Evaluation of nitrate and nitrite quantities releasing from the left tea leaves at Kitabi industry by compost method

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Abstract: Beside greenhouse gas and industry in global warming, there are other core contributors in climate change which are mostly not recognized. The degradation of left tea leaves showed the distribution of nitrate and nitrite derived from the nitrogen are directly going to the atmosphere and this lead to the ozone degradation too. In this paper, we make use of the Kjeldahl method, colorimetric, volumetric and spectrometry atomic absorption to analyze the quantity of nitrite and nitrate into the compost and show the possible reduction of emission these chemical components during the decomposition process. The analysis of results showed that the quantity of nitrate found in the surface was 66.3 ppm and 90.61 ppm in the fosse, for the nitrite 14.76 ppm on the surface and 22.96 ppm in the fosse. The comparison reveals that the method used in this investigation is efficient and powerful tool in reducing the quantity of harmful chemical compounds that are being released during the process of degradation.
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1. Introduction

Tea is perhaps the most used leave in the world; this leave was for the first time introduced in Rwanda in the year 1952 [1]. It is important to point out that, nowadays tea is the main source of income in Rwanda this was shown in the investigation done in 2012 by [1]. Most plantations of tea in Rwanda can be usually found on hillsides altitude ranging from 1900 to 2500 m and also on well drained marshes at an altitude ranging from 1550 to 1800 m. A careful investigation undertaken by NAEB in 2012 has showed that, the total quantities of tea exported in Rwanda was estimated to 19 828 021 in 2008, 18 775 683 in 2009, 22 350 151 in 2010 and finally 24 671 838 in 2011 [1]. From the results obtained from this investigation we can see that as time goes the quantity of exportation of this in Rwanda increases.

After, the harvest all leaves are transported to a specific area where a care selection of good and bad leaves will be done. After the section, the waste are sometime dumped in some empty land. The main idea behind the dumping is that, these wastes will be decomposed and transformed to good fertilizer. However, it is perhaps important to make use of some chemical knowledge to show that, during this process there is another important chemical reaction taking place. The chemical reaction is the emission of NO_3^- generally called nitrate and the second one is NO_2^- called nitrite. Now when these two compounds are in contact with the air, there is another important process taking place called photochemical which consist of the following

$$NO_2^- + hv \longrightarrow NO^* + O^*$$

The first component of the right side of the above equation is very harmful, in particular this compound can cause skin cancer.

$$2NO_3^- + 1/2O_2 + 4H^+ \longrightarrow 2HNO_3 + H_2O$$

Again the second compound of the right side is quit harmful. This can deteriorate the living tissue for instance the skin and flesh.

The key motivation of this work is to present a suitable and efficient method called "Decompostage"[3-4], which is a scientific method used to control the decomposition of organic compounds. An interesting reader can found other studies about the tea leaves waste in the following works [5- 13].

2. Evaluation of waste quantities in Kitabi tea industry

During our investigation that took place in the Kitabi tea industry we found out that in general, organic tea waste from Kitabi tea industry has estimated around 1000 kg per week. In order to assess the average quantity of waste in this industry, a minimum period of time was spend to measure the daily production on one hand and on the other hand the average daily waste produced by the industry. The core idea behind this investigation was to have a clear picture of the daily waste released by the industry in order to minimize the quantity of pollutant.

In fact, from the green tea leaves productions from 2003 up to 2008 as shown below in table, it is perhaps possible to put in evidence the quantity lost which was very important. Generally speaking it is obvious see that the more leave of tea the industry produce, the more waste is significant. Therefore in the below table we present the quantities of production of some industries in Rwanda this will also include the Kitabi industry which is among the major producer in Rwanda.

