ASSESING THE DEGRADATIVE ACTIVITY OF MIXED MICROBIAL CULTURES ON DOMESTIC FOOD WASTES (DFW)

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Abstract

Domestic food wastes were inoculated with mixture of microorganisms, left to decompose for 42 days at ambient temperature (28oC) during which samples were taken at 7-day intervals for microbial analyses using standard microbial methods. Different species of fungi namely *Aspergillus flavus, Aspergillus fumigatus, Rhizopus nigricans, Varicosporium elodeae, Trichoderma roseum, Penicillium italicum* and *Rhizopus nigricans* were found to inhabit the domestic food wastes. The test bacteria were confirmed to be *Lactobacillusdelbrueckii, Geobacillus stearothermophilus, Bacillus megaterium, Lactobacillus jensenii, Bacillus sphaericus, Macromonnas mobilis, Azotobacter, Listeria monocytogenes* and *Kurthia* species.The microbial load showed that DFW sample inoculated with *Azotobacter* and *Penicillium italicum* had the highest cell count ($2.7x10^7$ cfu/ml) while DFW sample inoculated with *Kurthia* speciesand *Aspergillus niger* had the lowest microbial load of (1.2×10^4 sfu/ml) at week 6.

Keywords: domestic food wastes, microorganisms, composts, composting, degradative

1. Introduction

Composting is a managed system that uses the activity of aerobic microorganisms to degrade raw organic materials, such as yard trimmings, so that the end-product is relatively stable, reduced in quantity (when compared to the initial amount of waste), and free from offensive odors (Mcleod and Eltis,2008). Composting has been a way to recycle waste and a critical means in reducing the volume of garbage needlessly sent to landfills and also provides a means of supplying necessary nutrients to plants (Cornell Waste Management Institute, 2004). The composting process is currently viewed primarily as a waste management method to stabilize organic waste, such as manure, yard trimmings, municipal biosolids, and organic urban wastes. The stabilized end-product (compost) is widely used as a soil amendment to improve soil structure, provide plant nutrients, and facilitate the revegetation of disturbed or eroded soil (Apun *et al*., 2000). Compost is biologically active. When this product is ploughed into the soil, it supplies a range of microorganisms increasing soil's microbial diversity, populations and activity (Arnedo and Parrado, 2002). With the increased level of activity of the microbes there is accelerated extraction of the nutrients from the soil and the organic materials, making them available for root up-take and plant development. (BBC Laboratories, 2004). The objective of the study is therefore to assess the degradative ability of mixed microorganisms isolated from domestic food wastes during composting.

2. Materials and methods

The domestic food waste (DFW) used were: vegetables ('Ugu': *Telfairia occidentalis*) 'Tete': *Amaranthus* species), pulp and peels of banana and oranges, boiled rice grain (Capricorn Brand, Thailand), green grass (*Centrosema pubescence*) and chicken droppings. The test organisms used were *Lactobacillus delbrueckii, Geobacillus stearothermophilus, Bacillus megaterium, Lactobacillus jensenii, Bacillus sphaericus, Macromonnas mobilis, Azotobacter, Listeria monocytogenes, Kurthia* species, *Penicillium italicum, Aspergillus niger, Varicosporium elodeae* and *Rhizopus nigricans*.Samples of domestic food wastes (DFW) were collected at different depths (2 cm, 5 cm and 10 cm) of the dump wastes in Akure main dumpsite situated at Oda road Akure, Ondo State. Individual DFW listed above were collected from Akure main market into separate sterile plastic bowls.

Inoculation of the prepared domestic food wastes

The bacteria and fungus were inoculated separately into sterile (10 ml) nutrient brothand Saboraud dextrose broth. The grown cells were combined into twos based on mixing bacterium with fungus, bacterium with bacterium, fungus with fungus, and inoculated aseptically into each separate portion of the sterilized DFW. Thus, the total number of combinations was seven (*Lactobacillus delbrueckii* + *Geobacillus stearothermophilus, Bacillus megaterium* + *Lactobacillus jensenii, Bacillus sphaericus* + *Macromonnas mobilis, Azotobacter* + *Penicillium italicum,Listeria monocytogenes* + *Aspergillus niger, Kurthia* species+ *Aspergillus niger* and *Varicosporium elodeae* +*Rhizopus nigricans*). They were left to decompose for 42 days at a room temperature of 28^{o}C during which each sample was watered with sterile water (5 ml) and turned with a sterile spoon for good aeration. Samples were taken aseptically at 7 days intervals for microbial analyses. At the end of the 42 days, the decomposed domestic food wastes were referred to as composts.

