

The Effects of *Myrothecium verrucaria* (MV) on Corn Stover during Co-composting process under room temperature conditions

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Abstract: In China, the production of crop straw has been estimated to be approximately 800 Million tons yearly of which about 40% was burned. Corn stover is one of the main agricultural wastes in China. It has shown that lignin in corn stover could be effectively removed by *Myrothecium verrucaria*. The effects of the pretreatment of corn stover by *Myrothecium verrucaria* on compost were studied. The results showed that corn stover pretreatment by *Myrothecium verrucaria*, the Cellulose, Hemicellulose, and lignin were degraded and the results were 33.43%, 11.53% and 18.70% respectively. Scanning electron microscope (SEM) analysis showed that the surface structure of corn stover was changed. Fourier transform infrared spectroscopy (FTIR) analysis showed that the degradation products of lignin were increased. The exposed area of cellulose and hemicellulose was increased. Compared with the control group, the pH value was stable and the temperature was higher. The content of nitrogen in the material decreased, while the contents of total phosphorus and total potassium increased. The C/N ratio of materials decreased after composting. The results showed that the pretreatment of *Myrothecium verrucaria* improve the degradation of lignocelluloses, a great contribution was made to reduce the causes loss of plant nutrient and to fight against environmental pollution.

Keywords: *Myrothecium verrucaria*; lignocelluloses; Scanning electron microscope (SEM); Fourier transform infrared spectroscopy (FTIR); pretreatment; degradation; co-composting; corn stover; cow manure.

1. Introduction

In the global world, lignocellulosic crop wastes are produced in huge quantities and are effective carbon materials for the production of many compounds that have a great effect on the soil. Despite this, in many countries, they're usually burned after harvest to facilitate land preparation, which causes loss of plant nutrients and leads to a real disaster that will increase environmental pollution [1]. For example, in China, the production of crop straw has been estimated to be approximately 800 Million tons yearly of which about 40% was burned [2]

Composting has become an important method widely used for treating agricultural organic waste through the decomposition of biodegradable components by bacteria, fungal and actinomycetal microbial communities. However, lignocellulose, the main component of straw is not easily degraded and is the most limiting factor influencing the composting process. The aromatic barriers in lignocelluloses, including lignins (consisting of phenylpropanoid units of various types) and low molecular weight phenolic acids, limit the degradation of the lignocellulose [3]

In this regard, pretreatment plays a vital role in disrupting the complex network of lignocellulosic biomass for the sustainable production of value-added products [4]. The biological method, with the advantages of simple operation, low cost, and environmental friendliness, is considered a promising pretreatment method. Biological pretreatment employs microorganisms and their enzymatic machinery to break down lignin and alter lignocellulose structure [5]. The utilization of commercial microbial inoculants (MI) has been reported to be effective in enhancing the degradation rate of the composting materials. The microorganisms that degrade lignocellulose by secreting extracellular peroxidases are most often chosen as inoculants; the microorganisms played vital roles in the composting temperature increasing, whereas the temperature is the most critical factor for controlling composting reaction rate because of its effect on microbial metabolic rate and population structure [6].

Some of the most promising microorganisms for biological pretreatment are white-rot fungi that can mineralize lignin to CO₂ and water in pure culture [7]. *Myrothecium verrucaria* has been reported as a novel lignin depletion fungus that leads to lignin degradation reaching $45.50 \pm 2.12\%$ in birch sawdust, and it was effective in removing lignin selectively [8].

In this study, corn stover was pretreated by *Myrothecium verrucaria* before being co-composed with cow manure. We propose the hypothesis that the pretreatment of corn stover by *Myrothecium verrucaria* can directly enhance corn stover lignocellulose degradation before co-composting, and then help to improve the subsequent co-composting process, as this avoids both the competition and suppressive effects during the co-composting. The novel aspect of this treatment is that the direct effects of *Myrothecium verrucaria* on corn stover lignocellulose degradation were conducted before co-composting. The compost stability and maturity index were measured and compared with the treatments without MI and also without *Myrothecium verrucaria* addition or the treatments with MI inoculation during the co-composting process. The main objective of this research was to evaluate the feasibility of corn stover pretreated by *Myrothecium verrucaria* before the co-composting of cow manure with corn stover, to optimize the composting procedures, and to improve the utilization of agricultural byproducts. It specifically aims to (1) this study constitutes a pioneer base of knowledge and the Effect of *Myrothecium verrucaria* on corn stover co-composting process of straw comprehensive utilization, finally to allow a better understanding by scientists and farmers the process of co-composting with cow manure; (2) Pretreatment of corn Stover and enhancement of the lignocelluloses subsequently before the composting process.

2. Materials and Methods

2.1.Experimental site

The experiment was conducted at the key Laboratory of Straw Biology and Utilization, the Ministry of Education- Jilin Agricultural University.

