultry/complit.htm.

Brown S., Chad K. and Scott S., 2009: Greenhouse Gas Balance for Composting Operations. J. Environ. Qual. 37:1396–1410.

Cayuela M.L., Sanchez-Monedero M.A., and Roig A., 2006. Evaluation of two different aeration systems for composting twophase olive mill wastes. Process Biochem., 41, 616-623.

Chang C. and Janzen H.H., 1996. Long-term fate of nitrogen from annual feedlot manure applications. J. Environ. Quality, 25, 785-790.

Cottenie, A.; Verloo, M.; Kiekens, L.; Velghe, G. and Camerlynck, R.(1982). Chemical Analysis of Plants and Soils Laboratory of Analytical and Agro chemistry State University . Ghent- Belgium.

Diaz M.J., Madejon E., Ariza J., Lopez R., and Cabrera F., 2002. Co-composting of beet vinasse and grape marc in windrows and static pile system. Compost Sci. Utilization, 10(3), 258-269.

Eghball B., 1997. Composting Manure and other Organic Residues. Inst. Agric. Natural Resources, University of Nebraska Press, Lincoln, NB, USA. <http://ianrwww.unl.edu/pubs/wastemgt/g1315.htm>.

Eghball B., Power J.F., Gilley J.E., and Doran J.W., 1997. Nutrient, carbon and mass loss during composting of beef cattle feedlot manure. J. Environ. Quality, 26, 189-193.

El-Gizawy, E. S., 2005. The role of compost quality and compost tea to enhance organic agriculture system. . Ph.D. Thesis, Soil Science Dept., Fac. of Agric. Alex. Univ. Egypt.

Gracia-Gomez A., Roig A., and Bernal M. P., 2003. Composting of the solid fraction of olive mill wastewater with olive leaves: organic matter degradation and biological activity. Bioresource Technol., 86(1), 59-64.

Grigatti M., Ciavatta C., and Gessa C., 2004. Evolution of organic matter from sewage sludge and garden trimming during composting. Bioresource Technol., 91, 163-169.

He, X. T.; Traina, S. J. and Long, T. (1992). Chemical properties of municipal solid waste composts. J. Environ. Qual. 21:318- 329.

Kaloosh, A. A. (1994). Changes in composition of compost prepared from different organic materials and its effect on *Vicia faba* yield. J. Agric. Sci., Mansoura Univ.19:829-836.

Luostarinen, S., and J. Rintala. 2007. Anaerobic on-site treatment of kitchen waste in combination with black water in UASB-septic tanks at low temperatures. Bioresour. Technol. 98:1734–1740.

Misra R.V., Roy R.N., and Hiraoka H., 2003. On-farm composting methods. FAO Corporate Document Repository. <http://www.fao.org/docerp/007/y5104e/y5104e05.htm>.

Moore P.A., Huff W.E. Jr., Daniel T.C., Edward D.R., and Saucer T.C., 1997. Effect of aluminium sulfate on ammonia fluxes from poultry litter in commercial broiler houses. Transactions of the ASAE, 2, 883-891.

Ogunwande G.A., Osunade J.A., Adekalu K.O., and Ogunjimi L.A.O., 2008. Nitrogen loss in chicken compost as affected by carbon to nitrogen ratio and turning frequency. Bioresource Technology (in press).

Page, A.L.; Miller, R.H. and Keeney, D.R. (1982). Methods of Soil Analysis. Part(2). Amer. Soc, Agr. Inc. Madison.

Rynk, R. (2000). Large-scale contained composting systems. BioCycle 1:67-73.

Sanchez-Monedero M.A., Bernal M.P., Roig A., Cegarra J., and Garcia D., 1996. The effectiveness of the Rutgers system and the addition of bulking agent in reducing N-losses during composting. In: Progress in Nitrogen Cycling Studies (Eds O. Van Cleemput, G. Hofman, A. Vermoesen). Dordretch: Kluwer Academic, 133-139.