Microbial analyses of decomposing domestic food wastes

One gram each of the decomposing domestic food wastes (DFW) or compost sample was suspended into 9 ml of sterile water and serially diluted. An aliquot of 0.1 ml of the various dilutions was pour plated in triplicates with nutrient agar (for bacteria) and potato dextrose agar (for fungi) at 37^{o}C for 24 hr and 28^{o}C for 48 hr. Bacterial and fungal counts were determined.

3. Results and discussions

Microbial load of the domestic food wastes during decomposition

Generally, the microbial populations showed an increase during the early weeks of composting and a decreasing trend down compost maturity. The increase in microbial numbers in the earlier weeks of composting, indicate that the environment was conducive for their growth as a result of available nutrients under good growth conditions. The highest microbial population was recorded for the domestic food wastes from the dumpsite at 0 to 6weeks with a mean value of 3.4 x 10^{7} ± 0.1 cfu/ml and 3.5 x 10^{4} sfu/ml for bacterial and fungal count respectively; this could be as a result of the inherent microorganisms present in the dumpsite. Domestic food wastes (DFW) inoculated with bacteria and fungi had a higher microbial count than the DFW inoculated with

separate bacterium or fungus. The high bacteria count in DFW inoculated with *Listeria monocytogenes* and *Aspergillus niger* of ($5.6x10^7$± 0.1 cfu/ml and $6.5x10^7$±0.1 cfu/ml) at week 0 and 2 respectively could be attributed to the fact that bacteria grew better together with fungi than being alone. (Chen *et al*., 2003). According to Bio-Logic Enviromental System (2001)when bacteria and fungi are grown separately and in coexistence on domestic food wastes, the two groups displayed both synergistic and antagonistic interactions hence the varying growth pattern observed. It was observed from the microbial analysis that bacteria grew better in the presence of fungi than without fungi (Figure 1). In this study *Bacillus megaterium* required no organic growth factors in the laboratory, under optimal conditions of growth, *Bacillus* species exhibit generation times of about 25 minutes. This explains the high microbial count at week 0 for *B. megatarium*. Compost made with "*B. megaterium* + *L. jensenii* and "*L delbrueckii* + *G. stearothermophilus* had the high bacteria counts which could be attributed to the production of spores by these organisms enabling them survive in unfavorable conditions (Czaczyk *et al*, 2001). Sterilized domestic food wastes inoculated with all the microorganisms (CSM) had the fungal count of 2.6 ± 0.1 sfu/ml. Of all the test samples DFW inoculated with *Varicosporium elodeae* and *Rhizopus nigricans* had the highest fungal population throughout 0 to 6 weeks with a mean value of 2.4 x 10^4 ± 0.2 sfu/ml at week 6. The sample inoculated with *Azotobacter* and *Penicillium italicum.*'had a fungal population of 2.7 x 10^4 ± 0.2 sfu/ml, followed by sample inoculated with *listeria monocytogenes* and *Aspergillus niger* with fungal population of 2.3 x10^4 ± 0.1 sfu/ml.