2.2.Experimental apparatus

The type of in-vessel made compost was chosen, because it has an advantage, can process large amounts of waste without taking up as much space as the windrow method and it can accommodate virtually any type of organic waste (e.g, meat, animal manure, biosolids, food scraps). This allows good control of the environmental conditions such as temperature, moisture, and airflow. The material is mechanically turned or mixed to make sure the material is aerated. The size of the vessel can vary in size and capacity.

This method produces compost in just a few weeks. It takes a few more weeks or months until it is ready to use because the microbial activity needs to balance and the pile needs to cool. We used rectangular vessels. We therefore installed 3 vessels (boxes) in one line of each, and each vessel had the length of 72cm, 52cm of width and a height of 43cm. All vessels

were numbered and named from 1-3 in the following manner (control group or CK, microbial inoculant or MI and *Myrothecium verrucaria* or MV).

It signed to report the first vessel (CK) is considered as control will not be malled and microorganism will not be added or inoculated.

Corn straw was collected from the experimental field of Jilin Agricultural University, and dried under natural conditions after harvest. Corn stover was smashed to pass through 0.45-mm screen. The composition of the corn stover and Cow manure are shown in Table 1.



Figure 1:Experimental apparatus (boxes)

2.2.1. Biological material

The biological materials that we used during our research were in particular constituted of different samples of corn stover pretreated with microorganisms (commercial microbial inoculants: CMI and *Myrothecium verrucaria*) on the one hand and on the other hand the samples of co-composting of the corn stover, the cow manure and the microorganisms

(commercial microbial inoculants: CMI and *Myrothecium verrucaria*) were collected at room temperature, manually in the composting room at our key laboratory of straw biology and utilization, the ministry of education.

Myrothecium verrucaria Strain 3H6 (Preservation No: CCTCC M 2018800) was stored in a -80°C freezer at the (Key Laboratory of Straw Biology and Utilization, the Ministry of Education). This strain was recovered by growing aerobically on Potato medium agar (PDA: potato 200 g/ L, glucose 20 g/ L, and agar 18 g/L), at 30°C, pH 7.0 for 48 h.

2.3.Methods

a) Pretreatment of Corn Stover before co-composting with cow manure

Boxes of polystyrene (100L)) were used as composting reactors with the length of 72cm, 52cm of width, and the height of 43cm. untreated corn stover (CK: control group), corn stover pretreated with commercial microbial inoculants (MI: group), and corn stover pretreated with *Myrothecium verrucaria* (MV: treatment group). Each treatment had 3 replicates

A total of 3kg of corn stover was mixed with 1% of *Myrothecium verrucaria* as the amount of inoculant. The corn stover was adjusted to 65% moisture and kept for 20 days under room temperature conditions. After pretreatment, the corn stover was used as the substrate for the subsequent co-composting with cow manure.



Figure 2: Corn Stover before pretreatment

b) Co-composting of corn stover and cow manure (composting set-up)

The corn stover after co-pretreatment was then mixed with the cow manure according to the gotten results of C/N ratio (30:1) to perform the co-composting, the core temperature and pH of the co-composting pile was measured daily using Digital thermometer, which was plunged into the compost at a depth of 15 cm. For the pH, a sample of 20g was mixed with 100ml of H₂O, then shaken for few minutes then left for 1h-3h, the measure was done using a pH meter 818 (SMART SENSOR), respectively.

Pile-turning was conducted every 2-3days during the high temperature stage and every 4-6 days during the moderate temperature stage.

The moisture content was then maintained in the range of 60%- 65% by adding distilled water during the composting pile.



Figure 3: Corn Stover untreated and pretreated mixed with cow manure on the first day and Corn Stover pretreated, MI pretreated and *Myrothecium verrucaria* MV pretreated after 30 days.

c) Measurement of physio-chemical parameters

- ❖ **Effects of Co-pretreatment on the structure of corn stover before/after**
- ❖ **Scanning electron microscope (SEM) analysis**

The untreated corn stover and the pretreated corn stover were dehydrated using a freeze dryer. The different surface morphologies of untreated and pretreated corn stover were characterized by scanning electron microscopy (S-3400 N, Hitachi, Japan).

- ❖ **Fourier transform infrared spectroscopy (FTIR) analysis**

The chemical changes of corn stover before and after different pretreatment methods were investigated by Fourier transform infrared spectroscopy (FTIR) spectrometer (Nicolet 6700, Thermo Fisher Scientific Inc.). Samples were prepared by KBr pelleting. The resolution of the spectra was 2 cm^{-1} in the range of $500\text{--}4000\text{ cm}^{-1}$, and 32 scans were carried out for each sample.

- ❖ **Composition analysis of corn stover before/after**

The content of cellulose, hemicellulose, and lignin was analyzed according to the method of the National Renewable Energy Laboratory, Golden, CO, USA [9] to evaluate the effect of pretreatment for corn stover. Untreated corn stover was selected as the control. Each analysis was performed in triplicate.