Tiquia S.M., 1996. Further composting of pig manure disposed from the pig-on-litter(POL) system in Hong Kong. Ph.D. Thesis, Univ. Hong Kong Pokfulam Road, Hong Kong.

Tiquia S.M. and Tam N.F.Y., 2000. Fate of nitrogen during composting of chicken litter. Environ. Pollution, 110, 535-541.

Tiquia S.M., Tam N.F.Y., and Hodgkiss I.J., 1997. Effects of turning frequency on composting of spent pig-manure sawdust litter. Bioresource Technol., 62, 37-42.

Tuomela M., Vikman M., Hatakka A., and Itavaara M., 2000. Biodegradation of lignin in a compost environment: A review. Bioresource Technol., 72(2), 169-183.

Vuorinen, A.H. and Shahrinen, M.H. (1997). Evolution of microbiological and chemical parameters during manure and straw co- composting in a drum composting system. Agric. Eco. and Environ. 66: 19- 29.

Walker F., 2004. On – Farm Composting of Poultry Litter. The Agricultural Extension Service, Univ. Tennessee, Institute Agric.

Wong J.W.C., Mak K.F., Chan N.W., Lam A., Fang M., Zhou L.X., Wu Q.T., and Liao X.D., 2001. Co-composting of soybean residues and leaves in Hong Kong. Bioresource Technol., 76(2), 99-106.

**تأثير التقليب المتكرر على بعض مواصفات جودة الكمبوست**

**عيد سليمان على الجيزاوي**
**قسم بحوث الميكروبيولوجيا الزراعية – معهد بحوث الأراضي والمياه والبيئة – مركز البحوث الزراعية- مصر.**

تم إنتاج كمبوست من سبلة الدواجن المضاف إليها نشارة الخشب بأسلوب الكمبوست المقلب وكان الهدف الأساسي من إجراء هذا البحث هو التحقق من تأثير عمليات التقليب المتكرر للكومبوست على بعض الخواص الفيزيائية والكيميائية للكمبوست الناتج. كان هناك ثلاث مستويات من التقليب – الأولى بدون تقليب نهائي (نظام الكمبوست الساكن) والثانية التقليب كل 3 أيام والثالثة التقليب كل 7 أيام. تم تحليل الصفات المدروسة في المواد الخام أولا وتم ضبط مستوى الرطوبة في خليط المواد الخام عند مستوى حوالي 55 ٪ في بداية تصنيع الكمبوست وعدم إجراء أي تعديل في الرطوبة بعد ذلك حتى النضج. وأظهرت النتائج أن تكرار عمليات التقليب كان له تأثيره المعنوي (*P<0.05*) على محتوى الرطوبة و الكربون الكلى والنيتروجين ونسبة الكربون إلى النيتروجين في أكوام الكمبوست .

الفقد الملحوظ في المحتوى الرطوبى تراوح من 54.42إلى 70.24 ٪ من محتوى الرطوبة الأولية ، الفقد في الكربون الكلى تراوح من 18.37 إلى 36.60 ٪ من نسبة الكربون الكلى الأولي لكل المعاملات أما النيتروجين الكلي فكان الفقد 1.01 و 14.61 ٪ من النيتروجين الكلى الأولي للمعاملات بدون تقليب والمقلب كل 3 أيام على التوالي لكنه زاد بنسبة 8.40 % في معاملة التقليب كل 7 أيام . والفقد في الكربون العضوي الكلى قد تعزى إلى عمليات الأكسدة والتحول إلى غازات مثل أول وثاني أكسيد الكربون ، في حين أن الفقد في النيتروجين الكلى كانت تعزى إلى حد كبير إلى تطاير الأمونيا في صورة غازية. فترة الكمر كانت في حوالي 70 يوم وهى عندما انخفضت درجات الحرارة في الكمبوست لدرجة حرارة الهواء الجوى المحيط . الفقد في نسب الكربون الكلى والنيتروجين الكلى كانت أعلى بشكل ملموس في معاملات الكمبوست المقلب كل 3 وكل 7 أيام عن الكمبوست الغير مقلب وخاصة في الأربع أسابيع الأولى من التصنيع.

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