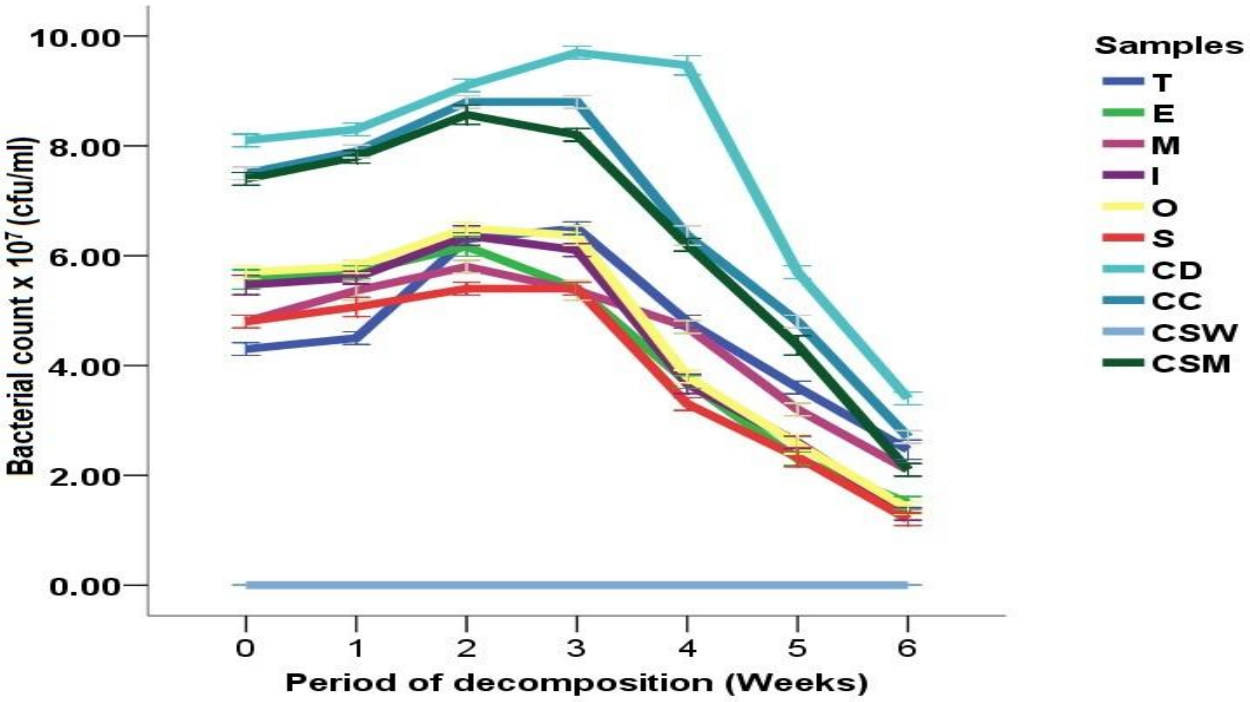

Figure 1: Bacterial population of domestic food wastes (DFW) during decomposition

Legend:

CD: Domestic food waste from Akure main dumpsite

CC: Constituted Domestic food wastes

CSW: Sterilized domestic food wastes uninoculated with microorganisms

CSM: Sterilized domestic food wastes inoculated with microorganisms.

T: Domestic food wastes inoculated with *Lactobacillus delbrueckii* and *Geobacillus stearothermophilus*

E: Domestic food wastes inoculated with *Bacillus megaterium* and *Lactobacillus jensenii.*

M: Domestic food wastes inoculated with *Bacillus sphaericus* and *Macromonnas mobilis*

I: Domestic food wastes inoculated with *Azotobacter* and *Penicillium italicum*

S: Domestic food wastes inoculated with *Listeria monocytogenes* and *Aspergillus niger*

O: Domestic food wastes inoculated with *Kurthia* speciesand *Aspergillus niger*

P: Domestic food wastes inoculated with *Varicosporium elodeae* and *Rhizopus nigricans*