- ❖ **Determination of total nitrogen:** was determined using the Kjeldahl method

[10]

- ❖ **Determination of total carbon:** was determined by using the potassium dichromate external bath heating method [11]
- ❖ **Determination of potassium:** was determined by using ammonium acetate flame photometer method [12]
- ❖ **Determination of phosphorus:** was determined by using ammonium vanadate colorimetry method [13].
- ❖ **The temperature and pH:** were determined by using measured daily using Digital thermometer which was plunged into the compost at a depth of 15 cm and pH meter, a sample of 20g was mixed with 100ml of H_2O , then shaken for

few minutes then left for 1h-3h, the measure was done using a pH meter 818 (SMART SENSOR), respectively.

3. Results

3.1. Effects of microbial inoculant (MI) and *Myrothecium verrucaria* (MV) co-pretreatment on the corn stover surface structure

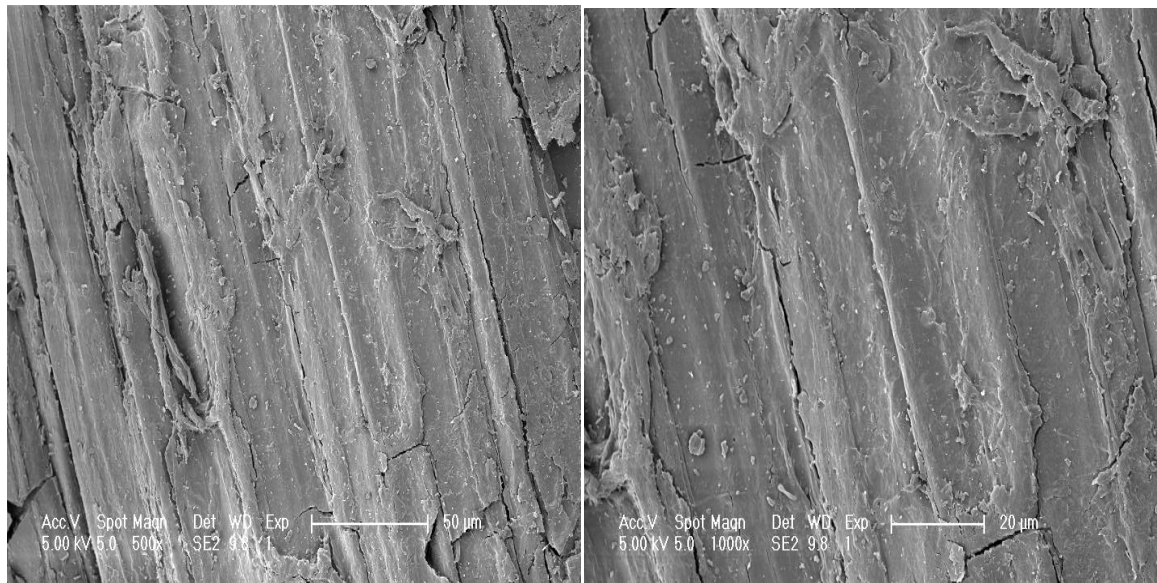


Figure4: Scanning electron microscope (SEM) analysis micrographs of untreated corn stover (CK)

Looking at the image (figure 4) after the Scanning electron microscope (SEM) analysis, we notice that the surface and the physicochemical structure or even its composition has not changed at all, a has not undergone a modification from the physicochemical point of view and especially structural by keeping its shape intact with a strong, rigid and solid layer.