Table 1: **Approximate production of tea leave in all industries in Rwanda from 2003 to 2008 (in Kg)[14]**

Unit	2003	2004	2005	2006	2007	2008
Mulindi	9286082	8731340	11271253	11148716	13904534	13678308
Shagasha	8304331	7079048	8568525	8882328	8983909	8416102
Gisakura	7947499	6912341	7802875	8070487	9209332	8563521
Mata	3889086	3376914	3535977	4326502	6870547	7411882
Kitabi	5943801	5267756	4968648	5848124	7409745	7451741
Rubaya	6027139	5770962	6613999	3974990	0	0
Nyabihu	2700023	2794659	3538853	2339116	0	0
Pfunda	5139920	4242623	0	0	0	0
Gisovu	5051689	4726258	5302738	5069642	7211168	7462706
Nshili	2320895	1935155	1919587	244355	0	0
Nkuli	0	0		0	0	0
TOT OCIR	56 610 465	50837056	53522455	49904260	53589235	52984260
Nshili privet				2077457	2668913	2551519
Assopthe	8194730	7257937	9160857	8363615	10779740	12373187
Sorwathe	2477315	2641513	3448056	3144716	4523021	
Pfunda TC+ATP	0	806242	5437043	5846109	6583270	7550706
Rubaya RMT				2264835	5228341	5094844
Nyabihu RMT				1407267	4538952	5143871
TOT privets	10672045	10705692	18045946	23103999	34322237	32714127
	67282510	61542748	71568411	73008259	87911472	85698387

It is important to point out that the value zero in the above table shows that the industry did not produce tea leave.

3. Methodology

In order to show the efficiency and possible application of the compost method, we in this section present the discussion underpinning the description of the method. In order to achieve our goal, a careful collection of quantity of tea leaves from Kitabi industry was done. These tea leaves were put in a bags this was to avoid any king of extra contamination that could possible lead to a fast decomposition. The total quantity was divided into two portions, one part was deposited in the fosse and covered properly and the other part was deposited on the empty surface. After one month, we collected the sample of compost from the surface and the fosses respectively for a careful analysis. The results obtained from this investigation are recorded in the table below (Table 2).

Table 2: Experimental results

Species	Quantities on Surface	Quantities in the Fosse
Ammoniac nitrogen	9.38	20.86
Nitrate	66.3	90.61
Nitrogen	2.84	2.79
Nitrite	14.76	22.96

In the following section, we present the discussion underpinning the comparison of results obtained from the decompose method and the other one. This will be presented in form of graphs.

4. Data analysis

Physical- chemical parameters controlled during compost of tea waste gave information about progress in processing of maturation of compost. Those are dimensions of waste tea leaves, humidity, temperature, aeration and oxygenation, odor and fermentation, pH, ammoniac nitrogen, nitrate, nitrite and carbon-nitrogen ratio.

5. Results and discussion

5.1.Dosage of ammoniac nitrogen

In the below table 3 we listed the dosage of ammoniac nitrogen.

Table 3: Dosage of ammoniac nitrogen

	On surface	In fosse
Ages (month)	$N\text{-}NH_4$ (ppm)	$N\text{-}NH_4$ (ppm)
1	61.74	42.84
2	18.06	33.74
3	20.58	41.44
4	9.38	20.86

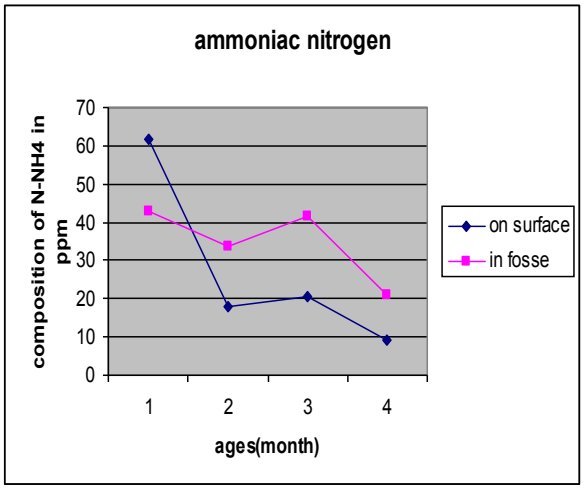

Figure 1: ***Comparison of quantities of ammoniac nitrogen for surface and fosse***

"A Chinese proverb says and image is equivalent to 10000 words" thus from the above figure 1 one can clearly see that the quantity of ammoniac nitrogen remaining in the fosse after emission is high than the quantity on the surface this implies the quantity of nitrogen released in the atmosphere from the surface was high than the one released from the fosse.

5.2. Dosage of nitrate

The results listed in the below table 4 represent the concentration of nitrate in ppm.