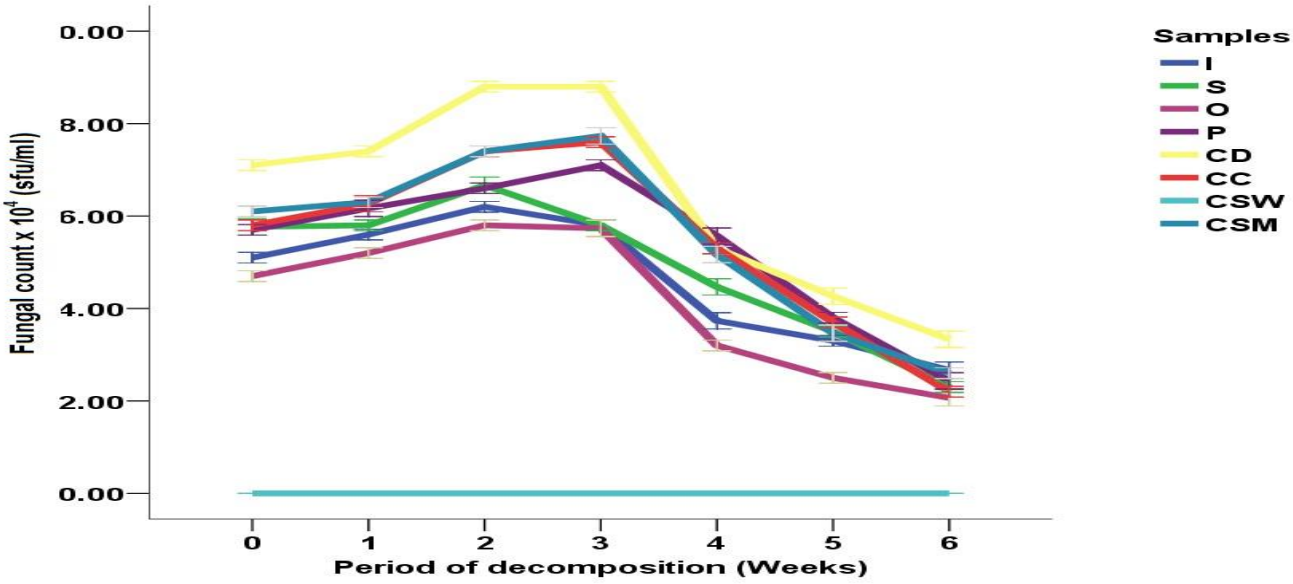

Figure 2: Fungal population of domestic food wastes (DFW) during decomposition

Legend:

CD: Domestic food waste from Akure main dumpsite

CC: Constituted Domestic food wastes

CSW: Sterilized domestic food wastes uninoculated with microorganisms

CSM: Sterilized domestic food wastes inoculated with microorganisms.

T: Domestic food wastes inoculated with *Lactobacillus delbrueckii*and *Geobacillus stearothermophilus*

E: Domestic food wastes inoculated with *Bacillus megaterium* and *Lactobacillus jensenii.*

M: Domestic food wastes inoculated with *Bacillus sphaericus* and *Macromonnas mobilis*

I: Domestic food wastes inoculated with *Azotobacter* and *Penicillium italicum*

S: Domestic food wastes inoculated with *Listeria monocytogenes* and *Aspergillus niger*

O: Domestic food wastes inoculated with *Kurthia* speciesand *Aspergillus niger*

P: Domestic food wastes inoculated with *Varicosporium elodeae* and *Rhizopus nigricans*

This suggests that fungi provide the bacteria with resources that the bacteria were not able to acquire on their own which most probably were intermediate products of decomposition released by fungi The DFW containing sample (O) *Kurthia* species and *Aspergillus niger* had the lowest fungal count of 2.1 x 10^4 ± 0.1 sfu/ml all at week 6 (Figure 2). The data obtained in this work are further supported by the fact that during decomposition it is known that marked changes take place in nature and Some or (certain) species multiply rapidly at first but later dwindle in population as the environment changes and other organisms are able to thrive (Chien,2001). Changes in Temperature and available food supply probably exert the greatest influence in determining the species of organisms comprising the population at any one time.The reduction in microbial counts down the composting process period could be attributed to unfavorable environment conditions i.e. nutrient depletion, competition between organisms for available space and nutrients resulting to the survival of the fittest. It also indicates compost maturity. In addition, there was a negative effect of the bacteria on fungi, which appeared to be caused by suppression of fungal growth and biomass accrual (Cummings *et al*., 2006).

4. Conclusion

This study provided sound information on the best combinations of microorganisms that can be used for composting of domestic food wastesand that maize are nutritionally rich, low in anti-nutrients and are suitable for local consumption and industrial utilization these is in collaboration with the degradative ability of the mixed organisms used in the composting process.

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