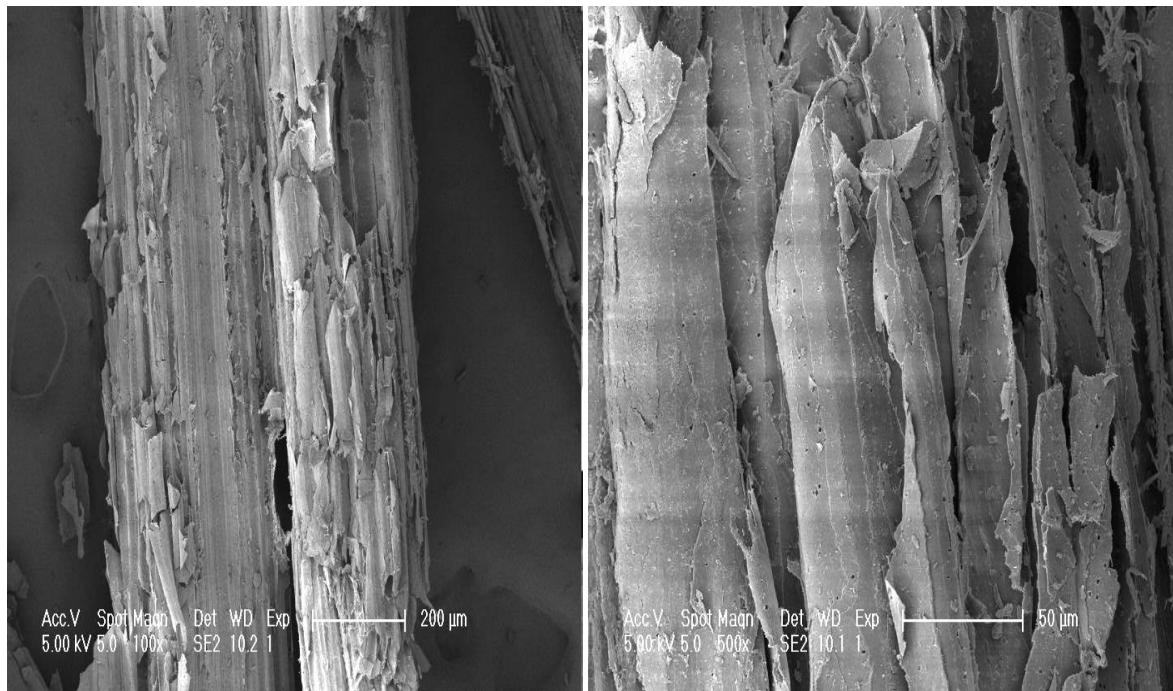


Figure 5: Scanning electron microscope (SEM) micrographs of microbial inoculant(MI)

If, we observe the image (figure 5) very well after analysis, the surface and the physico-chemical structure have changed, because we can see that there is the presence of holes, lesions but a clear degradation and reduction of the surface which has become thicker and brittle but above all there is a loss of rigidity with the use of microbial inoculant MI unlike with untreated corn stover CK.

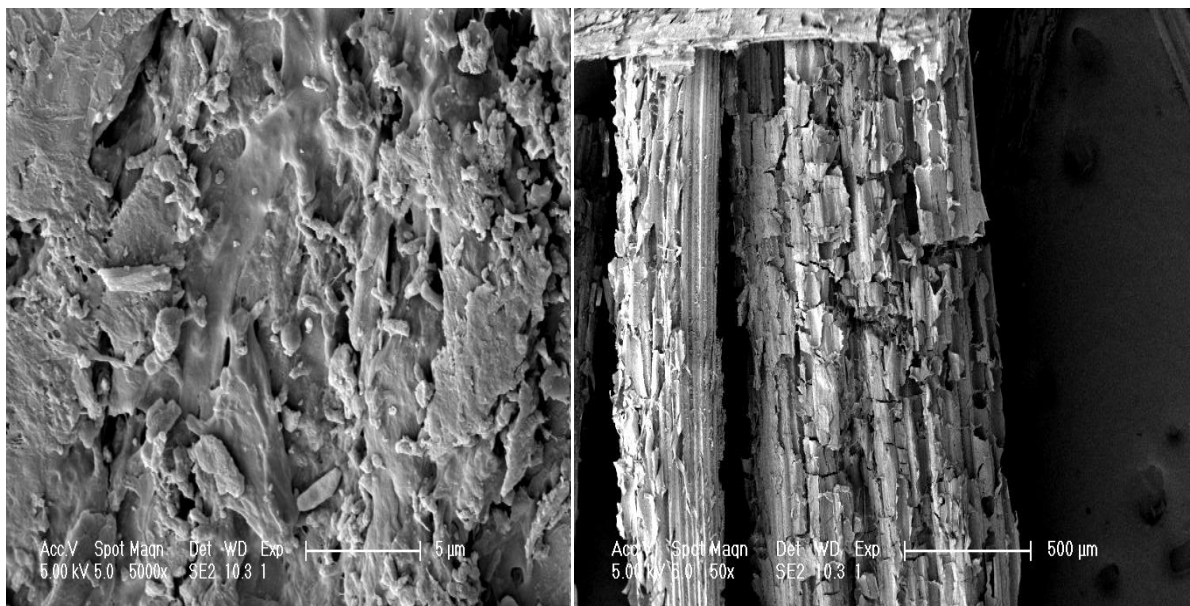


Figure 6: Scanning electron microscope (SEM) micrographs of *Myrothecium verrucaria*(MV)

The almost total change was observed (figure 6) after Scanning electron microscope (SEM) analysis with the use of *Myrothecium verrucaria* MV, where we see degradation, holes and even cuts observed on the surface and the physicochemical structure, the cornstover was

fragmented and segmented until become smooth with visible porosity and very advanced compared to the other two treatments untreated corn stover CK and microbial inoculant MI.

Several of these studies show that *Myrothecium verrucaria* (MV) or WRF and microbial inoculant (MI) degrade by secreting the enzymes which facilitate the reduction of the surface and the physico-chemical structure of the biomass (lignocelluloses) and to allow these latter (biomass) to partially lose their rigidity. It should therefore be noted that the degradation of the complete biomass remains a challenge nowadays because it takes more time a little longer, means cost but above all make use or intervene several microorganisms finally to facilitate a good degradation of the biomass (lignocelluloses).

3.2. Fourier Transform Infrared Spectroscopy FTIR analysis of co-pretreated corn stover

According to [21] and [22], it is possible to predict the digestibility of lignocellulosic materials with the information obtained from the FTIR-PAS and FTIR-ATR spectra by applying complex algorithms. The information related to the structure gotten from FTIR analysis supports the results obtained with the other analytical techniques and demonstrated that FTIR is important to determine the level of degradation of the pretreatment [23]. Fourier transform infrared spectroscopy (FTIR) analysis was performed to show the chemical changes of pretreated corn stover and untreated corn stover, the spectra after Fourier transform infrared spectroscopy FTIR analysis are shown in Figure 7.