Table 4: Dosage of nitrate

	On surface	In fosse
Age (month)	N-NO_3 (ppm) NO_3^-(ppm)	N-NO_3 (ppm) NO_3^-(ppm)
1	13.5 59.67	10 44.5
2	12.5 55.25	13 57.46
3	21.5 95.03	22.5 99.45
4	15 66.3	20.5 90.61

The evolution of nitrite is due to the different parameters such as temperature, humidity and pH during the nitrification. But the conditions undesired the nitrification favors in the nitratation. Those explain the increasing and the decreasing in NO_2^- and NO_3^- [2].

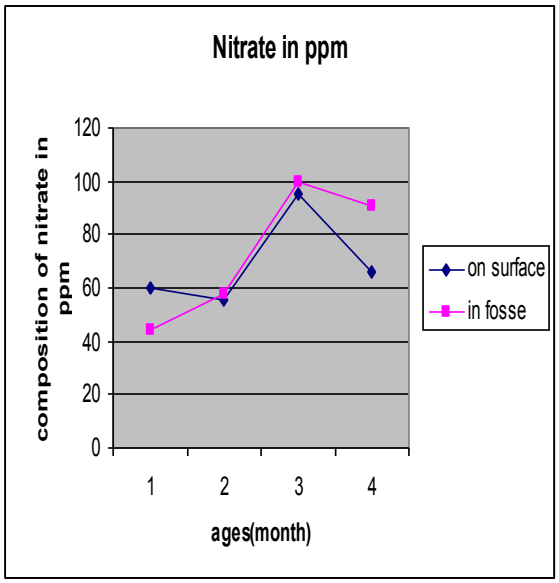

Figure 2: ***Comparison of quantities of nitrate for surface and fosse***

5.3. Dosage for nitrogen

The below table provides the comparison between the total quantity of nitrogen on the surface and fosse respectively.

Table 5: Comparison of to nitrogen on surface and fosse

	on surface	In fosse
Age (month)	N (%)	N (%)
1	2.69	2.45
2	3.14	3.14
3	2.89	3.28
4	2.84	2.79

The nitrogen exists in a big quantity because first of all the tea leaves contain twenty amino acids and also in growth of tea leaves it's necessary more nitrogen. Therefore in compost of tea leaves no need of addition of purin as indicated when nitrogen is lowest in compost [3].

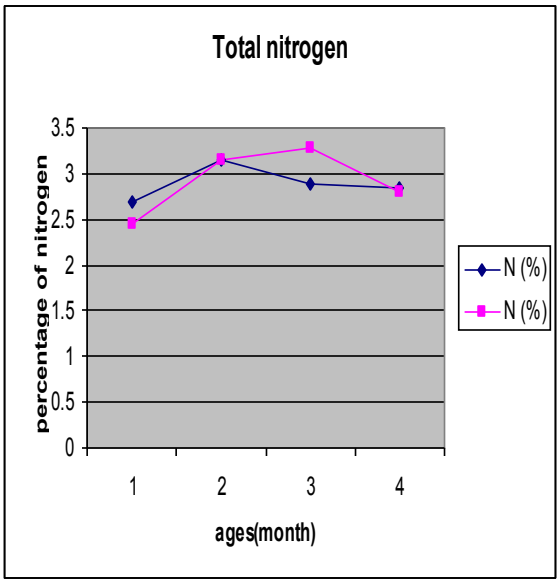

Figure 3: ***Comparison between the total quantity of nitrogen on the surface and fosse respectively.***

5.4. Dosage of nitrite

We listed in the below table the quantities of nitrite from the surface and the fosse respectively.

Table 6: ***results for dosage of nitrite***

	On surface		In Fosse	
Age (month)	NO_2-N (ppm)		NO_2-N (ppm)	
1	1.5	4.92	2.25	7.38
2	18	59.04	11.05	36.24
3	1.3	4.43	4	13.12
4	4.5	14.76	7	22.96

From the above graphs it can be concluded that, when the nitrate increases the nitrite decreases, which is interesting because it is to know how much quantities we shall avoid to be in contact with the existing environmental matter and to negative effect on them.

When we observe both composts (on surface and in fosse), the advantage relies in fosse than on surface, the high concentration in nitrate and in nitrite were observed in fosse compost which indicated that the quantities that went to the atmosphere were controlled in fosse.