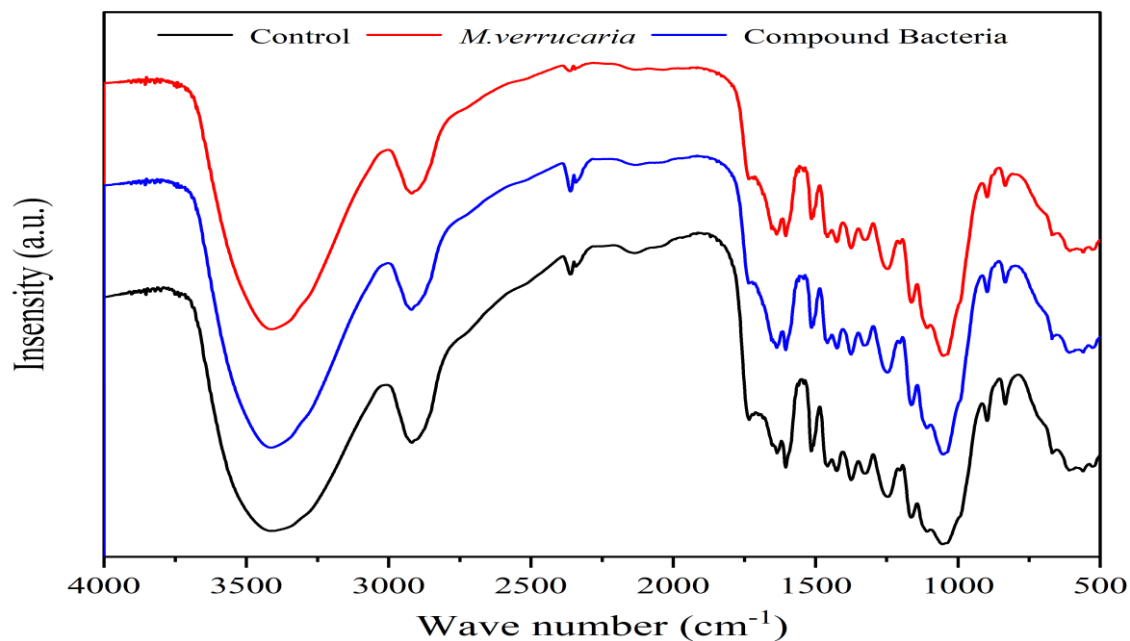


Figure 7. Fourier transform infrared spectroscopy (FTIR) spectra of untreated corn Stover (CK), pretreated corn Stover with microbial inoculant (MI), and pretreated corn Stover with *Myrothecium verrucaria* (MV)

3.2. The nutrient content of Cow manure and Corn Stover

Moisture content for Corn stover and cowmanure were 8.04% and 75.30% respectively, while organic C(%) were 46.37% and 41.37% respectively, N (%) were 0.9% and 1.9% , P were 0.35 and 0.86 respectively, K were 0.73 and 1.04 respectively, and C/N were 51.5% and 21.77 % respectively (table 1).

Table 1. The nutrient content of Cow manure and corn stover nutrient before pretreatment

	Moisture (%)	Organic C (%)	N (%)	P	K	C/N
Cow manure	75.30	41.37	1.9	0.86	1.04	21.77
Corn Stover	8.04	46.35	0.9	0.35	0.73	51.5

Table 2. The nutrient content of corn stover and cow manure after pretreatment.

Moisture content (%)	Organic C (%)	N (%)	P	K	C/N
65.15	29.58	1.22	0.91	1.13	24.24

3.3. Effect of co-pretreatment on the major components of corn stover

Myrothecium verrucaria was reported to ameliorate biomass degradation in birch sawdust and has high potential for the biotechnologies uses [32]. Thus, *M. verrucaria* was adopted the depletion of lignin in corn stover via SSF, which has been reported to produce much higher concentrations of enzymes [33]. The hemicelluloses depletion and their contents, are shown in Table 1. The biomass degradation was 38.07 ± 1.2

1 % after 30 days of the pretreatment period with *Myrothecium verrucaria*, which indicated that corn stover in some parts, were degraded. The relative contents of cellulose, hemicellulose and lignin decreased after pretreatment with *M. verrucaria* and MI from 36.16%, 20.04% and 21.41% to 30.52%, 11.58% and 20.57% for MI and to 33.43%, 11.53% and for MV pretreatment was respectively 18.70%. Thus there was no significant

degradation in the lignin and cellulose the ideal pretreatment for enzymatic saccharification could be better to reduce the content of lignin and to Increase the retention of cellulose [34].

Table 3. The content of lignin, cellulose and hemicellulose before/after treatment

	Biomass Loss	Cellulose (%)	Hemicellulose (%)	Lignin (%)
CK		36.13±0.56	20.04±0.78	21.41±0.13
MI	30.46±0.55	30.52±0.55	11.58±0.50	20.57±0.32
MV	38.07±1.21	33.43±0.74	11.53±0.67	18.70±0.76

CK: untreated corn stover; MI: microbial inoculant; MV: *Myrothecium verrucaria*

3.4. Effect of co-pretreatment on Temperature and pH

Examining the result obtained on the temperature taken daily in the morning at the same time, i.e. 9:30 a.m. it should be noted that among the 3 treatments the temperature started a little lower on the two CK and MI treatments, the first two days, i.e. 30.2, 29.2 and 32.5, 30.5 respectively for CK and MI, while the temperature was a little higher on MV, ie, 35.6 and 33.4 respectively on the first and second day. And suddenly on the 3rd and 4th day the roof changed and now the highest temperature lasted for at least two weeks until reaching 37.8 °C and this can be explained by the fact that the microbial activity was very intense on MI that on the other two treatments CK and MV and around the last ten days we observed that the temperature on all three treatments was almost the same, with an average of 29 °C (figure 8).

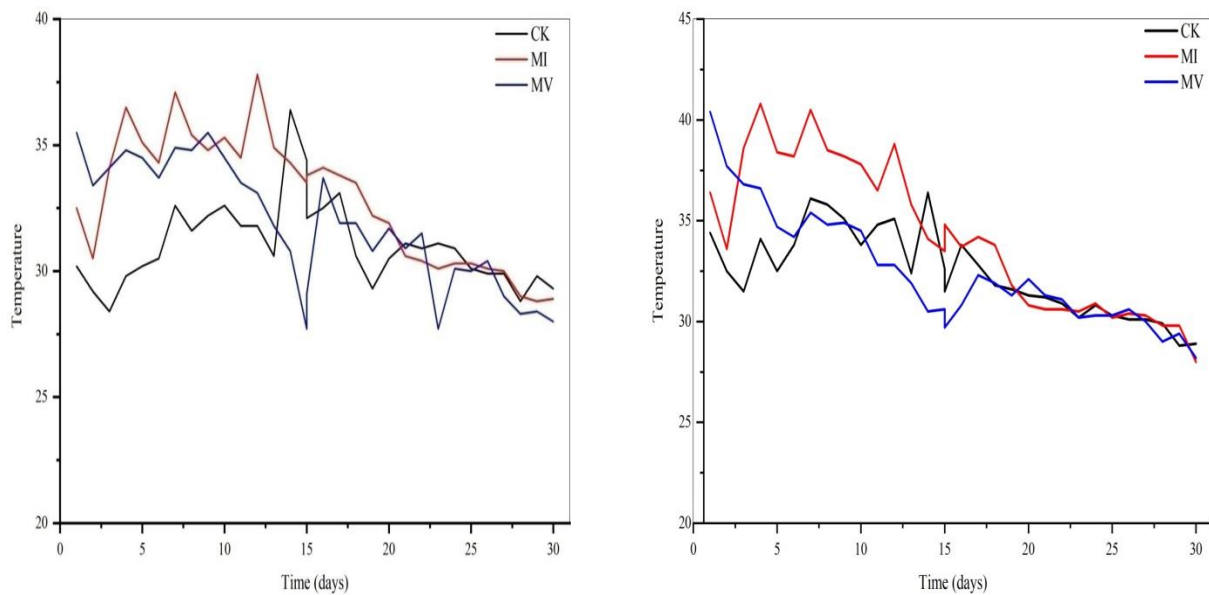


Figure 8: Temperature degree in the morning (T°M) in the left side and Temperature degree in the evening (T°E) in the right side.

Unlike the temperature taken in the morning that taken in the evening each day at the same time, i.e. 6.30 p.m. on the three treatments, it was observed that everywhere over the three treatments the temperature was high on the first 3 days, i.e., but a little higher on *Myrothecium verrucaria* (MV) compared to the morning, ie 34.4, 36.4 and 40.4 respectively for untreated (CK), microbial inoculant (MI) and *Myrothecium verrucaria* (MV). But as when sampling the temperature in the morning after, we made the same constant as when sampling the morning temperature on all 3 treatments, i.e. the temperature of microbial inoculant (MI) was higher on the other two treatments untreated corn stover (CK) and *Myrothecium verrucaria* (MV), in even reaching up to 40.8 °C and this phenomenon will be observed once more throughout the process for more than two weeks. And as when taking the temperature in the morning during the last 10 days, we will observe almost the same temperature on all three CK, MI and MV treatments with an average of 29 °C.

By comparing the two results on the temperature sampling, in the morning and in the evening on all 3 treatments CK, MI and MV, we noted that the temperature was high in the evening than in the morning in general but more particularly, high on MI that at CK and MV is with an average of 33.3 °C MI in the morning against an average of 35.3 in the evening.