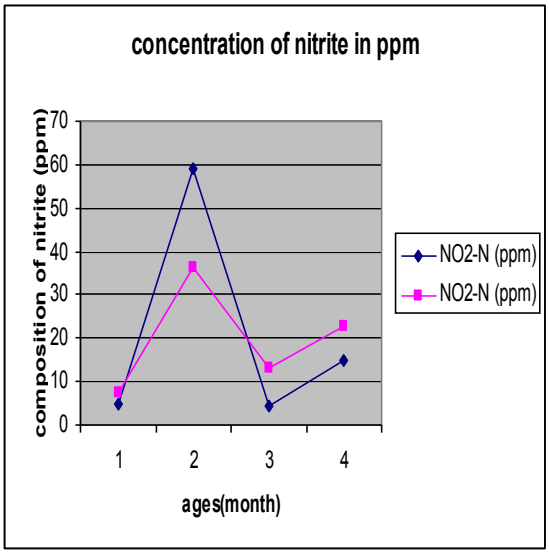

Figure 4: ***Concentration of nitrite in ppm from the surface and fosse***

5.5. Evolution of pH

Table 7: Results for evolution of pH

	On surface	On surface	In fosse	In fosse
Age(days)	pH water	pH KCl	pH water	pH KCl
1	7.7	7.1	7.65	7
10	8.12	7.61	8.17	7.5
30	6.39	5.4	5.81	5.16
60	5.22	4.89	5.06	4.42
90	4.93	4.45	4.42	4.34
120	4.78	4.02	4.02	4.4

The below table recorded the evolution of pH on both surface and fosse

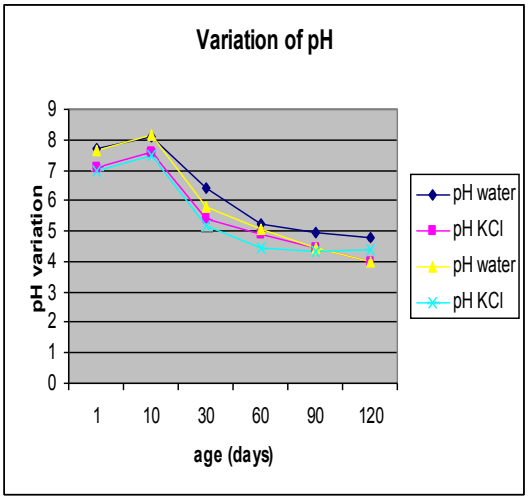

Figure 5: Variation of the pH

From the above figure 5 we can see that, due to the liberation of some gases such as NH_3 NH_4^+ as

shown in below reaction, $RNH_2 \rightarrow NH_3 + H_2O$ +organic matter $\rightarrow NH_4^+ + OH^-$ + organic matters, the pH of our tea compost increased in first time, but at maturation, the pH decreased due to the stabilization and complete reactions.

5.6. Evolution of ratio C/N

Table 8: ***Results showing the evolution of ratio C/N***

	On surface	In fosse
Age (month)	Ratio C/N	Ratio C/N
1	14.1	15.9
2	10.0	10.8
3	10.2	8.86
4	8.15	9.43

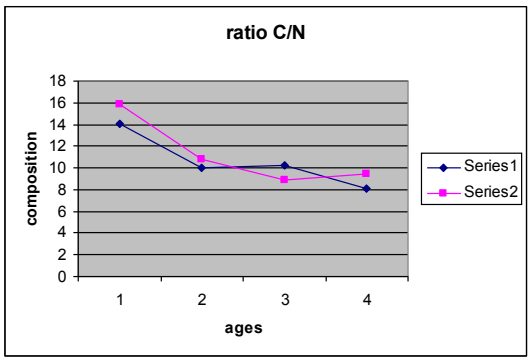

Figure 6: Evolution of ratio C/N

From the above figure 6, there is decreasing of carbon quantity in function of time. This is due to the reaction of oxidation in aerobic fermentation by microorganism

$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + 6\,H_2O$

6. Conclusion

The left of tea leaves can be taken into consideration to protect the environment. As long as we take care and we use the method of compost in fosse, we can decrease the significant quantities of nitrate and nitrite which is harmful to human being and also which can be considered participating in global warming. The approach used in this work showed that this reduction can be successfully achieved. Other research about some enviromental studies can be found in [15-18].

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