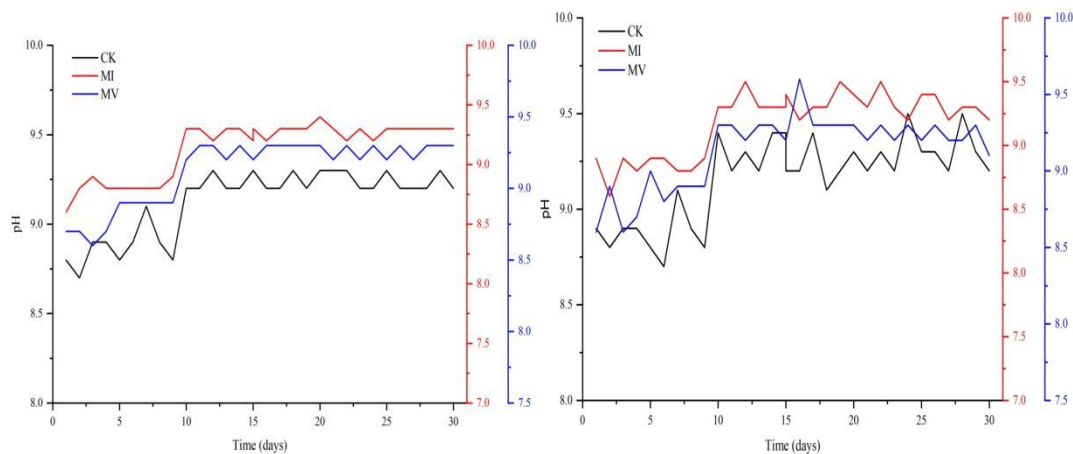


Figure 9: pH in the morning (pH M) in the left side and pH in the evening (pH E) in the right side.

By measuring the pH every day at the same time as when the temperature was taken in the morning at 8:30 am, we could observe that on the 3 treatments CK, MI and MV the pH was almost the same with an average of 8.7 using the thermometer fixed, but when we had to change the portable thermometer the pH value also changed to an average of 9.2, for all 3 treatments CK, MI and MV.

It has and observed the same constant in the morning, in the evening also the pH is not changed, it therefore remains stable except when we have changed the fixed thermometer to the portable thermometer with an average of 8.7, 8.8 and 8.6 in the evening and of 9.2, 9.3 and 9.3, respectively for CK, MI and MV. According to these results, it was observed that the pH value in the morning and in the evening was unchanged and stable almost everywhere over the 3 treatments despite the change in the thermometer, i.e. with an average of 8.8, 8.7 and 8.6 in using the fixed thermometer and the average pH value over all 3 treatments was of the order with an average of 9.3, 9.2 and 9.3 for CK, MI and MV respectively using the portable thermometer.

4. Discussion

After the Scanning electron microscope (SEM) analysis of these three treatments it was although clear that the surface and the physicochemical structure underwent a modification, a change, a degradation because we can see the presence of lesions, holes, with a relative reduction of the biomass on the two treatments microbial inoculant (MI) and *Myrothecium verrucaria* (MV), while CK did not undergo any modification, degradation while keeping its surface and its physicochemical structure almost intact. But it should be noted that the degradation, the reduction of the rigidity of the lesions, of the very clear holes was observed more on *Myrothecium verrucaria* (MV) than on microbial inoculant (MI).

where the degradation of the surface and of the physico-chemical structure was not really as on *Myrothecium verrucaria* (MV). Similar results were obtained or observed in [14], [15], [16], [17], [18], [19], [20].

The broad absorption band Fourier transform infrared spectroscopy (FTIR) analysis located from 3300 to 3500 cm^{-1} corresponded to the -OH stretching vibration signals and increased remarkably after co- pretreatment, indicating the exposure of cellulose [24]. Compared to the spectrum of untreated corn stover, the absorption at approximately 1515 cm^{-1} to 1650 cm^{-1} , which was related to aromatic ring C=C stretching in lignin, clearly decreased in the spectra of corn stover after *Myrothecium verrucaria*(MV) and microbial inoculant(MI) pretreatments, suggesting the partial removal/dissolution of lignin. The increased intensity of the peaks at 1220–1240 cm^{-1} (the ether bond between lignin phenylpropane monomers) indicated that lignin degradation products increased, because these peaks represents phenols, ethers, alcohols and esters which were decomposed from lignin [25]. The bands at 1375 cm^{-1} were related to the un-conjugated C-O stretching of hemicellulose, which was decreased after *M. verrucaria* pretreatment and MI pretreatment, indicating a decrease of hemicellulose content [22]. The peaks at 1030 cm^{-1} (C-O-H stretching of primary and secondary alcohol groups of cellulose) were enhanced by *M. verrucaria* pretreatment, and MI pretreatment which indicated that the proportion of cellulose increased [26].

From Table 1 and 2, the results showed that nutrient content is shown in the C/N ratio and moisture content exhibited a decreasing trend during composting. This trend is similar to that reported in [27], [28] and [29] who reported that there was a decrease in the C/N ratio as the decomposition progressed. During composting, microorganisms require carbon for growth and energy, and nitrogen for protein synthesis. Thus, the rate of decomposition of organic wastes depends on a proper balance of carbon and nitrogen. Rapid composting is achieved when wastes or mixtures of wastes have a C/N ratio of between 15 and 35 [30].

On the other hand, Looking at table 2, it emerges a constant that the nutrients contents of cow manure and corn stover were high before but after the pretreatment hence the need to use the *Myrothecium verrucaria* (MV) for the pretreatment finally to reduce and improve, hemicellulose, cellulose, and lignin. After pretreatment, the nutrient content was in the order of 65.15%, 29.58, 1.22, 0.91, 1.13, and 24.24 respectively for moisture content, organic carbon, N, P, K, and C/N ratio, this trend is similar to that reported in [27], [31] and [29]. By comparing the two tables 1 and 2 and theirs related results either before pretreatment and

after pretreatment and the main elements of nutrient content we clearly observed a marked improvement before and after the corn stover pretreatment, we can therefore illustrate by the following elements: nitrogen which decreased compared to before, Phosphorus and Potassium experienced to be increased after the pretreatment and finally, the C/N ratio also decreased after pretreatment. With regard to all these results obtained, we can conclude that *M. verrucaria* has played its role of degrader of hemicellulose, cellulose, and lignin after the pretreatment of corn stover.

The results shown that *M. verrucaria* fermentation was an ideal pretreatment method to improve lignin in the corn stover during the process. The same result of lignin degradation (34.1%) was determined for pretreatment with *D. squalens* [35]. [20] had not obtained the same result that we had, for him, the hemicelluloses augmented after the pretreatment with *M. verrucaria* from 38.21% and 19.35% to 48.07% and 23.37%, respectively.

While the average for the two CK and MV treatments in the morning was 32.6 and 31.6 respectively against an average of 32.8 and 34.3 for CK and MV in the evening. In view of what precedes on the two results we can therefore conclude that the temperature was high in the evening than in the morning because of the microbial activity which was more intense during the day in general but in particular in MI. We therefore suggest that the in-depth studies are to be carried out in the future to determine with more precision for more details on this phenomena.

By comparing the results obtained with those of [36] who has gotten the opposite to ours where the pH value was rather high during the pretreatment of corn stover mixed with microbes, whose pH value was between 5.18 as a minimum and 6.81 as the maximum, on the other hand [37] used the *Mci* composite strain for the pretreatment of corn stalks and found that the pH to drop below 5.0 to the minimum and then increase to above of 8.0, also [38]

When optimizing and degrading lignin pretreated with MV, he obtained that its pH value was varied from 4.5 to 6.5.

But also that the pH value obtained was high during the pretreatment of the corn stover with the microorganisms either 8.0 and lower or at the acidification 4.5 and 5.0 respectively for the biological pretreatment and the composting pretreatment, and then remot quickly after this period acidification in [14] and the similar result was observed in [39].

5. Conclusion

In the present study, *Myrothecium verrucaria* (MV) has proven to be the high-efficiency, for degradation and depletion of lignin during the pretreatment of Corn Stover. During the experiment, the temperature was high, the average for the two treatments CK and

MV in the morning was 32.6 and 31.6 respectively against an average of 32.8 and 34.3 for CK and MV in the evening., also the pH value was very stable,the average of 8.7 using the thermometer fixed and with the portable thermometer the average was 9.2, for all 3 treatments CK, MI and MV.

The gotten results showed the C/N ratio was reduced, the nutrient content such as the total potassium and phosphorus increased, the same result showed also that Nitrogen content decreased, and finally according to the gotten results of corn stover pretreatment by *Myrothecium verrucaria* (MV) the Cellulose, Hemicellulose, and lignin were degraded and the results were 33.43%, 11.53% and 18.70% respectively. Scanning electron microscope (SEM) and Fourier transform infrared spectroscopy (FTIR) analysis located from 3300 to 3500 cm^{-1} corresponded to the -OH stretching vibration signals and increased remarkably after co- pretreatment, indicating the exposure of cellulose, the spectrum of untreated corn stover, the absorption at approximately 1515 cm^{-1} to 1650 cm^{-1} , which was related to aromatic ring C=C stretching in lignin, clearly decreased in the spectra of corn stover after *Myrothecium verrucaria*(MV) and microbial inoculant(MI) pretreatments, suggesting the partial removal/dissolution of lignin, The increased intensity of the peaks at 1220–1240 cm^{-1} (the ether bond between lignin phenylpropane monomers) indicated that lignin degradation products increased, because these peaks represents phenols, ethers, alcohols and esters which were decomposed from lignin, showed that the *Myrothecium verrucaria* pretreatment process had significant change and effects on corn stover, the degradation products of cellulose, hemicellulose, and lignin were increased, and it really enhances significantly the degradation and depletion of lignocellulose, our main objective has been achieved.

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AKWAKWA and Ming Yao; Resources, GABRIEL AKWAKWA, Guo Lei, Huan Chen and Sitong Zhang; Software, Ming Yao and DIDY ONAUTSHU; Writing – original draft, GABRIEL AKWAKWA.

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